Contents

1   rosinstall/catkin.rosinstall

```
 1  - git:
 2      local-name: skill_transfer
 3      uri: https://github.com/lubiluk/skill_transfer.git
 4      version: master
 5  - git:
 6      local-name: giskard_ros
 7      uri: https://github.com/SemRoCo/giskard_ros.git
 8      version: master
 9  - git:
10      local-name: giskard_ros_utils
11      uri: https://github.com/SemRoCo/giskard_ros_utils.git
12      version: master
13  - git:
14      local-name: pysdf
15      uri: https://github.com/lubiluk/pysdf
16      version: shallow-search
17  - git:
18      local-name: gazebo2rviz
19      uri: https://github.com/lubiluk/gazebo2rviz
20      version: fixing
```

2   tasks/scraping.yaml

```yaml
 1  name: Scraping
 2
 3  required-object-info:
 4    tool: true
 5    target-object: true
 6    task: scraping_butter
 7
 8  # The following motion phases will be executed in a sequence
 9  motion-phases:
10    - name: Position Above
11      # Giskard file
12      file: scraping_position_above.yaml
13      # Stop conditions
14      stop:
15        # When measured gripper velocity drops below this threshold
16        measured-velocity-min-threshold: 0.002
17        # When desired (set by the controller) gripper velocity drops below this
             threshold
18        desired-velocity-min-threshold: 0.002
19        # Stop on contact
20        contact: false
21        # Ignore stop conditions until the distance
22        # from the target configuration is less than this
23        activation-distance: 0.15
24    - name: Edge Contact
25      file: scraping_edge_contact.yaml
26      stop:
27        measured-velocity-min-threshold: 0.002
28        desired-velocity-min-threshold: 0.002
29        contact: true
30        activation-distance: 0.15
31    - name: Scrape Off
32      file: scraping_scrape_off.yaml
33      stop:
34        measured-velocity-min-threshold: 0.002
35        desired-velocity-min-threshold: 0.002
36        contact: false
37        activation-distance: 0.15
```

3   tasks/cutting.yaml

```yaml
1  name: "Cutting"
2
3  required-object-info:
4    tool: true
5    target-object: false
6    task: cutting_lasagna
7
8  # The following motion phases will be executed in a sequence
9  motion-phases:
10   - name: "Position Above"
11     # Giskard file
12     file: "cutting_position_above.yaml"
13     # Stop conditions
14     stop:
15       # When measured gripper velocity drops below this threshold
16       measured-velocity-min-threshold: 0.02
17       # When desired (set by the controller) gripper velocity drops below this
             threshold
18       desired-velocity-min-threshold: 0.02
19       # Stop on contact
20       contact: false
21       # Ignore stop conditions until the distance
22       # from the target configuration is less than this
23       activation-distance: 0.15
24   - name: "Cut"
25     file: "cutting_cut.yaml"
26     stop:
27       measured-velocity-min-threshold: 0.002
28       desired-velocity-min-threshold: 0.002
29       contact: false
30       activation-distance: 0.15
31   - name: "Pull"
32     file: "cutting_pull.yaml"
33     stop:
34       measured-velocity-min-threshold: 0.02
35       desired-velocity-min-threshold: 0.02
36       contact: false
37       activation-distance: 0.15
```

4 tasks/tiltgrabbing.yaml

```yaml
name: TiltGrabbing

required-object-info:
  tool: true
  target-object: true
  task: grabbing_book

# The following motion phases will be executed in a sequence
motion-phases:
  - name: Position Above
    # Giskard file
    file: tilting_position_above.yaml
    # Stop conditions
    stop:
      # When measured gripper velocity drops below this threshold
      measured-velocity-min-threshold: 0.02
      # When desired (set by the controller) gripper velocity drops below this
          threshold
      desired-velocity-min-threshold: 0.02
      # Stop on contact
      contact: false
      # Ignore stop conditions until the distance
      # from the target configuration is less than this
      activation-distance: 0.15
  - name: Position infront one
    file: tilting_position_front.yaml
    stop:
      measured-velocity-min-threshold: 0.02
      desired-velocity-min-threshold: 0.02
      contact: false
      activation-distance: 0.15
  - name: Position infront two
    file: tilting_position_front_2.yaml
    stop:
      measured-velocity-min-threshold: 0.02
      desired-velocity-min-threshold: 0.02
      contact: false
      activation-distance: 0.15
  - name: Touch top
    file: tilting_touch_top.yaml
    stop:
      measured-velocity-min-threshold: 0.01
      desired-velocity-min-threshold: 0.01
      contact: true
      activation-distance: 0.15
  - name: Tilt
    file: tilting_tilt.yaml
    stop:
      measured-velocity-min-threshold: 0.002
      desired-velocity-min-threshold: 0.002
      contact: false
      activation-distance: 0.15
  - name: Grab
    file: tilting_grab.yaml
    stop:
```

```yaml
55          measured-velocity-min-threshold: 0.002
56          desired-velocity-min-threshold: 0.002
57          contact: false
58          activation-distance: 0.5
59      - name: Lift finger
60        file: tilting_position_above.yaml
61        stop:
62          measured-velocity-min-threshold: 0.002
63          desired-velocity-min-threshold: 0.002
64          contact: false
65          activation-distance: 0.15
66      - name: Pull
67        file: tilting_pull.yaml
68        stop:
69          measured-velocity-min-threshold: 0.002
70          desired-velocity-min-threshold: 0.002
71          contact: false
72          activation-distance: 0.15
```

5   tasks/scooping.yaml

```
 1  name: "Scooping"
 2
 3  required-object-info:
 4    tool: true
 5    target-object: true
 6    task: scooping_grains
 7
 8  # The following motion phases will be executed in a sequence
 9  motion-phases:
10    - name: "Position␣Above"
11      # Giskard file
12      file: "scooping_position_above.yaml"
13      # Stop conditions
14      stop:
15        # When measured gripper velocity drops below this threshold
16        measured-velocity-min-threshold: 0.02
17        # When desired (set by the controller) gripper velocity drops below this
             threshold
18        desired-velocity-min-threshold: 0.02
19        # Stop on contact
20        contact: true
21        # Ignore stop conditions until the distance
22        # from the target configuration is less than this
23        activation-distance: 0.15
24    - name: "Insert"
25      file: "scooping_insert.yaml"
26      stop:
27        measured-velocity-min-threshold: 0.02
28        desired-velocity-min-threshold: 0.02
29        contact: false
30        activation-distance: 0.15
31    - name: "Scoop"
32      file: "scooping_scoop.yaml"
33      stop:
34        measured-velocity-min-threshold: 0.02
35        desired-velocity-min-threshold: 0.02
36        contact: false
37        activation-distance: 0.15
38    - name: "Lift"
39      file: "scooping_lift.yaml"
40      stop:
41        measured-velocity-min-threshold: 0.02
42        desired-velocity-min-threshold: 0.02
43        contact: false
44        activation-distance: 0.15
```

6   experiments/scraping$_1$.yaml

```yaml
1   name: Scraping Butter
2
3   # Object scans a.k.a. object knowledge base
4   tool-3d-scan: b_spatula.ply
5   target-object-3d-scan: b_big_bowl.ply
6
7   # Transformation from the end effector to the target object
8   tool-grasp:
9     frame:
10      - quaternion: [-0.0500550264148, 0.705614610626, 0.700932017793,
            -0.0910868927763] # x, y, z, w
11      - vector3: [0.14, 0.028, -0.002] # x, y, z
12
13  # Transformation from the end effector to the tool
14  target-object-grasp:
15    frame:
16      - quaternion: [-0.171777970707, -0.685860866607, -0.0174027448572,
            0.706954273563]
17      - vector3: [0.06, 0.11, 0]
18
19  # Task to execute a.k.a. motion knowledge base
20  task: scraping_butter.yaml
```

7 experiments/cutting₁.yaml

```
1   name: Cutting Lasagna
2
3   # Object scans a.k.a. object knowledge base
4   tool-3d-scan: iai_spatula.ply
5   target-object-3d-scan: iai_big_bowl.ply
6
7   # Transformation from the end effector to the target object
8   tool-grasp:
9     frame:
10      - quaternion: [-0.0500550264148, 0.705614610626, 0.700932017793,
            -0.0910868927763] # x, y, z, w
11      - vector3: [0.14, 0.028, -0.002] # x, y, z
12
13  # Transformation from the end effector to the tool
14  target-object-grasp:
15    frame:
16      - quaternion: [-0.171777970707, -0.685860866607, -0.0174027448572,
            0.706954273563]
17      - vector3: [0.06, 0.11, 0]
18
19  # Task to execute a.k.a. motion knowledge base
20  task: cutting_lasagna.yaml
```

8 experiments/scooping₁.yaml

```yaml
1  name: Scooping Grains
2
3  # Object scans a.k.a. object knowledge base
4  tool-3d-scan: iai_spatula.ply
5  target-object-3d-scan: iai_big_bowl.ply
6
7  # Transformation from the end effector to the tool
8  tool-grasp:
9    frame:
10     - quaternion: [-0.0500550264148, 0.705614610626, 0.700932017793,
                      -0.0910868927763] # x, y, z, w
11     - vector3: [0.14, 0.028, -0.002] # x, y, z
12
13  # Transformation from the end effector to the tool
14  target-object-grasp:
15    frame:
16     - quaternion: [-0.171777970707, -0.685860866607, -0.0174027448572,
                      0.706954273563]
17     - vector3: [0.06, 0.11, 0]
18
19  # Task to execute a.k.a. motion knowledge base
20  task: scooping_grains.yaml
```

9   setups/book$_on_shelf4.yaml$

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
4     target-object: book.ply
5
6   tool-mass: 0.05
7
8   # Transformation from the end effector to the tool
9   # need this as it is assumed left and right ee are gripping something
10  tool-grasp:
11    frame:
12      - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
13      - vector3: [0.0, 0.0, 0.0] # x, y, z
14
15  target-object-grasp:
16    frame: # the position of the corner of the book
17      - quaternion: [0.0, 0.0, 0.0, 1.0]
18      - vector3: [0.24, 0.860967, 0.681249] #[0.08415, 0, 0.3887]
19
20  object-width: 0.2
21
22  target-object-grasp-2:
23    frame:
24      - quaternion: [0.0, 0.0, 0.0, 1.0]
25      - vector3: [0.0, 0.0, 0.0]
```

10 setups/freezer$_b$ox7.yaml

```
1  point -clouds:
2    tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
3    target -object: book.ply
4
5  tool -mass: 0.5
6
7  # Transformation from the end effector to the tool
8  # need this as it is assumed left and right ee are gripping something
9  tool -grasp:
10   frame:
11     - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
12     - vector3: [0.0, 0.0, 0.0] # x, y, z
13
14 target -object -grasp:
15   frame: # the position of the corner of the book
16     - quaternion: [0.0, -0.707, -0.0, 0.707]
17     - vector3: [0.14, 0.0, 0.2] #[0.08415, 0, 0.3887]
18
19 object -width: 0.2
20
21 target -object -grasp -2:
22   frame:
23     - quaternion: [0.0, 0.0, 0.0, 1.0]
24     - vector3: [0.0, 0.0, 0.0]
```

11 setups/b$_c$offee$_c$up$_{bs}$patula.yaml

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: b_spatula.ply
4     target-object: b_coffee_cup.ply
5
6   tool-mass: 0.11
7
8   # Transformation from the end effector to the target object
9   tool-grasp:
10    frame:
11      - quaternion: [-0.00253608,-0.708985,-0.705215,0.0025501] # x, y, z, w
12      - vector3: [0.146581,0.005236,-0.007987] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.127523,-0.986637,-0.100226,-0.0154688]
18      - vector3: [0.0284501,0.0346428,-0.0213798]
```

12 setups/b$_f$rying$_p$an$_{bk}$nife.yaml

```yaml
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_knife.ply
4    target-object: b_frying_pan.ply
5
6  tool-mass: 0.4
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [-0.720776,0,0,0.693168] # x, y, z, w
12     - vector3: [0.090993,0.003448,-0.000959] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.130649,-0.693518,0.0126058,0.708382]
18      - vector3: [0.0186144,0.0468562,0.224672]
```

13 setups/b$_w$ildo$_b$owl$_{bt}$hin$_s$patula.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_thin_spatula.ply
4    target-object: b_wildo_bowl.ply
5
6  tool-mass: 0.11
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10    frame:
11      - quaternion: [0.0256081,0.729689,-0.682751,0.0273691] # x, y, z, w
12      - vector3: [0.094321,0.007657,0.009274] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [0.705296,-0.0280521,-0.693065,0.146397]
18      - vector3: [0.0089419,0.0135799,0.0780419]
```

14 setups/book$_o$n$_s$helf8.yaml

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
4     target-object: book.ply
5
6   tool-mass: 0.05
7
8   # Transformation from the end effector to the tool
9   # need this as it is assumed left and right ee are gripping something
10  tool-grasp:
11    frame:
12      - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
13      - vector3: [0.0, 0.0, 0.0] # x, y, z
14
15  target-object-grasp:
16    frame: # the position of the corner of the book
17      - quaternion: [0.0, 0.0, 0.0, 1.0]
18      - vector3: [0.165, 0.860967, 0.581249] #[0.08415, 0, 0.3887]
19
20  object-width: 0.05
21
22  target-object-grasp-2:
23    frame:
24      - quaternion: [0.0, 0.0, 0.0, 1.0]
25      - vector3: [0.0, 0.0, 0.0]
```

15 setups/$b_bucket_{bt}able_knife.yaml$

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: b_table_knife.ply
4     target-object: b_bucket.ply
5
6   tool-mass: 0.12
7
8   # Transformation from the end effector to the target object
9   tool-grasp:
10    frame:
11      - quaternion: [0.723185,0,0,0.690655] # x, y, z, w
12      - vector3: [0.060878,-0.002438,0.005864] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.0216269,-0.756025,-0.121089,-0.642881]
18      - vector3: [0.0577053,0.0189525,0.101375]
```

16 setups/b$_r$ed$_m$ug$_{bk}$nife.yaml

```yaml
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_knife.ply
4    target-object: b_red_mug.ply
5
6  tool-mass: 0.4
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [-0.720776,0,0,0.693168] # x, y, z, w
12     - vector3: [0.090993,0.003448,-0.000959] # x, y, z
13
14 # Transformation from the end effector to the tool
15 target-object-grasp:
16   frame:
17     - quaternion: [0.680965,-0.00654093,0.713979,0.162724]
18     - vector3: [-0.00780861,0.00428533,0.0614876]
```

17   setups/b$_p$ot$_{bs}$patula.yaml

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: b_spatula.ply
4     target-object: b_pot.ply
5
6   tool-mass: 0.11
7
8   # Transformation from the end effector to the target object
9   tool-grasp:
10    frame:
11      - quaternion: [-0.00253608,-0.708985,-0.705215,0.0025501] # x, y, z, w
12      - vector3: [0.146581,0.005236,-0.007987] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.130649,-0.693518,0.0126058,0.708382]
18      - vector3: [0.023942,0.0237816,0.132364]
```

18 setups/b$_b$ig$_b$owl$_{bt}$hin$_s$patula.yaml

```yaml
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_thin_spatula.ply
4    target-object: b_big_bowl.ply
5
6  tool-mass: 0.11
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10    frame:
11      - quaternion: [0.0256081,0.729689,-0.682751,0.0273691] # x, y, z, w
12      - vector3: [0.094321,0.007657,0.009274] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.171777970707, -0.685860866607, -0.0174027448572,
              0.706954273563]
18      - vector3: [0.06, 0.11, 0]
```

19   setups/b$_p$ot$_{bt}$able$_k$nife.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_table_knife.ply
4    target-object: b_pot.ply
5
6  tool-mass: 0.12
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [0.723185,0,0,0.690655] # x, y, z, w
12     - vector3: [0.060878,-0.002438,0.005864] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.130649,-0.693518,0.0126058,0.708382]
18      - vector3: [0.023942,0.0237816,0.132364]
```

20 setups/freezer$_b$ox.yaml

```
1  point-clouds:
2    tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
3    target-object: book.ply
4
5  tool-mass: 0.5
6
7  # Transformation from the end effector to the tool
8  # need this as it is assumed left and right ee are gripping something
9  tool-grasp:
10   frame:
11     - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
12     - vector3: [0.0, 0.0, 0.0] # x, y, z
13
14 target-object-grasp:
15   frame: # the position of the corner of the book
16     - quaternion: [0.0, -0.707, -0.0, 0.707]
17     - vector3: [-0.02, 0.0, 0.5] #[0.08415, 0, 0.3887]
18
19 object-width: 0.9
20
21 target-object-grasp-2:
22   frame:
23     - quaternion: [0.0, 0.0, 0.0, 1.0]
24     - vector3: [0.0, 0.0, 0.0]
```

21   setups/b$_b$ig$_b$owl$_{bs}$patula.yaml

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: b_spatula.ply
4     target-object: b_big_bowl.ply
5
6   tool-mass: 0.11
7
8   # Transformation from the end effector to the target object
9   tool-grasp:
10    frame:
11      - quaternion: [-0.0500550264148, 0.705614610626, 0.700932017793,
            -0.0910868927763] # x, y, z, w
12      - vector3: [0.14, 0.028, -0.002] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.171777970707, -0.685860866607, -0.0174027448572,
            0.706954273563]
18      - vector3: [0.06, 0.11, 0]
```

22   setups/book$_o n_s helf.yaml$

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
4    target-object: book.ply
5
6  tool-mass: 0.05
7
8  # Transformation from the end effector to the tool
9  # need this as it is assumed left and right ee are gripping something
10 tool-grasp:
11   frame:
12     - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
13     - vector3: [0.0, 0.0, 0.0] # x, y, z
14
15 target-object-grasp:
16   frame: # the position of the corner of the book
17     - quaternion: [0.0, 0.0, 0.0, 1.0]
18     - vector3: [0.23415, 0.661, 0.86594] #[0.08415, 0, 0.3887]
19
20 object-width: 0.037
21
22 target-object-grasp-2:
23   frame:
24     - quaternion: [0.0, 0.0, 0.0, 1.0]
25     - vector3: [0.0, 0.0, 0.0]
```

23   setups/freezer$_b$ox3.yaml

```yaml
1  point-clouds:
2    tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
3    target-object: book.ply
4
5  tool-mass: 0.5
6
7  # Transformation from the end effector to the tool
8  # need this as it is assumed left and right ee are gripping something
9  tool-grasp:
10    frame:
11      - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
12      - vector3: [0.0, 0.0, 0.0] # x, y, z
13
14  target-object-grasp:
15    frame: # the position of the corner of the book
16      - quaternion: [0.0, -0.707, -0.0, 0.707]
17      - vector3: [-0.02, 0.0, 0.5] #[0.08415, 0, 0.3887]
18
19  object-width: 0.5
20
21  target-object-grasp-2:
22    frame:
23      - quaternion: [0.0, 0.0, 0.0, 1.0]
24      - vector3: [0.0, 0.0, 0.0]
```

24 setups/book$_on_shelf7.yaml$

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
4     target-object: book.ply
5
6   tool-mass: 0.05
7
8   # Transformation from the end effector to the tool
9   # need this as it is assumed left and right ee are gripping something
10  tool-grasp:
11    frame:
12      - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
13      - vector3: [0.0, 0.0, 0.0] # x, y, z
14
15  target-object-grasp:
16    frame: # the position of the corner of the book
17      - quaternion: [0.0, 0.0, 0.0, 1.0]
18      - vector3: [0.19, 0.860967, 0.581249] #[0.08415, 0, 0.3887]
19
20  object-width: 0.05
21
22  target-object-grasp-2:
23    frame:
24      - quaternion: [0.0, 0.0, 0.0, 1.0]
25      - vector3: [0.0, 0.0, 0.0]
```

25 setups/b$_r$ed$_m$ug$_{bs}$patula.yaml

```yaml
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_spatula.ply
4    target-object: b_red_mug.ply
5
6  tool-mass: 0.11
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [-0.00253608,-0.708985,-0.705215,0.0025501] # x, y, z, w
12     - vector3: [0.146581,0.005236,-0.007987] # x, y, z
13
14 # Transformation from the end effector to the tool
15 target-object-grasp:
16   frame:
17     - quaternion: [0.680965,-0.00654093,0.713979,0.162724]
18     - vector3: [-0.00780861,0.00428533,0.0614876]
```

26 setups/b$_b$ig$_b$owl$_{bs}$erving$_s$poon.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_serving_spoon.ply
4    target-object: b_big_bowl.ply
5
6  tool-mass: 0.06
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [0.636851429939, 0.0316718295217, 0.0261988528073,
           0.769890606403] # x, y, z, w
12     - vector3: [0.112571612, 0.00813051871955, -0.0153673645109] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16   frame:
17     - quaternion: [-0.171777970707, -0.685860866607, -0.0174027448572,
           0.706954273563]
18     - vector3: [0.06, 0.11, 0]
```

27 setups/b$_r$ed$_m$ug$_{bt}$able$_k$nife.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_table_knife.ply
4    target-object: b_red_mug.ply
5
6  tool-mass: 0.12
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [0.723185,0,0,0.690655] # x, y, z, w
12     - vector3: [0.060878,-0.002438,0.005864] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16   frame:
17     - quaternion: [0.680965,-0.00654093,0.713979,0.162724]
18     - vector3: [-0.00780861,0.00428533,0.0614876]
```

28 setups/$\mathbf{b}_c offee_c up_{bk} nife.yaml$

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: b_knife.ply
4     target-object: b_coffee_cup.ply
5
6   tool-mass: 0.4
7
8   # Transformation from the end effector to the target object
9   tool-grasp:
10    frame:
11      - quaternion: [-0.720776,0,0,0.693168] # x, y, z, w
12      - vector3: [0.090993,0.003448,-0.000959] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.127523,-0.986637,-0.100226,-0.0154688]
18      - vector3: [0.0284501,0.0346428,-0.0213798]
```

29 setups/freezer$_b$ox2.yaml

```
1  point-clouds:
2    tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
3    target-object: book.ply
4
5  tool-mass: 0.5
6
7  # Transformation from the end effector to the tool
8  # need this as it is assumed left and right ee are gripping something
9  tool-grasp:
10    frame:
11      - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
12      - vector3: [0.0, 0.0, 0.0] # x, y, z
13
14  target-object-grasp:
15    frame: # the position of the corner of the book
16      - quaternion: [0.0, -0.707, -0.0, 0.707]
17      - vector3: [-0.02, 0.0, 0.5] #[0.08415, 0, 0.3887]
18
19  object-width: 0.5
20
21  target-object-grasp-2:
22    frame:
23      - quaternion: [0.0, 0.0, 0.0, 1.0]
24      - vector3: [0.0, 0.0, 0.0]
```

30   setups/book$_o n_s helf2.yaml$

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
4     target-object: book.ply
5
6   tool-mass: 0.05
7
8   # Transformation from the end effector to the tool
9   # need this as it is assumed left and right ee are gripping something
10  tool-grasp:
11    frame:
12      - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
13      - vector3: [0.0, 0.0, 0.0] # x, y, z
14
15  target-object-grasp:
16    frame: # the position of the corner of the book
17      - quaternion: [0.0, 0.0, 0.0, 1.0]
18      - vector3: [0.24, 0.860967, 0.981249] #[0.08415, 0, 0.3887]
19
20  object-width: 0.5
21
22  target-object-grasp-2:
23    frame:
24      - quaternion: [0.0, 0.0, 0.0, 1.0]
25      - vector3: [0.0, 0.0, 0.0]
```

31 setups/$b_bucket_{bk}nife.yaml$

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_knife.ply
4    target-object: b_bucket.ply
5
6  tool-mass: 0.4
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [-0.720776,0,0,0.693168] # x, y, z, w
12     - vector3: [0.090993,0.003448,-0.000959] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.0216269,-0.756025,-0.121089,-0.642881]
18      - vector3: [0.0577053,0.0189525,0.101375]
```

32 setups/b$_c$off ee$_c$up$_{bs}$erving$_s$poon.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_serving_spoon.ply
4    target-object: b_coffee_cup.ply
5
6  tool-mass: 0.06
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [0.636851429939, 0.0316718295217, 0.0261988528073,
             0.769890606403] # x, y, z, w
12     - vector3: [0.112571612, 0.00813051871955, -0.0153673645109] # x, y, z
13
14 # Transformation from the end effector to the tool
15 target-object-grasp:
16   frame:
17     - quaternion: [-0.127523,-0.986637,-0.100226,-0.0154688]
18     - vector3: [0.0284501,0.0346428,-0.0213798]
```

33   setups/freezer$_b$ox4.yaml

```yaml
 1  point-clouds:
 2    tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
 3    target-object: book.ply
 4
 5  tool-mass: 0.5
 6
 7  # Transformation from the end effector to the tool
 8  # need this as it is assumed left and right ee are gripping something
 9  tool-grasp:
10    frame:
11      - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
12      - vector3: [0.0, 0.0, 0.0] # x, y, z
13
14  target-object-grasp:
15    frame: # the position of the corner of the book
16      - quaternion: [0.0, -0.707, -0.0, 0.707]
17      - vector3: [-0.02, 0.0, 0.5] #[0.08415, 0, 0.3887]
18
19  object-width: 0.2
20
21  target-object-grasp-2:
22    frame:
23      - quaternion: [0.0, 0.0, 0.0, 1.0]
24      - vector3: [0.0, 0.0, 0.0]
```

34 setups/b$_w$ildo$_b$owl$_{bt}$able$_k$nife.yaml

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: b_table_knife.ply
4     target-object: b_wildo_bowl.ply
5
6   tool-mass: 0.12
7
8   # Transformation from the end effector to the target object
9   tool-grasp:
10    frame:
11      - quaternion: [0.723185,0,0,0.690655] # x, y, z, w
12      - vector3: [0.060878,-0.002438,0.005864] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [0.705296,-0.0280521,-0.693065,0.146397]
18      - vector3: [0.0089419,0.0135799,0.0780419]
```

35   setups/b$_b$ucket$_{bs}$erving$_s$poon.yaml

```
 1  # Object scans a.k.a. object knowledge base
 2  point-clouds:
 3    tool: b_serving_spoon.ply
 4    target-object: b_bucket.ply
 5
 6  tool-mass: 0.06
 7
 8  # Transformation from the end effector to the target object
 9  tool-grasp:
10    frame:
11      - quaternion: [0.636851429939, 0.0316718295217, 0.0261988528073,
                0.769890606403] # x, y, z, w
12      - vector3: [0.112571612, 0.00813051871955, -0.0153673645109] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.0216269,-0.756025,-0.121089,-0.642881]
18      - vector3: [0.0577053,0.0189525,0.101375]
```

36 setups/b$_w$ildo$_b$owl$_{bk}$nife.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_knife.ply
4    target-object: b_wildo_bowl.ply
5
6  tool-mass: 0.4
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [-0.720776,0,0,0.693168] # x, y, z, w
12     - vector3: [0.090993,0.003448,-0.000959] # x, y, z
13
14 # Transformation from the end effector to the tool
15 target-object-grasp:
16   frame:
17     - quaternion: [0.705296,-0.0280521,-0.693065,0.146397]
18     - vector3: [0.0089419,0.0135799,0.0780419]
```

37 setups/b$_f$$rying_p an_{bt} able_k nife.yaml$

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_table_knife.ply
4    target-object: b_frying_pan.ply
5
6  tool-mass: 0.12
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [0.723185,0,0,0.690655] # x, y, z, w
12     - vector3: [0.060878,-0.002438,0.005864] # x, y, z
13
14 # Transformation from the end effector to the tool
15 target-object-grasp:
16   frame:
17     - quaternion: [-0.130649,-0.693518,0.0126058,0.708382]
18     - vector3: [0.0186144,0.0468562,0.224672]
```

38 setups/b$_f$rying$_p$an$_{bs}$erving$_s$poon.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_serving_spoon.ply
4    target-object: b_frying_pan.ply
5
6  tool-mass: 0.06
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [0.636851429939, 0.0316718295217, 0.0261988528073,
           0.769890606403] # x, y, z, w
12     - vector3: [0.112571612, 0.00813051871955, -0.0153673645109] # x, y, z
13
14 # Transformation from the end effector to the tool
15 target-object-grasp:
16   frame:
17     - quaternion: [-0.130649,-0.693518,0.0126058,0.708382]
18     - vector3: [0.0186144,0.0468562,0.224672]
```

39 setups/b$_r$ed$_m$ug$_{bs}$erving$_s$poon.yaml

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: b_serving_spoon.ply
4     target-object: b_red_mug.ply
5
6   tool-mass: 0.06
7
8   # Transformation from the end effector to the target object
9   tool-grasp:
10    frame:
11      - quaternion: [0.636851429939, 0.0316718295217, 0.0261988528073,
                0.769890606403] # x, y, z, w
12      - vector3: [0.112571612, 0.00813051871955, -0.0153673645109] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [0.680965,-0.00654093,0.713979,0.162724]
18      - vector3: [-0.00780861,0.00428533,0.0614876]
```

40   setups/freezer$_b$ox6.yaml

```
1  point -clouds:
2    tool: nothing.ply # no tool therefore no pointcloud , but still need pointcloud
3    target -object: book.ply
4
5  tool -mass: 0.5
6
7  # Transformation from the end effector to the tool
8  # need this as it is assumed left and right ee are gripping something
9  tool -grasp:
10   frame:
11     - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
12     - vector3: [0.0, 0.0, 0.0] # x, y, z
13
14 target -object -grasp:
15   frame: # the position of the corner of the book
16     - quaternion: [0.0, -0.707, -0.0, 0.707]
17     - vector3: [0.14, 0.0, 0.5] #[0.08415, 0, 0.3887]
18
19 object -width: 0.2
20
21 target -object -grasp -2:
22   frame:
23     - quaternion: [0.0, 0.0, 0.0, 1.0]
24     - vector3: [0.0, 0.0, 0.0]
```

41 setups/book$_o n_s helf 5.yaml$

```yaml
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
4    target-object: book.ply
5
6  tool-mass: 0.05
7
8  # Transformation from the end effector to the tool
9  # need this as it is assumed left and right ee are gripping something
10 tool-grasp:
11   frame:
12     - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
13     - vector3: [0.0, 0.0, 0.0] # x, y, z
14
15 target-object-grasp:
16   frame: # the position of the corner of the book
17     - quaternion: [0.0, 0.0, 0.0, 1.0]
18     - vector3: [0.24, 0.860967, 0.681249] #[0.08415, 0, 0.3887]
19
20 object-width: 0.05
21
22 target-object-grasp-2:
23   frame:
24     - quaternion: [0.0, 0.0, 0.0, 1.0]
25     - vector3: [0.0, 0.0, 0.0]
```

42 setups/b$_f$$rying_p$$an_{bt}$$hin_s$$patula.yaml$

```
 1  # Object scans a.k.a. object knowledge base
 2  point-clouds:
 3    tool: b_thin_spatula.ply
 4    target-object: b_frying_pan.ply
 5
 6  tool-mass: 0.11
 7
 8  # Transformation from the end effector to the target object
 9  tool-grasp:
10    frame:
11      - quaternion: [0.0256081,0.729689,-0.682751,0.0273691] # x, y, z, w
12      - vector3: [0.094321,0.007657,0.009274] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.130649,-0.693518,0.0126058,0.708382]
18      - vector3: [0.0186144,0.0468562,0.224672]
```

43 setups/b$_r$ed$_m$ug$_{bt}$hin$_s$patula.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_thin_spatula.ply
4    target-object: b_red_mug.ply
5
6  tool-mass: 0.11
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [0.0256081,0.729689,-0.682751,0.0273691] # x, y, z, w
12     - vector3: [0.094321,0.007657,0.009274] # x, y, z
13
14 # Transformation from the end effector to the tool
15 target-object-grasp:
16   frame:
17     - quaternion: [0.680965,-0.00654093,0.713979,0.162724]
18     - vector3: [-0.00780861,0.00428533,0.0614876]
```

44   setups/b$_b$ig$_b$owl$_{bk}$nife.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_knife.ply
4    target-object: b_big_bowl.ply
5
6  tool-mass: 0.4
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [-0.720776,0,0,0.693168] # x, y, z, w
12     - vector3: [0.090993,0.003448,-0.000959] # x, y, z
13
14 # Transformation from the end effector to the tool
15 target-object-grasp:
16   frame:
17     - quaternion: [-0.171777970707, -0.685860866607, -0.0174027448572,
           0.706954273563]
18     - vector3: [0.06, 0.11, 0]
```

45 setups/b$_p$ot$_{bs}$erving$_s$poon.yaml

```
 1   # Object scans a.k.a. object knowledge base
 2   point-clouds:
 3     tool: b_serving_spoon.ply
 4     target-object: b_pot.ply
 5
 6   tool-mass: 0.06
 7
 8   # Transformation from the end effector to the target object
 9   tool-grasp:
10     frame:
11       - quaternion: [0.636851429939, 0.0316718295217, 0.0261988528073,
                        0.769890606403] # x, y, z, w
12       - vector3: [0.112571612, 0.00813051871955, -0.0153673645109] # x, y, z
13
14   # Transformation from the end effector to the tool
15   target-object-grasp:
16     frame:
17       - quaternion: [-0.130649,-0.693518,0.0126058,0.708382]
18       - vector3: [0.023942,0.0237816,0.132364]
```

46 setups/b$_f$rying$_p$an$_{bs}$patula.yaml

```
 1  # Object scans a.k.a. object knowledge base
 2  point-clouds:
 3    tool: b_spatula.ply
 4    target-object: b_frying_pan.ply
 5
 6  tool-mass: 0.11
 7
 8  # Transformation from the end effector to the target object
 9  tool-grasp:
10    frame:
11      - quaternion: [-0.00253608, -0.708985, -0.705215, 0.0025501] # x, y, z, w
12      - vector3: [0.146581, 0.005236, -0.007987] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.130649,-0.693518,0.0126058,0.708382]
18      - vector3: [0.0186144,0.0468562,0.224672]
```

47   setups/Readme.md

```
1   This directory contains files that provide handcoded information to the robot:
2
3   * Grasps (how have I grasped objects)
4   * Object models (what is in my hands)
5   * Object info (edge, tip, etc.)
6
7   Ideally this should not be needed at all, because the robot should be able
8   to infer or recognize all such data about it's environment.
9
10  Note:
11  When object info is given then feature_detector will be bypassed.
12
13
14  Sample file:
15
16  ```
17  # Object scans a.k.a. object knowledge base
18  point-clouds:
19    tool: b_table_knife.ply
20    target-object: b_bucket.ply
21
22  tool-mass: 0.050
23
24  # Transformation from the end effector to the tool
25  tool-grasp:
26    frame:
27      - quaternion: [0.723185,0,0,0.690655] # x, y, z, w
28      - vector3: [0.060878,-0.002438,0.005864] # x, y, z
29
30  # Transformation from the end effector to the target object
31  target-object-grasp:
32    frame:
33      - quaternion: [-0.0216269,-0.756025,-0.121089,-0.642881]
34      - vector3: [0.0577053,0.0189525,0.101375]
35  ```
```

48 setups/freezer$_b$ox5.yaml

```
 1  point -clouds:
 2    tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
 3    target -object: book.ply
 4
 5  tool -mass: 0.5
 6
 7  # Transformation from the end effector to the tool
 8  # need this as it is assumed left and right ee are gripping something
 9  tool -grasp:
10    frame:
11      - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
12      - vector3: [0.0, 0.0, 0.0] # x, y, z
13
14  target -object -grasp:
15    frame: # the position of the corner of the book
16      - quaternion: [0.0, -0.707, -0.0, 0.707]
17      - vector3: [0.13, 0.0, 0.5] #[0.08415, 0, 0.3887]
18
19  object -width: 0.5
20
21  target -object -grasp -2:
22    frame:
23      - quaternion: [0.0, 0.0, 0.0, 1.0]
24      - vector3: [0.0, 0.0, 0.0]
```

49 setups/$b_bucket_{bt}hin_sspatula.yaml$

```
 1  # Object scans a.k.a. object knowledge base
 2  point-clouds:
 3    tool: b_thin_spatula.ply
 4    target-object: b_bucket.ply
 5
 6  tool-mass: 0.11
 7
 8  # Transformation from the end effector to the target object
 9  tool-grasp:
10    frame:
11      - quaternion: [0.0256081,0.729689,-0.682751,0.0273691] # x, y, z, w
12      - vector3: [0.094321,0.007657,0.009274] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.0216269,-0.756025,-0.121089,-0.642881]
18      - vector3: [0.0577053,0.0189525,0.101375]
```

50   setups/b$_c$offee$_c$up$_{bt}$hin$_s$patula.yaml

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: b_thin_spatula.ply
4     target-object: b_coffee_cup.ply
5
6   tool-mass: 0.11
7
8   # Transformation from the end effector to the target object
9   tool-grasp:
10    frame:
11      - quaternion: [0.0256081,0.729689,-0.682751,0.0273691] # x, y, z, w
12      - vector3: [0.094321,0.007657,0.009274] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.127523,-0.986637,-0.100226,-0.0154688]
18      - vector3: [0.0284501,0.0346428,-0.0213798]
```

51   setups/b$_w$ildo$_b$owl$_{bs}$patula.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_spatula.ply
4    target-object: b_wildo_bowl.ply
5
6  tool-mass: 0.11
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [-0.00253608,-0.708985,-0.705215,0.0025501] # x, y, z, w
12     - vector3: [0.146581,0.005236,-0.007987] # x, y, z
13
14 # Transformation from the end effector to the tool
15 target-object-grasp:
16   frame:
17     - quaternion: [0.705296,-0.0280521,-0.693065,0.146397]
18     - vector3: [0.0089419,0.0135799,0.0780419]
```

52 setups/b$_c$off ee$_c$up$_{bt}$able$_k$nif e.yaml

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: b_table_knife.ply
4     target-object: b_coffee_cup.ply
5
6   tool-mass: 0.12
7
8   # Transformation from the end effector to the target object
9   tool-grasp:
10    frame:
11      - quaternion: [0.723185,0,0,0.690655] # x, y, z, w
12      - vector3: [0.060878,-0.002438,0.005864] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.127523,-0.986637,-0.100226,-0.0154688]
18      - vector3: [0.0284501,0.0346428,-0.0213798]
```

53 setups/book$_on_shelf6.yaml$

```yaml
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
4     target-object: book.ply
5
6   tool-mass: 0.05
7
8   # Transformation from the end effector to the tool
9   # need this as it is assumed left and right ee are gripping something
10  tool-grasp:
11    frame:
12      - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
13      - vector3: [0.0, 0.0, 0.0] # x, y, z
14
15  target-object-grasp:
16    frame: # the position of the corner of the book
17      - quaternion: [0.0, 0.0, 0.0, 1.0]
18      - vector3: [0.24, 0.860967, 0.581249] #[0.08415, 0, 0.3887]
19
20  object-width: 0.05
21
22  target-object-grasp-2:
23    frame:
24      - quaternion: [0.0, 0.0, 0.0, 1.0]
25      - vector3: [0.0, 0.0, 0.0]
```

54 setups/b$_p$ot$_{bk}$nife.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_knife.ply
4    target-object: b_pot.ply
5
6  tool-mass: 0.4
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [-0.720776,0,0,0.693168] # x, y, z, w
12     - vector3: [0.090993,0.003448,-0.000959] # x, y, z
13
14 # Transformation from the end effector to the tool
15 target-object-grasp:
16   frame:
17     - quaternion: [-0.130649,-0.693518,0.0126058,0.708382]
18     - vector3: [0.023942,0.0237816,0.132364]
```

55 setups/b$_p$ot$_{bt}$hin$_s$patula.yaml

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: b_thin_spatula.ply
4    target-object: b_pot.ply
5
6  tool-mass: 0.11
7
8  # Transformation from the end effector to the target object
9  tool-grasp:
10   frame:
11     - quaternion: [0.0256081,0.729689,-0.682751,0.0273691] # x, y, z, w
12     - vector3: [0.094321,0.007657,0.009274] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.130649,-0.693518,0.0126058,0.708382]
18      - vector3: [0.023942,0.0237816,0.132364]
```

56   setups/b$_big_bowl_btable_knife.yaml$

```
1   # Object scans a.k.a. object knowledge base
2   point-clouds:
3     tool: b_table_knife.ply
4     target-object: b_big_bowl.ply
5
6   tool-mass: 0.12
7
8   # Transformation from the end effector to the target object
9   tool-grasp:
10    frame:
11      - quaternion: [0.723185,0,0,0.690655] # x, y, z, w
12      - vector3: [0.060878,-0.002438,0.005864] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.171777970707, -0.685860866607, -0.0174027448572,
            0.706954273563]
18      - vector3: [0.06, 0.11, 0]
```

57 setups/b$_w$ildo$_b$owl$_{bs}$erving$_s$poon.yaml

```
 1  # Object scans a.k.a. object knowledge base
 2  point-clouds:
 3    tool: b_serving_spoon.ply
 4    target-object: b_wildo_bowl.ply
 5
 6  tool-mass: 0.06
 7
 8  # Transformation from the end effector to the target object
 9  tool-grasp:
10    frame:
11      - quaternion: [0.636851429939, 0.0316718295217, 0.0261988528073,
                0.769890606403] # x, y, z, w
12      - vector3: [0.112571612, 0.00813051871955, -0.0153673645109] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [0.705296,-0.0280521,-0.693065,0.146397]
18      - vector3: [0.0089419,0.0135799,0.0780419]
```

58   setups/b$_b$ucket$_b$spatula.yaml

```
 1  # Object scans a.k.a. object knowledge base
 2  point-clouds:
 3    tool: b_spatula.ply
 4    target-object: b_bucket.ply
 5
 6  tool-mass: 0.11
 7
 8  # Transformation from the end effector to the target object
 9  tool-grasp:
10    frame:
11      - quaternion: [-0.00253608,-0.708985,-0.705215,0.0025501] # x, y, z, w
12      - vector3: [0.146581,0.005236,-0.007987] # x, y, z
13
14  # Transformation from the end effector to the tool
15  target-object-grasp:
16    frame:
17      - quaternion: [-0.0216269,-0.756025,-0.121089,-0.642881]
18      - vector3: [0.0577053,0.0189525,0.101375]
```

```
1  # Object scans a.k.a. object knowledge base
2  point-clouds:
3    tool: nothing.ply # no tool therefore no pointcloud, but still need pointcloud
4    target-object: book.ply
5
6  tool-mass: 0.05
7
8  # Transformation from the end effector to the tool
9  # need this as it is assumed left and right ee are gripping something
10 tool-grasp:
11   frame:
12     - quaternion: [0.0, 0., 0., 1.00000000001] # x, y, z, w
13     - vector3: [0.0, 0.0, 0.0] # x, y, z
14
15 target-object-grasp:
16   frame: # the position of the corner of the book
17     - quaternion: [0.0, 0.0, 0.0, 1.0]
18     - vector3: [0.24, 0.860967, 0.681249] #[0.08415, 0, 0.3887]
19
20 object-width: 0.5
21
22 target-object-grasp-2:
23   frame:
24     - quaternion: [0.0, 0.0, 0.0, 1.0]
25     - vector3: [0.0, 0.0, 0.0]
```

60   srv/GetTaskSpec.srv

```
1  ---
2  int32 motion_phase_count
```

61 srv/DetectTargetObjectInfo.srv

```
1  string point_cloud_file_name
2  ---
3  geometry_msgs/Point edge_point
4  geometry_msgs/Vector3 alignment_vector
```

62 srv/GetMotionSpec.srv

```
1  int32 index
2  ---
3  string spec
4  StopCondition stop_condition
```

63   srv/DetectToolInfo.srv

```
1   string point_cloud_file_name
2   float64 tool_mass
3   string task_name
4   geometry_msgs/Point edge_point
5   geometry_msgs/Vector3 alignment_vector
6   ---
7   float64 affordance_score
8   geometry_msgs/Point grasp_center
9   geometry_msgs/Point action_center
10  geometry_msgs/Point tool_tip
11  geometry_msgs/Vector3 tool_tip_vector
12  geometry_msgs/Quaternion tool_quaternion
13  geometry_msgs/Point tool_heel
```

64 launch/experiment.launch

```
1  <launch>
2    <node pkg="skill_transfer" type="feature_detector" name="feature_detector"
         output="screen">
3      <param name="point_cloud_directory_path" type="string" value="$(find␣
           skill_transfer)/point_clouds/" />
4      <param name="trained_data_directory_path" type="string" value="$(find␣
           skill_transfer)/trained_data/" />
5      <param name="show_results" type="boolean" value="true" />
6    </node>
7
8    <node pkg="skill_transfer" type="knowledge_manager" name="knowledge_manager"
         output="screen">
9      <param name="task_file_path" type="string" value="$(find␣skill_transfer)/
           tasks/$(arg␣task).yaml" />
10     <param name="motion_template_file_path" type="string" value="$(find␣
           skill_transfer)/motion_templates/$(arg␣robot).yaml"/>
11     <param name="motion_directory_path" type="string" value="$(find␣
           skill_transfer)/motions/" />
12     <param name="setup_file_path" type="string" value="$(find␣skill_transfer)/
           setups/$(arg␣setup).yaml" />
13     <param name="info_cache_directory_path" type="string" value="$(find␣
           skill_transfer)/info_cache/" />
14   </node>
15
16   <node pkg="skill_transfer" type="constraint_controller_$(arg␣robot)" name="
         constraint_controller" output="screen"/>
17
18   <node pkg="skill_transfer" type="task_executive" name="task_executive" output=
         "screen"/>
19  </launch>
```

65 launch/pr2.launch

```
 1  <launch>
 2    <group>
 3      <include file="$(find iai_pr2_description)/launch/upload_pr2.launch" />
 4
 5      <node pkg="iai_naive_kinematics_sim" type="simulator"
 6            name="simulator" output="screen">
 7        <rosparam command="load"
 8            file="$(find skill_transfer)/initial_poses/pr2_scraping.yaml" />
 9        <remap from="~joint_states" to="/joint_states" />
10        <remap from="~commands" to="/whole_body_controller/velocity_controller/
            command" />
11      </node>
12
13      <node pkg="robot_state_publisher" type="robot_state_publisher"
14            name="robot_state_publisher" />
15
16      <node pkg="tf2_ros" type="buffer_server" name="tf2_buffer_server" />
17
18      <include file="$(find iai_pr2_sim)/launch/fake_localization.launch" />
19    </group>
20
21    <include file="$(find giskard_pr2)/launch/qp_controller.launch" >
22      <arg name="sim" value="true" />
23      <arg name="trajectory_controller" value="false" />
24    </include>
25
26    <group>
27      <node pkg="rviz" type="rviz" name="rviz" required="true"
28            args="-d $(find skill_transfer)/config/simulator.rviz" />
29    </group>
30
31  </launch>
```

66   launch/simulation.launch

```xml
1   <launch>
2     <!-- We resume the logic in empty_world.launch, changing only the name of the
           world to be launched -->
3     <include file="$(find␣gazebo_ros)/launch/empty_world.launch">
4       <arg name="world_name" value="$(find␣skill_transfer)/worlds/$(arg␣world).
             world"/>
5       <arg name="paused" value="false"/>
6       <arg name="use_sim_time" value="true"/>
7       <arg name="gui" value="true"/>
8       <arg name="headless" value="false"/>
9       <arg name="debug" value="false"/>
10      <arg name="verbose" value="true"/>
11      <arg name="physics" default="ode"/>
12    </include>
13  </launch>
```

67 launch/visualization.launch

```
1  <launch>
2    <env name="GAZEBO_MODEL_PATH" value="$(find␣skill_transfer)/models"/>
3
4    <include file="$(find␣gazebo2rviz)/launch/gazebo2rviz.launch"/>
5    <node name="rviz" pkg="rviz" type="rviz"/>
6  </launch>
```

68 include/skill$_t$ransfer/giskard$_a$dapter.h

```cpp
#ifndef GISKARD_ADAPTER_H
#define GISKARD_ADAPTER_H

#include <giskard_core/giskard_core.hpp>
#include <geometry_msgs/Twist.h>
#include <sensor_msgs/JointState.h>
#include <visualization_msgs/Marker.h>
#include <string>
#include <vector>

class GiskardAdapter
{
public:
  GiskardAdapter(int nWSR);

  void createController(const std::string &constraints);
  void startController(const Eigen::VectorXd &inputs);
  void updateController(const Eigen::VectorXd &inputs);
  geometry_msgs::Twist getDesiredFrameTwistMsg(
      const Eigen::VectorXd &inputs,
      const std::string &frame_name);
  geometry_msgs::Twist getMeasuredFrameTwistMsg(
      const Eigen::VectorXd &inputs,
      const Eigen::VectorXd &velocities,
      const std::string &frame_name);
  sensor_msgs::JointState getDesiredJointVelocityMsg();
  double getDistance();
  std::vector<visualization_msgs::Marker> getVisualizationMsgs();

  bool controller_started_;
  int nWSR_;

private:
  giskard_core::QPController controller_;
};

#endif // GISKARD_ADAPTER_H
```

69 include/skill$_t$ransfer/twist$_l$og.h

```
1   #ifndef TWIST_LOG_H
2   #define TWIST_LOG_H
3
4   #include <deque>
5   #include <geometry_msgs/Twist.h>
6
7   class TwistLog
8   {
9   public:
10    TwistLog(unsigned int size);
11    void push(geometry_msgs::Twist twist);
12    void clear();
13    bool allFilledAndBelowThreshold(double threshold);
14
15  protected:
16    std::deque<geometry_msgs::Twist> log_;
17    std::deque<geometry_msgs::Twist>::size_type size_;
18  };
19
20  #endif
```

```
1   /*
2    * Copyright (C) 2016-2017 Georg Bartels <georg.bartels@cs.uni-bremen.de>
3    *
4    * This file is part of giskard.
5    *
6    * giskard is free software; you can redistribute it and/or
7    * modify it under the terms of the GNU General Public License
8    * as published by the Free Software Foundation; either version 2
9    * of the License, or (at your option) any later version.
10   *
11   * This program is distributed in the hope that it will be useful,
12   * but WITHOUT ANY WARRANTY; without even the implied warranty of
13   * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
14   * GNU General Public License for more details.
15   *
16   * You should have received a copy of the GNU General Public License
17   * along with this program; if not, write to the Free Software
18   * Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA  02110-1301, USA
        .
19   */
20
21   #ifndef __GISKARD_WATCHDOG_HPP__
22   #define __GISKARD_WATCHDOG_HPP__
23
24   namespace giskard_ros
25   {
26     template<class Time, class Duration>
27     class Watchdog
28     {
29       public:
30         bool barking(const Time& now)
31         {
32           return (now - last_kick_) > period_;
33         }
34
35         void setPeriod(const Duration& period)
36         {
37           period_ = period;
38         }
39
40         const Duration& getPeriod() const
41         {
42           return period_;
43         }
44
45         void kick(const Time& now)
46         {
47           last_kick_ = now;
48         }
49
50         const Time& getLastPetTime() const
51         {
52           return last_kick_;
53         }
54       private:
```

```
55          Duration period_;
56          Time last_kick_;
57      };
58  }
59
60  #endif // __GISKARD_WATCHDOG__HPP
```

```cpp
1   #ifndef CONVERSIONS_H
2   #define CONVERSIONS_H
3
4   #include <map>
5   #include <vector>
6   #include <giskard_core/giskard_core.hpp>
7   #include <kdl_conversions/kdl_msg.h>
8   #include <sensor_msgs/JointState.h>
9
10  template <class T, class U>
11  inline std::map<T, U> toMap(const std::vector<T> &keys, const std::vector<U> &
        values)
12  {
13    // FIXME: move move to another package
14    if (keys.size() != values.size())
15      throw std::runtime_error("Number␣of␣keys␣not␣equal␣to␣numbers␣of␣values.");
16
17    std::map<T, U> result;
18    for (size_t i = 0; i < keys.size(); ++i)
19      result.insert(std::pair<T, U>(keys[i], values[i]));
20
21    return result;
22  }
23
24  inline Eigen::VectorXd msgPoseToEigenVector(const geometry_msgs::Pose &pose)
25  {
26    // FIXME: refactor this into a header file
27    KDL::Frame frame;
28    tf::poseMsgToKDL(pose, frame);
29
30    Eigen::VectorXd result(6);
31
32    result(0) = pose.position.x;
33    result(1) = pose.position.y;
34    result(2) = pose.position.z;
35
36    KDL::Rotation::Quaternion(
37        pose.orientation.x, pose.orientation.y, pose.orientation.z, pose.
            orientation.w)
38        .GetEulerZYX(result(3), result(4),
39                     result(5));
40
41    return result;
42  }
43
44  inline Eigen::VectorXd kdlFrameToEigenVector(const KDL::Frame &frame)
45  {
46    Eigen::VectorXd result(6);
47
48    result(0) = frame.p.x();
49    result(1) = frame.p.y();
50    result(2) = frame.p.z();
51    frame.M.GetEulerZYX(result(3), result(4), result(5));
52
53    return result;
```

```cpp
54  }
55
56  inline std::vector<double> eigenVectorToStdVector(const Eigen::VectorXd &v)
57  {
58    // FIXME: where to put this?
59    std::vector<double> result;
60    for (int i = 0; i < v.rows(); ++i)
61      result.push_back(v(i));
62
63    return result;
64  }
65
66  inline geometry_msgs::Twist eigenVectorToMsgTwist(const Eigen::VectorXd &t)
67  {
68    if (t.rows() != 6)
69      throw std::runtime_error("Did␣not␣receive␣vector␣representing␣a␣twist␣with␣6
          ␣values.");
70
71    geometry_msgs::Twist result;
72
73    result.linear.x = t(0);
74    result.linear.y = t(1);
75    result.linear.z = t(2);
76    result.angular.x = t(3);
77    result.angular.y = t(4);
78    result.angular.z = t(5);
79
80    return result;
81  }
82
83  inline sensor_msgs::JointState eigenVectorToMsgJointState(const Eigen::VectorXd
      &t)
84  {
85    if (t.rows() != 15)
86      throw std::runtime_error("Did␣not␣receive␣vector␣representing␣a␣twist␣with␣6
          ␣values.");
87
88    sensor_msgs::JointState result;
89
90    result.name = std::vector<std::string>{
91      "torso_lift_joint",
92      "l_shoulder_pan_joint",
93      "l_shoulder_lift_joint",
94      "l_upper_arm_roll_joint",
95      "l_elbow_flex_joint",
96      "l_forearm_roll_joint",
97      "l_wrist_flex_joint",
98      "l_wrist_roll_joint",
99      "r_shoulder_pan_joint",
100     "r_shoulder_lift_joint",
101     "r_upper_arm_roll_joint",
102     "r_elbow_flex_joint",
103     "r_forearm_roll_joint",
104     "r_wrist_flex_joint",
105     "r_wrist_roll_joint"
106   };
107
```

```
108     result.velocity = std::vector<double>{
109         t(0),
110         t(1),
111         t(2),
112         t(3),
113         t(4),
114         t(5),
115         t(6),
116         t(7),
117         t(8),
118         t(9),
119         t(10),
120         t(11),
121         t(12),
122         t(13),
123         t(14)
124     };
125
126     return result;
127 }
128
129 #endif
```

72 include/skill$_t$ransfer/giskard$_u$tils.h

```
1   #ifndef GISKARD_UTILS
2   #define GISKARD_UTILS
3
4   #include <giskard_core/giskard_core.hpp>
5   #include "skill_transfer/conversions.h"
6
7   inline giskard_core::QPController generateController(const std::string &
        yaml_string)
8   {
9     // FIXME: add this to giskard_core
10    YAML::Node node = YAML::Load(yaml_string);
11    giskard_core::QPControllerSpec spec = node.as<giskard_core::QPControllerSpec
          >();
12    giskard_core::QPController controller = giskard_core::generate(spec);
13
14    return controller;
15  }
16
17  inline KDL::Jacobian getJacobian(const giskard_core::QPController &controller,
18                                   const std::string &frame_name, const Eigen::
                                        VectorXd &observables)
19  {
20    const KDL::Expression<KDL::Frame>::Ptr controlled_frame =
21        controller.get_scope().find_frame_expression(frame_name);
22
23    controlled_frame->setInputValues(eigenVectorToStdVector(observables));
24    controlled_frame->value();
25
26    const auto size = observables.size();
27
28    KDL::Jacobian jac(size);
29    for (size_t i = 0; i < size; ++i)
30      jac.setColumn(i, controlled_frame->derivative(i));
31
32    return jac;
33  }
34
35  #endif
```

```
1   #include <visualization_msgs/Marker.h>
2   #include <giskard_core/giskard_core.hpp>
3
4   inline visualization_msgs::Marker createPointMarker(const giskard_core::
        QPController &controller,
5                                                       const std::string &exp_name,
                                                          const std::string &
                                                          frame_id)
6   {
7     const KDL::Expression<KDL::Vector>::Ptr exp =
8         controller.get_scope().find_vector_expression(exp_name);
9
10    visualization_msgs::Marker marker;
11
12    marker.header.frame_id = frame_id;
13    marker.header.stamp = ros::Time::now();
14    marker.ns = "giskard_expressions/" + exp_name;
15    marker.id = 1;
16    marker.type = visualization_msgs::Marker::SPHERE;
17    marker.action = visualization_msgs::Marker::ADD;
18    marker.pose.position.x = exp->value().x();
19    marker.pose.position.y = exp->value().y();
20    marker.pose.position.z = exp->value().z();
21    marker.pose.orientation.w = 1.0;
22    marker.scale.x = 0.01;
23    marker.scale.y = 0.01;
24    marker.scale.z = 0.01;
25    marker.color.r = 244.0f / 255.0f;
26    marker.color.g = 180.0f / 255.0f;
27    marker.color.b = 47.0f / 255.0f;
28    marker.color.a = 1.0;
29
30    return marker;
31  }
32
33  inline visualization_msgs::Marker createPointDirectionMarker(const giskard_core
        ::QPController &controller,
34                                                               const std::string &
                                                                point_name,
35                                                               const std::string &
                                                                direction_name,
36                                                               const std::string &
                                                                frame_id)
37  {
38    const KDL::Expression<KDL::Vector>::Ptr point_exp =
39        controller.get_scope().find_vector_expression(point_name);
40    const KDL::Expression<KDL::Vector>::Ptr direction_exp =
41        controller.get_scope().find_vector_expression(direction_name);
42
43    visualization_msgs::Marker marker;
44
45    marker.header.frame_id = frame_id;
46    marker.header.stamp = ros::Time::now();
47    marker.ns = "giskard_expressions/" + direction_name;
48    marker.id = 1;
```

```cpp
49      marker.type = visualization_msgs::Marker::ARROW;
50      marker.action = visualization_msgs::Marker::ADD;
51      marker.points.resize(2);
52      marker.points[0].x = point_exp->value().x();
53      marker.points[0].y = point_exp->value().y();
54      marker.points[0].z = point_exp->value().z();
55      marker.points[1].x = point_exp->value().x() + direction_exp->value().x();
56      marker.points[1].y = point_exp->value().y() + direction_exp->value().y();
57      marker.points[1].z = point_exp->value().z() + direction_exp->value().z();
58      marker.scale.x = 0.01;
59      marker.scale.y = 0.02;
60      marker.scale.z = 0.0;
61      marker.color.r = 244.0f / 255.0f;
62      marker.color.g = 180.0f / 255.0f;
63      marker.color.b = 47.0f / 255.0f;
64      marker.color.a = 1.0;
65
66      return marker;
67  }
```

```cpp
1   #include <gazebo/common/Plugin.hh>
2   #include <gazebo/physics/physics.hh>
3   #include <ros/ros.h>
4   #include <ros/callback_queue.h>
5   #include <ros/subscribe_options.h>
6   #include <geometry_msgs/Twist.h>
7   #include <string>
8   #include <thread>
9   #include <tf2_ros/transform_listener.h>
10  #include <geometry_msgs/TransformStamped.h>
11  #include <tf2_ros/transform_broadcaster.h>
12
13  namespace gazebo
14  {
15  class TfBroadcasterPlugin : public ModelPlugin
16  {
17  public:
18    TfBroadcasterPlugin() : ModelPlugin()
19    {
20    }
21
22    ~TfBroadcasterPlugin()
23    {
24
25    }
26
27    void Load(physics::ModelPtr _parent, sdf::ElementPtr _sdf)
28    {
29      // Make sure the ROS node for Gazebo has already been initialized
30      if (!ros::isInitialized())
31      {
32        ROS_FATAL_STREAM("A ROS node for Gazebo has not been initialized, unable
              to load plugin. "
33          << "Load the Gazebo system plugin 'libgazebo_ros_api_plugin.so' in the
                gazebo_ros package)");
34        return;
35      }
36
37      // SDF values
38      link_name_ = _sdf->GetElement("linkName")->Get<std::string>();
39      frame_name_ = _sdf->GetElement("frameName")->Get<std::string>();
40
41      // Link
42      link_ = _parent->GetLink(this->link_name_);
43
44      // Custom Callback Queue
45      queue_thread_ = std::thread( boost::bind( &TfBroadcasterPlugin::QueueThread,
            this ) );
46
47      // Listen to the update event. This event is broadcast every
48      // simulation iteration.
49      update_connection_ = event::Events::ConnectWorldUpdateBegin(
50          boost::bind(&TfBroadcasterPlugin::UpdateChild, this, _1));
51    }
52
```

```cpp
52    void UpdateChild(const common::UpdateInfo &_info)
53    void UpdateChild(const common::UpdateInfo &_info)
54    {
55      const auto current_sim_time = _info.simTime;
56      const auto delta_sim_time = current_sim_time - this->previous_sim_time_;
57
58      PublishTf(delta_sim_time);
59    }
60
61    void PublishTf(const common::Time _delta_time)
62    {
63      math::Pose pose = link_->GetWorldPose();
64
65      geometry_msgs::TransformStamped transformStamped;
66
67      transformStamped.header.stamp = ros::Time::now();
68      transformStamped.header.frame_id = "world";
69      transformStamped.child_frame_id = frame_name_;
70      transformStamped.transform.translation.x = pose.pos.x;
71      transformStamped.transform.translation.y = pose.pos.y;
72      transformStamped.transform.translation.z = pose.pos.z;
73
74      transformStamped.transform.rotation.x = pose.rot.x;
75      transformStamped.transform.rotation.y = pose.rot.y;
76      transformStamped.transform.rotation.z = pose.rot.z;
77      transformStamped.transform.rotation.w = pose.rot.w;
78
79      br_.sendTransform(transformStamped);
80    }
81
82  private:
83    std::string link_name_;
84    std::string frame_name_;
85    ros::NodeHandle nh_;
86    ros::CallbackQueue queue_;
87    std::thread queue_thread_;
88    physics::LinkPtr link_;
89    event::ConnectionPtr update_connection_;
90    common::Time previous_sim_time_;
91    tf2_ros::TransformBroadcaster br_;
92
93    void QueueThread()
94    {
95      static const double timeout = 0.01;
96
97      while (this->nh_.ok())
98      {
99        this->queue_.callAvailable(ros::WallDuration(timeout));
100     }
101   }
102 };
103
104 GZ_REGISTER_MODEL_PLUGIN(TfBroadcasterPlugin)
105 }
```

75   plugins/giskard$_v$isualization$_p$lugin.cpp

```cpp
1   #include <gazebo/common/Plugin.hh>
2   #include <gazebo/physics/physics.hh>
3   #include <ros/ros.h>
4   #include <ros/callback_queue.h>
5   #include <ros/subscribe_options.h>
6   #include <visualization_msgs/Marker.h>
7   #include <boost/format.hpp>
8   #include <map>
9   #include <set>
10  #include <string>
11  #include <mutex>
12  #include <thread>
13
14  namespace gazebo
15  {
16  class GiskardVisualizationPlugin : public WorldPlugin
17  {
18  private:
19    /// \brief A node use for ROS transport
20    std::unique_ptr<ros::NodeHandle> node_handle_;
21    /// \brief A ROS subscriber
22    ros::Subscriber subscriber_;
23    /// \brief A ROS callbackqueue that helps process messages
24    ros::CallbackQueue queue_;
25    std::thread queue_thread_;
26    std::mutex mutex_;
27    physics::WorldPtr world_;
28    event::ConnectionPtr update_connection_;
29    std::map<std::string, visualization_msgs::Marker> markers_;
30    // To avoid duplicated markers, Gazebo sometimes doesn't
31    // realise that a model has already been created?
32    std::set<std::string> created_markers_;
33
34  public:
35    GiskardVisualizationPlugin() : WorldPlugin()
36    {
37    }
38
39    void Load(physics::WorldPtr _world, sdf::ElementPtr _sdf)
40    {
41      // Make sure the ROS node for Gazebo has already been initialized
42      if (!ros::isInitialized())
43      {
44        ROS_FATAL_STREAM("A ROS node for Gazebo has not been initialized, unable
               to load plugin. "
45                        << "Load the Gazebo system plugin '
                              libgazebo_ros_api_plugin.so' in the gazebo_ros package
                              )");
46        return;
47      }
48
49      this->world_ = _world;
50
51      // Create our ROS node. This acts in a similar manner to
52      // the Gazebo node
```

```cpp
53        this->node_handle_.reset(new ros::NodeHandle("gazebo_client"));
54
55        // Create a named topic, and subscribe to it.
56        ros::SubscribeOptions so =
57            ros::SubscribeOptions::create<visualization_msgs::Marker>(
58                "/giskard/visualization_marker",
59                10,
60                boost::bind(&GiskardVisualizationPlugin::OnRosMsg, this, _1),
61                ros::VoidPtr(), &this->queue_);
62        this->subscriber_ = this->node_handle_->subscribe(so);
63
64        // Custom Callback Queue
65        this->queue_thread_ = std::thread(boost::bind(&GiskardVisualizationPlugin::
            QueueThread, this));
66
67        this->update_connection_ = event::Events::ConnectWorldUpdateBegin(
68            boost::bind(&GiskardVisualizationPlugin::Update, this));
69    }
70
71    void Update()
72    {
73      std::lock_guard<std::mutex> lock{this->mutex_};
74
75      for (const auto p : this->markers_)
76      {
77        const visualization_msgs::Marker &msg = p.second;
78        const std::string &name = msg.ns;
79
80        if (created_markers_.find(name) != created_markers_.end())
81        {
82          auto model = this->world_->GetModel(name);
83
84          if (model)
85          {
86            updateMarkerModel(model, msg);
87          }
88        }
89        else
90        {
91          createMarkerModel(msg);
92        }
93      }
94    }
95
96    void createMarkerModel(const visualization_msgs::Marker &_msg)
97    {
98      const std::string &name = _msg.ns;
99
100     std::string pose = boost::str(boost::format("%1% %2% %3% 0 0 0") %
101                                   (_msg.pose.position.x) %
102                                   (_msg.pose.position.y) %
103                                   (_msg.pose.position.z));
104     sdf::SDF sphereSDF;
105     sphereSDF.SetFromString(
106         "<sdf version='1.6'>\
107          <model name='sphere'>\
108            <static>true</static>\
```

```cpp
109              <pose>" +
110          pose + "</pose>\
111              <link name='link'>\
112                <pose>0 0 0 0 0 0</pose>\
113                <visual name='visual'>\
114                  <geometry>\
115                    <sphere><radius>0.005</radius></sphere>\
116                  </geometry>\
117                  <material>\
118                    <script>\
119                      <name>Gazebo/Yellow</name>\
120                      <uri>file://media/materials/scripts/gazebo.material</uri
                          >\
121                    </script>\
122                  </material>\
123                </visual>\
124              </link>\
125            </model>\
126          </sdf>");

127
128      sdf::ElementPtr modelSDF = sphereSDF.Root()->GetElement("model");
129      modelSDF->GetAttribute("name")->SetFromString(name);
130      this->world_->InsertModelSDF(sphereSDF);
131      created_markers_.insert(name);

132
133      gzdbg << "Created Marker: " << name << "\n";
134    }

135
136    void updateMarkerModel(physics::ModelPtr model, const visualization_msgs::
          Marker &_msg)
137    {
138      math::Pose pose(_msg.pose.position.x,
139                      _msg.pose.position.y,
140                      _msg.pose.position.z,
141                      0.0, 0.0, 0.0);
142      model->SetWorldPose(pose);
143    }

144
145    /// \brief Handle an incoming message from ROS
146    void OnRosMsg(const visualization_msgs::MarkerConstPtr &_msg)
147    {
148      if (_msg->type != visualization_msgs::Marker::SPHERE)
149      {
150        return;
151      }

152
153      std::lock_guard<std::mutex> lock{this->mutex_};

154
155      this->markers_[_msg->ns] = *_msg;
156    }

157
158  private:
159    void QueueThread()
160    {
161      static const double timeout = 0.01;

162
163      while (this->node_handle_->ok())
```

```
164        {
165            this->queue_.callAvailable(ros::WallDuration(timeout));
166        }
167    }
168  };
169
170  GZ_REGISTER_WORLD_PLUGIN(GiskardVisualizationPlugin)
171  }
```

```cpp
1   #include "GripPlugin.hh"
2
3   #include <gazebo/physics/physics.hh>
4   #include <string>
5
6   using namespace gazebo;
7
8   // Register this plugin with the simulator
9   GZ_REGISTER_MODEL_PLUGIN(GripPlugin);
10
11  void GripPlugin::Load(physics::ModelPtr _parent, sdf::ElementPtr _sdf) {
12      const auto parentModel = _parent;
13      const auto world = parentModel->GetWorld();
14      const auto physics = world->GetPhysicsEngine();
15
16      const std::string childLinkName = _sdf->GetElement("childLinkName")->Get<std
            ::string>();
17      const std::string parentLinkName = _sdf->GetElement("parentLinkName")->Get<
            std::string>();
18
19      const auto parentLink = parentModel->GetLink(parentLinkName);
20      const auto childLink = boost::dynamic_pointer_cast<physics::Link>(world->
            GetEntity(childLinkName));
21
22      math::Pose relativePose;
23
24      if (_sdf->HasElement("relativePose")) {
25        relativePose = _sdf->GetElement("relativePose")->Get<math::Pose>();
26
27        const auto parentPose = parentLink->GetWorldPose();
28        const auto childPose = math::Pose(parentPose.pos + (parentPose.rot.
              RotateVector(relativePose.pos)), parentPose.rot * relativePose.rot);
29
30        childLink->SetWorldPose(childPose);
31
32        gzdbg << "Grip:␣Relative␣pose␣given,␣adjusting␣child␣pose\n"
33              << childPose << "\n";
34      } else {
35        relativePose = parentLink->GetWorldPose() - childLink->GetWorldPose();
36
37        gzdbg << "Grip:␣Relative␣pose␣derrived\n";
38      }
39
40      // Create joint
41      const auto joint = physics->CreateJoint("fixed", parentModel);
42      // Bullet physics needs accurate joint position
43      // ODE does't care
44      joint->Load(parentLink, childLink, relativePose);
45      joint->Init();
46      joint->SetName("grip_joint_" + parentLink->GetScopedName() + "_" + childLink
            ->GetScopedName());
47
48      childLink->SetGravityMode(false);
49  }
```

77 plugins/GrainsFactoryPlugin.hh

```
1  #ifndef PLUGINS_GRAINSFACTORYPLUGIN_H
2  #define PLUGINS_GRAINSFACTORYPLUGIN_H
3
4
5  #include <gazebo/gazebo.hh>
6
7  namespace gazebo {
8      class GrainsFactoryPlugin : public WorldPlugin {
9          public: void Load(physics::WorldPtr _parent, sdf::ElementPtr _sdf)
                  override;
10     };
11 }
12
13
14 #endif //PLUGINS_GRAINSFACTORYPLUGIN_H
```

```cpp
1   #include "GrainsFactoryPlugin.hh"
2   #include <gazebo/physics/physics.hh>
3   #include <sstream>
4
5   using namespace gazebo;
6
7   GZ_REGISTER_WORLD_PLUGIN(GrainsFactoryPlugin)
8
9   void GrainsFactoryPlugin::Load(physics::WorldPtr _parent, sdf::ElementPtr _sdf)
        {
10      std::string poseArg = _sdf->GetElement("pose")->GetValue()->GetAsString();
11      std::istringstream pss(poseArg);
12
13      double x, y, z, pitch, yaw, roll;
14      pss >> x >> y >> z >> roll >> pitch >> yaw;
15
16      math::Pose pose(x, y, z, roll, pitch, yaw);
17
18      int quantity = 3;
19      double radius = 0.01;
20      double mass = 0.001;
21      double inertiaDiagonal = 0.4 * mass * radius * radius;
22      double friction = 0.4;
23      double friction2 = 0.4;
24      double velocityDecay = 0.6;
25
26      _sdf->GetElement("mass")->GetValue()->Get(mass);
27      _sdf->GetElement("radius")->GetValue()->Get(radius);
28      _sdf->GetElement("quantity")->GetValue()->Get(quantity);
29      _sdf->GetElement("friction")->GetValue()->Get(friction);
30      _sdf->GetElement("friction2")->GetValue()->Get(friction2);
31      _sdf->GetElement("velocity_decay")->GetValue()->Get(velocityDecay);
32
33      for (int i = 0; i < quantity; ++i) {
34          std::stringstream xml;
35          xml << "<sdf version='1.6'>\n";
36          xml << "<model name='grain_" << i << "'>\n";
37          xml << "\t<pose>" << pose << "</pose>\n";
38          xml << "\t\t<link name='link'>\n";
39          xml << "\t\t\t<pose>0 0 0 0 0 0</pose>\n";
40          xml << "\t\t\t<inertial>\n";
41          xml << "\t\t\t\t<pose>0 0 0 0 0 0</pose>\n";
42          xml << "\t\t\t\t<mass>" << mass << "</mass>\n";
43          xml << "\t\t\t\t<inertia>\n";
44          xml << "\t\t\t\t\t<ixx>" << inertiaDiagonal << "</ixx>";
45          xml << "\t\t\t\t\t<ixy>0</ixy>";
46          xml << "\t\t\t\t\t<ixz>0</ixz>";
47          xml << "\t\t\t\t\t<iyy>" << inertiaDiagonal << "</iyy>";
48          xml << "\t\t\t\t\t<iyz>0</iyz>";
49          xml << "\t\t\t\t\t<izz>" << inertiaDiagonal << "</izz>";
50          xml << "\t\t\t\t</inertia>";
51          xml << "\t\t\t</inertial>\n";
52          xml << "\t\t\t<velocity_decay>\n";
53          xml << "\t\t\t\t<angular>" << velocityDecay << "</angular>\n";
54          xml << "\t\t\t</velocity_decay>\n";
```

```
55          xml << "\t\t\t<collision␣name␣='collision'>\n";
56          xml << "\t\t\t\t<geometry >\n";
57          xml << "\t\t\t\t\t<sphere >\n";
58          xml << "\t\t\t\t\t\t<radius >" << radius << "</radius >\n";
59          xml << "\t\t\t\t\t</sphere >\n";
60          xml << "\t\t\t\t</geometry >\n";
61          xml << "\t\t\t\t<surface >\n";
62          xml << "\t\t\t\t\t<friction >\n";
63          xml << "\t\t\t\t\t\t<ode >\n";
64          xml << "\t\t\t\t\t\t\t<mu>" << friction << "</mu>\n";
65          xml << "\t\t\t\t\t\t\t<mu2>" << friction2 << "</mu2>\n";
66          xml << "\t\t\t\t\t\t</ode >\n";
67          xml << "\t\t\t\t\t\t<bullet >\n";
68          xml << "\t\t\t\t\t\t\t<friction >" << friction << "</friction >\n";
69          xml << "\t\t\t\t\t\t\t<friction2 >" << friction2 << "</friction2 >\n";
70          xml << "\t\t\t\t\t\t</bullet >\n";
71          xml << "\t\t\t\t\t</friction >\n";
72          xml << "\t\t\t\t</surface >\n";
73          xml << "\t\t\t</collision >\n";
74          xml << "\t\t\t<visual␣name␣='visual'>\n";
75          xml << "\t\t\t\t<geometry >\n";
76          xml << "\t\t\t\t\t<sphere >\n";
77          xml << "\t\t\t\t\t\t<radius >" << radius << "</radius >\n";
78          xml << "\t\t\t\t\t</sphere >\n";
79          xml << "\t\t\t\t</geometry >\n";
80          xml << "\t\t\t\t<material >\n";
81          xml << "\t\t\t\t\t<script >\n";
82          xml << "\t\t\t\t\t\t<uri>file://media/materials/scripts/gazebo.material
               </uri>\n";
83          xml << "\t\t\t\t\t\t<name >Gazebo/Gold </name >\n";
84          xml << "\t\t\t\t\t</script >\n";
85          xml << "\t\t\t\t</material >\n";
86          xml << "\t\t\t</visual >\n";
87          xml << "\t\t</link >\n";
88          xml << "</model >\n";
89          xml << "</sdf >\n";
90
91          // Create SDF from the XML string
92          sdf::SDF grainSDF;
93          grainSDF.SetFromString(xml.str());
94
95          // Insert the SDF into the world in runtime
96          _parent ->InsertModelSDF(grainSDF);
97
98          // Translate the position to stack the grains
99          pose.pos.z += radius * 2;
100     }
101 }
```

```cpp
1   #include "StickPlugin.hh"
2
3   #include <gazebo/physics/physics.hh>
4   #include <string>
5
6   using namespace gazebo;
7
8   // Register this plugin with the simulator
9   GZ_REGISTER_MODEL_PLUGIN(StickPlugin);
10
11  StickPlugin::StickPlugin(): ModelPlugin(), joint(nullptr) {
12
13  }
14
15  void StickPlugin::Load(physics::ModelPtr _parent, sdf::ElementPtr _sdf) {
16      this->model = _parent;
17      const auto world = this->model->GetWorld();
18      this->physics = world->GetPhysicsEngine();
19
20      const std::string childLinkName = _sdf->GetElement("childLinkName")->Get<std
            ::string>();
21      const std::string parentLinkName = _sdf->GetElement("parentLinkName")->Get<
            std::string>();
22      this->forceThreshold = _sdf->GetElement("force")->Get<double>();
23
24      this->parentLink = this->model->GetLink(parentLinkName);
25      this->childLink = boost::dynamic_pointer_cast<physics::Link>(world->
            GetEntity(childLinkName));
26
27      this->CreateJoint();
28  }
29
30  void StickPlugin::OnUpdate(const common::UpdateInfo &_info) {
31      if (_info.simTime < 1.0) {
32          // Let the stage settle down and position objects
33          return;
34      }
35
36      auto wrench = this->joint->GetForceTorque(0u);
37      auto measuredForce = wrench.body1Force;
38
39      auto force = this->forceThreshold;
40
41      auto measuredForceLength = measuredForce.GetLength();
42
43      if (measuredForceLength > force) {
44          gzdbg << "Removed joint:" << " (" << joint->GetName() << "), force:"
                << measuredForceLength << "\n";
45
46          this->BreakJoint();
47      }
48  }
49
50  void StickPlugin::Reset() {
51      if (this->joint == nullptr) {
```

```
52            this->CreateJoint();
53        }
54    }
55
56    void StickPlugin::CreateJoint() {
57        this->joint = this->physics->CreateJoint("fixed", this->model);
58        // Bullet physics needs accurate joint position
59        // ODE does't care
60        this->joint->Load(this->parentLink, this->childLink, this->parentLink->
               GetWorldPose() - this->childLink->GetWorldPose());
61        this->joint->Init();
62        this->joint->SetProvideFeedback(true);
63        this->joint->SetName("stick_joint_" + this->parentLink->GetScopedName() + "_
               " + this->childLink->GetScopedName());
64
65        // Disable gravity on the butter link
66        this->parentLink->SetGravityMode(false);
67
68        this->updateConnection = event::Events::ConnectWorldUpdateBegin(
69               boost::bind(&StickPlugin::OnUpdate, this, _1));
70    }
71
72    void StickPlugin::BreakJoint() {
73        this->joint->Detach();
74        this->joint = nullptr;
75
76        // Enable gravity on the childLink
77        this->parentLink->SetGravityMode(true);
78
79        event::Events::DisconnectWorldUpdateBegin(this->updateConnection);
80        this->updateConnection = nullptr;
81    }
```

```cpp
1  #include "OtherGraspPlugin.hh"
2
3  #include <ros/ros.h>
4  #include <gazebo/physics/physics.hh>
5  #include <string>
6  #include <gazebo/sensors/sensors.hh>
7
8  using namespace gazebo;
9  GZ_REGISTER_SENSOR_PLUGIN(OtherGraspPlugin)
10
11 /////////////////////////////////////////////////
12 OtherGraspPlugin::OtherGraspPlugin() : SensorPlugin()
13 {
14 }
15
16 /////////////////////////////////////////////////
17 OtherGraspPlugin::~OtherGraspPlugin()
18 {
19 }
20
21 /////////////////////////////////////////////////
22 void OtherGraspPlugin::Load(sensors::SensorPtr _sensor, sdf::ElementPtr _sdf)
23 {
24   //std::cout << "initialised graspingplugin \n";
25   ROS_INFO("Hello␣World!");
26   // Get the parent sensor.
27   this->parentSensor =
28     std::dynamic_pointer_cast<sensors::ContactSensor>(_sensor);
29
30   const std::string childLinkName1 = _sdf->GetElement("childLinkName1")->Get<std
        ::string>();
31   const std::string childLinkName2 = _sdf->GetElement("childLinkName2")->Get<std
        ::string>();
32   const std::string childLinkName3 = _sdf->GetElement("childLinkName3")->Get<std
        ::string>();
33   const std::string parentLinkName = _sdf->GetElement("parentLinkName")->Get<std
        ::string>();
34   const std::string SensorName = _sdf->GetElement("sensorName")->Get<std::string
        >();
35
36   // Make sure the parent sensor is valid.
37   if (!this->parentSensor)
38   {
39     gzerr << "ContactPlugin␣requires␣a␣ContactSensor.\n";
40     return;
41   }
42
43   // Connect to the sensor update event.
44   this->updateConnection = this->parentSensor->ConnectUpdated(
45       std::bind(&OtherGraspPlugin::OnUpdate, this));
46
47   // Make sure the parent sensor is active.
48   this->parentSensor->SetActive(true);
49
50   std::cout << "initialised␣graspingplugin␣\n";
```

```
51    gzdbg << "message" << std::endl;
52 }
53
54 /////////////////////////////////////////////////
55 void OtherGraspPlugin::OnUpdate()
56 {
57    // Get all the contacts.
58    msgs::Contacts contacts;
59    contacts = this->parentSensor->Contacts();
60    for (unsigned int i = 0; i < contacts.contact_size(); ++i)
61    {
62      std::cout << "Collision between[" << contacts.contact(i).collision1()
63                << "] and [" << contacts.contact(i).collision2() << "]\n";
64
65      for (unsigned int j = 0; j < contacts.contact(i).position_size(); ++j)
66      {
67        std::cout << j << "  Position:"
68                  << contacts.contact(i).position(j).x() << " "
69                  << contacts.contact(i).position(j).y() << " "
70                  << contacts.contact(i).position(j).z() << "\n";
71        std::cout << "   Normal:"
72                  << contacts.contact(i).normal(j).x() << " "
73                  << contacts.contact(i).normal(j).y() << " "
74                  << contacts.contact(i).normal(j).z() << "\n";
75        std::cout << "   Depth:" << contacts.contact(i).depth(j) << "\n";
76      }
77    }
78 }
```

81 plugins/GripPlugin.hh

```
1  #ifndef PLUGINS_GRIPPLUGIN_HH
2  #define PLUGINS_GRIPPLUGIN_HH
3
4  #include <gazebo/gazebo.hh>
5
6  namespace gazebo {
7      class GripPlugin : public ModelPlugin {
8      public: void Load(physics::ModelPtr _parent, sdf::ElementPtr _sdf) override;
9      };
10 }
11
12 #endif //PLUGINS_GRIPPLUGIN_HH
```

```
1   #include <gazebo/common/Plugin.hh>
2   #include <gazebo/physics/physics.hh>
3   #include <ros/ros.h>
4   #include <ros/callback_queue.h>
5   #include <ros/subscribe_options.h>
6   #include <geometry_msgs/Twist.h>
7   #include <string>
8   #include <thread>
9   #include <tf2_ros/transform_listener.h>
10  #include <geometry_msgs/TransformStamped.h>
11
12  namespace gazebo
13  {
14  class ForceControllerPlugin : public ModelPlugin
15  {
16  public:
17    ForceControllerPlugin() : ModelPlugin(), P_(0.0), I_(0.0), D_(0.0), tfListener
          (tfBuffer)
18    {
19    }
20
21    ~ForceControllerPlugin()
22    {
23
24    }
25
26    void Load(physics::ModelPtr _parent, sdf::ElementPtr _sdf)
27    {
28      // Make sure the ROS node for Gazebo has already been initialized
29      if (!ros::isInitialized())
30      {
31        ROS_FATAL_STREAM("A ROS node for Gazebo has not been initialized, unable
            to load plugin."
32          << "Load the Gazebo system plugin 'libgazebo_ros_api_plugin.so' in the
              gazebo_ros package)");
33        return;
34      }
35
36      // SDF values
37      this->link_name_ = _sdf->GetElement("linkName")->Get<std::string>();
38      this->target_frame_name_ = _sdf->GetElement("targetFrameName")->Get<std::
          string>();
39      this->reference_frame_name_ = _sdf->GetElement("referenceFrameName")->Get<
          std::string>();
40      this->P_ = 10000.0;
41      this->I_ = 0.0;
42      this->D_ = 7000.0;
43
44      // Link
45      this->link_ = _parent->GetLink(this->link_name_);
46
47      // Custom Callback Queue
48      this->queue_thread_ = std::thread( boost::bind( &ForceControllerPlugin::
          QueueThread, this ) );
49
```

```
50      // Listen to the update event. This event is broadcast every
51      // simulation iteration.
52      this->update_connection_ = event::Events::ConnectWorldUpdateBegin(
53          boost::bind(&ForceControllerPlugin::UpdateChild, this, _1));
54
55      double l_P = 1.0;
56      double l_I = 0.0;
57      double l_D = 1.0;
58
59      this->pid_linear_x_ = common::PID(P_, I_, D_);
60      this->pid_linear_y_ = common::PID(P_, I_, D_);
61      this->pid_linear_z_ = common::PID(P_, I_, D_);
62      this->pid_angular_x_ = common::PID(l_P, l_I, l_D);
63      this->pid_angular_y_ = common::PID(l_P, l_I, l_D);
64      this->pid_angular_z_ = common::PID(l_P, l_I, l_D);
65    }
66
67    void UpdateChild(const common::UpdateInfo &_info)
68    {
69      const auto current_sim_time = _info.simTime;
70      const auto delta_sim_time = current_sim_time - this->previous_sim_time_;
71
72      UpdateObjectForces(delta_sim_time);
73    }
74
75    void UpdateObjectForces(const common::Time _delta_time)
76    {
77      geometry_msgs::TransformStamped transformStamped;
78
79      try
80      {
81        transformStamped = tfBuffer.lookupTransform(
82          this->reference_frame_name_, this->target_frame_name_, ros::Time(0));
83      }
84      catch (tf2::TransformException &ex)
85      {
86        ROS_WARN("%s",ex.what());
87        return;
88      }
89
90      math::Pose current_pose = this->link_->GetWorldPose();
91      math::Pose desired_pose = math::Pose(
92        math::Vector3(transformStamped.transform.translation.x,
93                      transformStamped.transform.translation.y,
94                      transformStamped.transform.translation.z),
95        math::Quaternion(transformStamped.transform.rotation.w,
96                         transformStamped.transform.rotation.x,
97                         transformStamped.transform.rotation.y,
98                         transformStamped.transform.rotation.z)
99      );
100     math::Vector3 force;
101     math::Vector3 torque;
102
103     force.x = this->pid_linear_x_.Update(current_pose.pos.x - desired_pose.pos.x
104         , _delta_time);
105     force.y = this->pid_linear_y_.Update(current_pose.pos.y - desired_pose.pos.y
106         , _delta_time);
```

```
105        force.z = this->pid_linear_z_.Update(current_pose.pos.z - desired_pose.pos.z
              , _delta_time);
106
107    //   gzdbg   << "Current pos: " << current_pose.pos.x << " " << current_pose.pos
              .y << " " << current_pose.pos.z << "\n";
108    //   gzdbg   << "Desired pos: " << desired_pose.pos.x << " " << desired_pose.pos
              .y << " " << desired_pose.pos.z << "\n";
109    //   gzdbg   << "Error: "   << current_pose.pos.x - desired_pose.pos.x <<   " "
              << current_pose.pos.y - desired_pose.pos.y << " " << current_pose.pos.z -
              desired_pose.pos.z << "\n";
110    //   gzdbg   << "Force: " << force << "\n";
111
112        torque.x = this->pid_angular_x_.Update(current_pose.rot.GetRoll() -
              desired_pose.rot.GetRoll(), _delta_time);
113        torque.y = this->pid_angular_y_.Update(current_pose.rot.GetPitch() -
              desired_pose.rot.GetPitch(), _delta_time);
114        torque.z = this->pid_angular_z_.Update(current_pose.rot.GetYaw() -
              desired_pose.rot.GetYaw(), _delta_time);
115
116        // this->link_->SetForce(force);
117        // this->link_->SetTorque(torque);
118      // this->link_->set
119
120        this->link_->SetWorldPose(desired_pose);
121        // this->link_->SetAngularVel(math::Vector3(0.0, 0.0, 0.0));
122        // this->link_->SetLinearVel(math::Vector3(0.0, 0.0, 0.0));
123      }
124
125   private:
126      std::string link_name_;
127      std::string target_frame_name_;
128      std::string reference_frame_name_;
129      ros::NodeHandle nh_;
130      ros::CallbackQueue queue_;
131      std::thread queue_thread_;
132      physics::LinkPtr link_;
133      event::ConnectionPtr update_connection_;
134      common::PID pid_linear_x_;
135      common::PID pid_linear_y_;
136      common::PID pid_linear_z_;
137      common::PID pid_angular_x_;
138      common::PID pid_angular_y_;
139      common::PID pid_angular_z_;
140      common::Time previous_sim_time_;
141      // Setup a P-controller
142      double P_;
143      double I_;
144      double D_;
145      tf2_ros::Buffer tfBuffer;
146      tf2_ros::TransformListener tfListener;
147
148      void QueueThread()
149      {
150        static const double timeout = 0.01;
151
152        while (this->nh_.ok())
153        {
```

```
154          this->queue_.callAvailable(ros::WallDuration(timeout));
155        }
156    }
157  };
158
159  GZ_REGISTER_MODEL_PLUGIN(ForceControllerPlugin)
160  }
```

83 plugins/LasagnaFactoryPlugin.hh

```cpp
#ifndef PLUGINS_LASAGNAFACTORYPLUGIN_H
#define PLUGINS_LASAGNAFACTORYPLUGIN_H


#include <gazebo/gazebo.hh>

namespace gazebo {
    class LasagnaFactoryPlugin : public WorldPlugin {
        public: void Load(physics::WorldPtr _parent, sdf::ElementPtr _sdf)
            override;
    };
}


#endif //PLUGINS_LASAGNAFACTORYPLUGIN_H
```

```
1   #ifndef PLUGINS_STICKPLUGIN_H
2   #define PLUGINS_STICKPLUGIN_H
3
4
5   #include <gazebo/gazebo.hh>
6   #include <gazebo/physics/Joint.hh>
7
8   namespace gazebo {
9       class StickPlugin : public ModelPlugin {
10      public:
11          StickPlugin();
12          void Load(physics::ModelPtr _parent, sdf::ElementPtr _sdf) override;
13          void OnUpdate(const common::UpdateInfo & _info);
14          void Reset() override;
15          void CreateJoint();
16          void BreakJoint();
17
18      private:
19          physics::PhysicsEnginePtr physics;
20          physics::ModelPtr model;
21          physics::JointPtr joint;
22          physics::LinkPtr childLink;
23          physics::LinkPtr parentLink;
24          event::ConnectionPtr updateConnection;
25          double forceThreshold;
26      };
27  }
28
29
30  #endif //PLUGINS_STICKPLUGIN_H
```

85   plugins/OtherGraspPlugin.hh

```cpp
1   #ifndef PLUGINS_OTHERGRASPPLUGIN_H
2   #define PLUGINS_OTHERGRASPPLUGIN_H
3
4   #include <string>
5
6   #include <gazebo/gazebo.hh>
7   #include <gazebo/sensors/sensors.hh>
8
9   namespace gazebo
10  {
11    /// \brief An example plugin for a contact sensor.
12    class OtherGraspPlugin : public SensorPlugin
13    {
14      /// \brief Constructor.
15      public: OtherGraspPlugin();
16
17      /// \brief Destructor.
18      public: virtual ~OtherGraspPlugin();
19
20      /// \brief Load the sensor plugin.
21      /// \param[in] _sensor Pointer to the sensor that loaded this plugin.
22      /// \param[in] _sdf SDF element that describes the plugin.
23      public: virtual void Load(sensors::SensorPtr _sensor, sdf::ElementPtr _sdf);
24
25      /// \brief Callback that receives the contact sensor's update signal.
26      private: virtual void OnUpdate();
27
28      /// \brief Pointer to the contact sensor
29      private: sensors::ContactSensorPtr parentSensor;
30
31      /// \brief Connection that maintains a link between the contact sensor's
32      /// updated signal and the OnUpdate callback.
33      private: event::ConnectionPtr updateConnection;
34    };
35  }
36  #endif
```

```
1   /**
2    * Lasagna factory
3    *
4    * Credit:
5    * Based on Paulo Abelha's lasagna factory.
6    * https://github.com/pauloabelha/gazebo_tasks/blob/master/cutting_lasagna/
          plugins/factory_lasagna.cc
7    */
8   #include "LasagnaFactoryPlugin.hh"
9   #include <gazebo/physics/physics.hh>
10  #include <sstream>
11  #include <random>
12
13  using namespace gazebo;
14
15  GZ_REGISTER_WORLD_PLUGIN(LasagnaFactoryPlugin)
16
17  void LasagnaFactoryPlugin::Load(physics::WorldPtr _parent, sdf::ElementPtr _sdf)
        {
18    math::Pose pose {0.0, 0.0, 0.0, 0.0, 0.0, 0.0};
19    math::Vector3 size {5.0, 5.0, 5.0};
20    double radius {0.01};
21    double mass {0.5};
22    double friction {0.4};
23    double friction2 {0.4};
24    double cfm {0.0};
25    double erp {0.0};
26    double jointDamping {0.0};
27    double jointFriction {0.0};
28    double spotProbability {0.4};
29
30    // Read values from XML if available
31    if (_sdf->HasElement("pose"))
32      pose = _sdf->GetElement("pose")->Get<math::Pose>();
33
34    if (_sdf->HasElement("size"))
35      size = _sdf->GetElement("size")->Get<math::Vector3>();
36
37    if (_sdf->HasElement("radius"))
38      radius = _sdf->GetElement("radius")->Get<double>();
39
40    if (_sdf->HasElement("mass"))
41      mass = _sdf->GetElement("mass")->Get<double>();
42
43    if (_sdf->HasElement("friction"))
44      friction = _sdf->GetElement("friction")->Get<double>();
45
46    if (_sdf->HasElement("friction2"))
47      friction2 = _sdf->GetElement("friction2")->Get<double>();
48
49    if (_sdf->HasElement("cfm"))
50      cfm = _sdf->GetElement("cfm")->Get<double>();
51
52    if (_sdf->HasElement("erp"))
53      erp = _sdf->GetElement("erp")->Get<double>();
```

```
54
55      if (_sdf ->HasElement ("jointDamping"))
56        jointDamping = _sdf ->GetElement ("jointDamping")->Get <double >();
57
58      if (_sdf ->HasElement ("jointFriction"))
59        jointFriction = _sdf ->GetElement ("jointFriction")->Get <double >();
60
61      if (_sdf ->HasElement ("spotProbability"))
62        spotProbability = _sdf ->GetElement ("spotProbability")->Get <double >();
63
64      //
65      double xShift = -(size.x - 1) / 2 * radius;
66      double yShift = -(size.y - 1) / 2 * radius;
67      double zShift = -(size.z - 1) / 2 * radius;
68  //    double diameter = 2 * radius;
69      double sphereMass = mass / (size.x * size.y * size.z);
70  //    double inertiaDiagonal = 0.4 * sphereMass * radius * radius;
71
72      std::stringstream xml;
73      xml << "<sdf␣version␣='1.6'>\n";
74      xml << "<model␣name␣='lasagna'>\n";
75      xml << "\t<pose>" << pose << "</pose>\n";
76
77      for (int i = 0; i < size.x; ++i) {
78          for (int j = 0; j < size.y; ++j) {
79              for (int k = 0; k < size.z; ++k) {
80                  std::string index = std::to_string(i) + "_" + std::to_string(j)
81                      + "_" + std::to_string(k);
82                  std::string color = "Yellow";
83
84                  if (rand() % 100 + 1 <= (spotProbability * 100))
85                      color = "Red";
86
87                  xml << "\t\t<link␣name␣='link_" << index << "'>\n";
88                  xml << "\t\t\t<pose>"
89                                  << radius * i + xShift << "␣"
90                                  << radius * j + yShift << "␣"
91                                  << radius * k + zShift << "␣0␣0␣0"
92                      "</pose>\n";
93                  xml << "\t\t\t<inertial >\n";
94                  xml << "\t\t\t\t<pose>0␣0␣0␣0␣0␣0</pose>\n";
95                  xml << "\t\t\t\t<mass>" << sphereMass << "</mass>\n";
96                  // The default inertia keeps the lasagna stable
97  //                xml << "\t\t\t\t<inertia>\n";
98  //                xml << "\t\t\t\t\t<ixx>" << inertiaDiagonal << "</ixx>";
99  //                xml << "\t\t\t\t\t<ixy>0</ixy>";
100 //                xml << "\t\t\t\t\t<ixz>0</ixz>";
101 //                xml << "\t\t\t\t\t<iyy>" << inertiaDiagonal << "</iyy>";
102 //                xml << "\t\t\t\t\t<iyz>0</iyz>";
103 //                xml << "\t\t\t\t\t<izz>" << inertiaDiagonal << "</izz>";
104 //                xml << "\t\t\t\t</inertia>";
105                  xml << "\t\t\t</inertial >\n";
106                  xml << "\t\t\t<collision␣name␣='collision'>\n";
107                  xml << "\t\t\t\t<geometry >\n";
108                  xml << "\t\t\t\t\t<sphere >\n";
109                  xml << "\t\t\t\t\t\t<radius>" << radius << "</radius>\n";
```

```cpp
110                    xml << "\t\t\t\t\t</sphere>\n";
111                    xml << "\t\t\t\t</geometry>\n";
112                    xml << "\t\t\t\t<surface>\n";
113                    xml << "\t\t\t\t\t<friction>\n";
114                    xml << "\t\t\t\t\t\t<ode>\n";
115                    xml << "\t\t\t\t\t\t\t<mu>" << friction << "</mu>\n";
116                    xml << "\t\t\t\t\t\t\t<mu2>" << friction2 << "</mu2>\n";
117                    xml << "\t\t\t\t\t\t</ode>\n";
118                    xml << "\t\t\t\t\t\t<bullet>\n";
119                    xml << "\t\t\t\t\t\t\t<friction>" << friction << "</friction>\n"
                           ;
120                    xml << "\t\t\t\t\t\t\t<friction2>" << friction2 << "</friction2
                           >\n";
121                    xml << "\t\t\t\t\t\t</bullet>\n";
122                    xml << "\t\t\t\t\t</friction>\n";
123                    xml << "\t\t\t\t\t<contact>\n";
124                    xml << "\t\t\t\t\t\t<ode>\n";
125                    xml << "\t\t\t\t\t\t\t<soft_cfm>" << cfm << "</soft_cfm>\n";
126                    xml << "\t\t\t\t\t\t\t<soft_erp>" << erp << "</soft_erp>\n";
127                    xml << "\t\t\t\t\t\t</ode>\n";
128                    xml << "\t\t\t\t\t\t<bullet>\n";
129                    xml << "\t\t\t\t\t\t\t<soft_cfm>" << cfm << "</soft_cfm>\n";
130                    xml << "\t\t\t\t\t\t\t<soft_erp>" << erp << "</soft_erp>\n";
131                    xml << "\t\t\t\t\t\t</bullet>\n";
132                    xml << "\t\t\t\t\t</contact>\n";
133                    xml << "\t\t\t\t</surface>\n";
134                    xml << "\t\t\t</collision>\n";
135                    xml << "\t\t\t<visual name ='visual'>\n";
136                    xml << "\t\t\t\t<geometry>\n";
137                    xml << "\t\t\t\t\t<sphere>\n";
138                    xml << "\t\t\t\t\t\t<radius>" << radius << "</radius>\n";
139                    xml << "\t\t\t\t\t</sphere>\n";
140                    xml << "\t\t\t\t</geometry>\n";
141                    xml << "\t\t\t\t<material>\n";
142                    xml << "\t\t\t\t\t<script>\n";
143                    xml << "\t\t\t\t\t\t<uri>file://media/materials/scripts/gazebo.
                           material</uri>\n";
144                    xml << "\t\t\t\t\t\t<name>Gazebo/" << color << "</name>\n";
145                    xml << "\t\t\t\t\t</script>\n";
146                    xml << "\t\t\t\t</material>\n";
147                    xml << "\t\t\t</visual>\n";
148                    xml << "\t\t</link>\n";
149                }
150            }
151        }
152
153        for (int i = 0; i < size.x; ++i) {
154            for (int j = 0; j < size.y; ++j) {
155                for (int k = 1; k < size.z; ++k) {
156                    const auto currentIndex = std::to_string(i) + "_"
157                                            + std::to_string(j) + "_"
158                                            + std::to_string(k);
159                    const auto previousIndex = std::to_string(i) + "_"
160                                             + std::to_string(j) + "_"
161                                             + std::to_string(k - 1);
162
163                    xml << "\t\t<joint name ='joint_" << currentIndex << "_" <<
```

```
                          previousIndex << "'␣type='prismatic'>\n";
164                  xml << "\t\t\t\t<pose>0␣0␣0.03␣0␣0␣0</pose>\n";
165                  xml << "\t\t\t\t<parent>link_" << previousIndex << "</parent>\n"
                          ;
166                  xml << "\t\t\t\t<child>link_" << currentIndex << "</child>\n";
167                  xml << "\t\t\t\t<axis>\n";
168                  xml << "\t\t\t\t\t<dynamics>\n";
169                  xml << "\t\t\t\t\t\t<damping>" << jointDamping << "</damping>\n"
                          ;
170                  xml << "\t\t\t\t\t\t<friction>" << jointFriction << "</friction
                          >\n";
171                  xml << "\t\t\t\t\t</dynamics>\n";
172                  xml << "\t\t\t\t\t<xyz>0␣0␣1</xyz>\n";
173                  xml << "\t\t\t\t</axis>\n";
174                  xml << "\t\t</joint>\n";
175              }
176          }
177      }
178
179      xml << "</model>\n";
180      xml << "</sdf>\n";
181
182      // Create SDF from the XML string
183      sdf::SDF model;
184      model.SetFromString(xml.str());
185
186      // Insert the SDF into the world in runtime
187      _parent->InsertModelSDF(model);
188  }
```

```cpp
1  #include "QGripPlugin.hh"
2
3  #include <gazebo/physics/physics.hh>
4  #include <string>
5
6  using namespace gazebo;
7
8  // Register this plugin with the simulator
9  GZ_REGISTER_MODEL_PLUGIN(QGripPlugin);
10
11 void QGripPlugin::Load(physics::ModelPtr _parent, sdf::ElementPtr _sdf) {
12     const auto parentModel = _parent;
13     const auto world = parentModel->GetWorld();
14     const auto physics = world->GetPhysicsEngine();
15
16     const std::string childLinkName = _sdf->GetElement("childLinkName")->Get<std
           ::string>();
17     const std::string parentLinkName = _sdf->GetElement("parentLinkName")->Get<
           std::string>();
18
19     const auto parentLink = parentModel->GetLink(parentLinkName);
20     const auto childLink = boost::dynamic_pointer_cast<physics::Link>(world->
           GetEntity(childLinkName));
21
22     gzdbg << "QGrip parent link name: " << parentLink->GetScopedName() << "\n";
23     gzdbg << "QGrip child link name: " << childLink->GetScopedName() << "\n";
24
25     math::Pose relativePose;
26     math::Vector3 relativeTranslation;
27     math::Quaternion relativeRotation;
28     std::string relativeRotationStr;
29
30     if (_sdf->HasElement("relativeTranslation") && _sdf->HasElement("
           relativeRotationXYZW")) {
31       relativeTranslation = _sdf->GetElement("relativeTranslation")->Get<math::
             Vector3>();
32       relativeRotationStr = _sdf->GetElement("relativeRotationXYZW")->Get<std::
             string>();
33
34       std::istringstream i(relativeRotationStr);
35       double x,y,z,w;
36       i >> x;
37       i >> y;
38       i >> z;
39       i >> w;
40
41       relativeRotation = math::Quaternion(w, x, y, z);
42
43       gzdbg << "xyz: " << relativeTranslation.x << " " << relativeTranslation.y
               << " " << relativeTranslation.z << " " << "\n";
44       gzdbg << "xyzw: " << relativeRotation.x << " " << relativeRotation.y << "
               " << relativeRotation.z << " " << relativeRotation.w << "\n";
45
46       const auto parentPose = parentLink->GetWorldPose();
47       const auto childPose = math::Pose(parentPose.pos + (parentPose.rot.
```

```
                 RotateVector ( relativeTranslation )) , parentPose . rot * relativeRotation );
48
49        childLink -> SetWorldPose ( childPose );
50
51        gzdbg << "QGrip:␣Relative␣pose␣given,␣adjusting␣child␣pose\n"
52             << childPose << "\n";
53    } else {
54      relativePose = parentLink -> GetWorldPose () - childLink -> GetWorldPose ();
55
56        gzdbg << "QGrip:␣Relative␣pose␣derrived\n";
57    }
58
59    // Create joint
60    const auto joint = physics -> CreateJoint ("fixed", parentModel );
61    // Bullet physics needs accurate joint position
62    // ODE does't care
63    joint -> Load ( parentLink , childLink , math :: Pose ());
64    joint -> Init ();
65    joint -> SetName ("grip_joint_" + parentLink -> GetScopedName () + "_" + childLink
            -> GetScopedName ());
66
67    childLink -> SetGravityMode ( false );
68  }
```

```
1   #include <gazebo/common/Plugin.hh>
2   #include <gazebo/physics/physics.hh>
3   #include <ros/ros.h>
4   #include <ros/callback_queue.h>
5   #include <ros/subscribe_options.h>
6   #include <geometry_msgs/Twist.h>
7   #include <string>
8   #include <thread>
9   #include <mutex>
10
11  namespace gazebo
12  {
13  class ForceControllerPlugin : public ModelPlugin
14  {
15  public:
16    ForceControllerPlugin() : ModelPlugin()
17    {
18    }
19
20    ~ForceControllerPlugin()
21    {
22    }
23
24    void Load(physics::ModelPtr _parent, sdf::ElementPtr _sdf)
25    {
26      // Make sure the ROS node for Gazebo has already been initialized
27      if (!ros::isInitialized())
28      {
29        ROS_FATAL_STREAM("A ROS node for Gazebo has not been initialized, unable
               to load plugin. "
30                        << "Load the Gazebo system plugin '
                           libgazebo_ros_api_plugin.so' in the gazebo_ros package
                           )");
31        return;
32      }
33
34      // SDF values
35      this->link_name_ = _sdf->GetElement("linkName")->Get<std::string>();
36      this->topic_name_ = _sdf->GetElement("topicName")->Get<std::string>();
37
38      // if (_sdf->HasElement("gains"))
39      // {
40      //    const auto gains = _sdf->GetElement("gains");
41      //    const auto linearGains = gains->GetElement("linear");
42      //    this->linear_P_ = linearGains->GetElement("P")->Get<double>();
43      //    this->linear_I_ = linearGains->GetElement("I")->Get<double>();
44      //    this->linear_D_ = linearGains->GetElement("D")->Get<double>();
45      //    const auto angularGains = gains->GetElement("angular");
46      //    this->angular_P_ = angularGains->GetElement("P")->Get<double>();
47      //    this->angular_I_ = angularGains->GetElement("I")->Get<double>();
48      //    this->angular_D_ = angularGains->GetElement("D")->Get<double>();
49      // }
50      // else
51      // {
52        this->linear_P_ = 100.0;
```

```cpp
53            this->linear_I_  = 0.0;
54            this->linear_D_  = 25.0;
55            this->angular_P_ = 0.001;
56            this->angular_I_ = 0.0;
57            this->angular_D_ = 0.0002;
58
59        //    gzdbg << "Using default PID gains\n";
60        // }
61
62        // Link
63        this->link_ = _parent->GetLink(this->link_name_);
64
65        // Subscribe to the topic
66        auto so = ros::SubscribeOptions::create<geometry_msgs::Twist>(
67            this->topic_name_, 1,
68            boost::bind(&ForceControllerPlugin::UpdateObjectVelocity, this, _1),
69            ros::VoidPtr(), &this->queue_);
70        this->sub_ = this->nh_.subscribe(so);
71
72        // Custom Callback Queue
73        this->queue_thread_ = std::thread(boost::bind(&ForceControllerPlugin::
74            QueueThread, this));
75        // Listen to the update event. This event is broadcast every
76        // simulation iteration.
77        this->update_connection_ = event::Events::ConnectWorldUpdateBegin(
78            boost::bind(&ForceControllerPlugin::UpdateChild, this, _1));
79
80        this->pid_linear_x_ = common::PID(linear_P_, linear_I_, linear_D_);
81        this->pid_linear_y_ = common::PID(linear_P_, linear_I_, linear_D_);
82        this->pid_linear_z_ = common::PID(linear_P_, linear_I_, linear_D_);
83        this->pid_angular_x_ = common::PID(angular_P_, angular_I_, angular_D_,
84            0.001, -0.001);
85        this->pid_angular_y_ = common::PID(angular_P_, angular_I_, angular_D_,
86            0.001, -0.001);
87        this->pid_angular_z_ = common::PID(angular_P_, angular_I_, angular_D_,
88            0.001, -0.001);
86    }
87
88    void UpdateObjectVelocity(const geometry_msgs::Twist::ConstPtr &_msg)
89    {
90        std::lock_guard<std::mutex> lock{this->mutex_};
91
92        this->desired_twist_.linear.x  = _msg->linear.x;
93        this->desired_twist_.linear.y  = _msg->linear.y;
94        this->desired_twist_.linear.z  = _msg->linear.z;
95        this->desired_twist_.angular.x = _msg->angular.x;
96        this->desired_twist_.angular.y = _msg->angular.y;
97        this->desired_twist_.angular.z = _msg->angular.z;
98    }
99
100   void UpdateChild(const common::UpdateInfo &_info)
101   {
102       const auto current_sim_time = _info.simTime;
103
104       if (current_sim_time < 1)
105           return;
```

```
106
107        const auto delta_sim_time = current_sim_time - this->previous_sim_time_;
108
109        UpdateObjectForces(delta_sim_time);
110    }
111
112    void UpdateObjectForces(const common::Time _delta_time)
113    {
114        std::lock_guard<std::mutex> lock{this->mutex_};
115
116        auto current_linear_vel = this->link_->GetWorldLinearVel();
117        auto current_angular_vel = this->link_->GetWorldAngularVel();
118
119        math::Vector3 force{0.0, 0.0, 0.0};
120        math::Vector3 torque{0.0, 0.0, 0.0};
121
122        force.x = this->pid_linear_x_.Update(current_linear_vel.x - this->
                desired_twist_.linear.x, _delta_time);
123        force.y = this->pid_linear_y_.Update(current_linear_vel.y - this->
                desired_twist_.linear.y, _delta_time);
124        force.z = this->pid_linear_z_.Update(current_linear_vel.z - this->
                desired_twist_.linear.z, _delta_time);
125
126        // Gazebo freaks out :|
127        // torque.x = this->pid_angular_x_.Update(current_angular_vel.x - this->
                desired_twist_.angular.x, _delta_time);
128        // torque.y = this->pid_angular_y_.Update(current_angular_vel.y - this->
                desired_twist_.angular.y, _delta_time);
129        // torque.z = this->pid_angular_z_.Update(current_angular_vel.z - this->
                desired_twist_.angular.z, _delta_time);
130
131        this->link_->SetForce(force);
132        this->link_->SetAngularVel(math::Vector3{this->desired_twist_.angular.x,
                this->desired_twist_.angular.y, this->desired_twist_.angular.z});
133    }
134
135 private:
136    std::string link_name_;
137    std::string topic_name_;
138    ros::NodeHandle nh_;
139    ros::Subscriber sub_;
140    ros::CallbackQueue queue_;
141    std::thread queue_thread_;
142    physics::LinkPtr link_;
143    std::mutex mutex_;
144    geometry_msgs::Twist desired_twist_;
145    event::ConnectionPtr update_connection_;
146    common::PID pid_linear_x_;
147    common::PID pid_linear_y_;
148    common::PID pid_linear_z_;
149    common::PID pid_angular_x_;
150    common::PID pid_angular_y_;
151    common::PID pid_angular_z_;
152    common::Time previous_sim_time_;
153    // Setup a P-controller
154    double linear_P_;
155    double linear_I_;
```

```
156    double linear_D_;
157    double angular_P_;
158    double angular_I_;
159    double angular_D_;
160
161    void QueueThread()
162    {
163      static const double timeout = 0.01;
164
165      while (this->nh_.ok())
166      {
167        this->queue_.callAvailable(ros::WallDuration(timeout));
168      }
169    }
170  };
171
172  GZ_REGISTER_MODEL_PLUGIN(ForceControllerPlugin)
173  }
```

```cpp
#ifndef PLUGINS_TILTGRABPLUGIN_H
#define PLUGINS_TILTGRABPLUGIN_H


#include <gazebo/gazebo.hh>
#include <gazebo/physics/Joint.hh>
#include <gazebo/sensors/sensors.hh>

namespace gazebo {
    class TiltGrabPlugin : public ModelPlugin {
    public:
        TiltGrabPlugin();
        void Load(physics::ModelPtr _parent, sdf::ElementPtr _sdf) override;
        void OnUpdate(const common::UpdateInfo & _info);
        void Reset() override;
        void CreateFirstJoint();
        void CreateSecondJoints();
        void BreakJoint();

    private:
        physics::PhysicsEnginePtr physics;
        physics::ModelPtr model;
        physics::ModelPtr book_model;
        physics::JointPtr joint1;
        physics::JointPtr joint2;
        physics::JointPtr joint3;
        physics::LinkPtr childLink1;
        physics::LinkPtr childLink2;
        physics::LinkPtr childLink3;
        physics::LinkPtr parentLink;
        event::ConnectionPtr updateConnection;
        int grabPhase;
        sensors::ContactSensorPtr parentSensor;
        physics::ContactManager *cMgr;
        bool curcontact;
        bool left_finger_touching;
        bool right_fingers_touching;
        double goalZ;
    };
}


#endif //PLUGINS_TILTGRABPLUGIN_H
```

```cpp
1  #include "TiltGrabPlugin.hh"
2
3  #include <gazebo/physics/physics.hh>
4  #include <gazebo/sensors/sensors.hh>
5  #include <string>
6  #include <ros/ros.h>
7
8  using namespace gazebo;
9
10 // Register this plugin with the simulator
11 GZ_REGISTER_MODEL_PLUGIN(TiltGrabPlugin);
12
13
14 TiltGrabPlugin::TiltGrabPlugin(): ModelPlugin(), joint1(nullptr) {
15
16 }
17
18 void TiltGrabPlugin::Load(physics::ModelPtr _parent, sdf::ElementPtr _sdf) {
19     ROS_INFO("Hello␣World!");
20     ROS_DEBUG("Hello␣World!");
21     this->model = _parent;
22     const auto world = this->model->GetWorld();
23     this->physics = world->GetPhysicsEngine();
24     this->cMgr = this->physics->GetContactManager();
25     if (!this->cMgr)
26     {
27         std::cout << "oops␣\n";
28         gzerr << "nullptr.␣\n";
29         return;
30     }
31     //sensors::SensorManager *mgr = gazebo::sensors::SensorManager::Instance();
32
33     const std::string childLinkName1 = _sdf->GetElement("childLinkName1")->Get<
           std::string>();
34     const std::string childLinkName2 = _sdf->GetElement("childLinkName2")->Get<
           std::string>();
35     const std::string childLinkName3 = _sdf->GetElement("childLinkName3")->Get<
           std::string>();
36     const std::string parentLinkName = _sdf->GetElement("parentLinkName")->Get<
           std::string>();
37     const std::string SensorName = _sdf->GetElement("sensorName")->Get<std::
           string>();
38     //int y = model->GetSensorCount();
39     //std::cout << y << "\n";
40     //std::cout << SensorName << "\n";
41     //sensors::Sensor_V all = mgr->GetSensors();
42     //std::cout << "used mgr \n";
43     //std::string name;
44     //std::cout << all.size() << "\n";
45     //for(int i = 0; i < all.size(); i++)
46     //{
47     //    name = all[i]->Name();
48     //    std::cout << name << "\n";
49     //}
50     this->grabPhase = 0;
```

```cpp
51
52        this->parentLink = this->model->GetLink(parentLinkName);
53        this->childLink1 = boost::dynamic_pointer_cast<physics::Link>(world->
              GetEntity(childLinkName1));
54        this->childLink2 = boost::dynamic_pointer_cast<physics::Link>(world->
              GetEntity(childLinkName2));
55        this->childLink3 = boost::dynamic_pointer_cast<physics::Link>(world->
              GetEntity(childLinkName3));
56        this->book_model = this->parentLink->GetModel();
57
58
59
60        this->left_finger_touching = false;
61        this->right_fingers_touching = false;
62
63        const gazebo::math::Pose &modelstart = this->book_model->GetWorldPose();
64        std::cout << modelstart.pos;
65        this->goalZ = modelstart.pos.z;
66        this->goalZ += 0.05;
67
68
69
70        //sensors::SensorPtr SensorPointer = mgr->GetSensor(SensorName);
71        //if (!SensorPointer)
72        //    {
73        //        std::cout << "oops \n";
74        //        gzerr << "nullptr. \n";
75        //        return;
76        //    }
77        //this->parentSensor = std::dynamic_pointer_cast<sensors::ContactSensor>(
              SensorPointer);
78
79
80        //this->updateConnection = this->parentSensor->ConnectUpdated(std::bind(&
              TiltGrabPlugin::OnUpdate, this));
81        //this->parentSensor->SetActive(true);
82        this->curcontact = true;
83        this->updateConnection = event::Events::ConnectWorldUpdateBegin(
84                boost::bind(&TiltGrabPlugin::OnUpdate, this, _1));
85
86  }
87
88  void TiltGrabPlugin::OnUpdate(const common::UpdateInfo &_info) {
89        if (_info.simTime < 1.0) {
90          // Let the stage settle down and position objects
91          return;
92        }
93        std::vector<physics::Contact*> contacts;
94        //physics::Contact contacts;
95        //msgs::Contacts contacts;
96        contacts = this->cMgr->GetContacts();
97        int number = this->cMgr->GetContactCount();
98        for (unsigned int i = 0; i < number; ++i)
99        {
100           physics::Collision *col1 = contacts[i]->collision1;
101           physics::Collision *col2 = contacts[i]->collision2;
102           physics::ModelPtr mod1 = col1->GetModel();
```

```
103            physics::ModelPtr mod2 = col2->GetModel();
104            std::string name1 = mod1->GetName();
105            std::string name2 = mod2->GetName();
106            //std::cout << "Collision between[" << name1 << "] and [" << name2 <<
                   "]\n";
107            this->curcontact = true;
108            if (name1 == "left_ee" || name2 == "left_ee")
109            {
110                this->left_finger_touching = true;
111                //std::cout << "Collision between[" << name1 << "] and [" << name2
                       << "]\n";
112            }
113            if (name1 == "right_ee" || name2 == "right_ee")
114            {
115                this->right_fingers_touching = true;
116                //std::cout << "Collision between[" << name1 << "] and [" << name2
                       << "]\n";
117            }
118            if (name1 == "right_ee_2" || name2 == "right_ee_2")
119            {
120                this->right_fingers_touching = true;
121                //std::cout << "Collision between[" << name1 << "] and [" << name2
                       << "]\n";
122            }
123
124        }
125        if (number == 0 and curcontact)
126        {
127            //std::cout << "no Collisions \n";
128            //std::cout << contacts << "\n";
129            this->curcontact = false;
130        }
131
132        if (this->grabPhase == 0){
133            if (this->left_finger_touching){
134                    this->CreateFirstJoint();
135                    this->grabPhase = 1;
136                std::cout << "made first joint \n";
137                gzdbg << "made first joint \n";
138            }
139        }
140
141        if (this->grabPhase == 1){
142            if (this->right_fingers_touching){
143                    this->BreakJoint();
144                    this->CreateSecondJoints();
145                    this->grabPhase = 2;
146                std::cout << "made second joints \n";
147                gzdbg << "made second joints \n";
148            }
149        }
150        this->left_finger_touching = false;
151        this->right_fingers_touching = false;
152        if (this->grabPhase == 2){
153            const gazebo::math::Pose &modelend = this->book_model->GetWorldPose();
154            if (modelend.pos.z > this->goalZ){
155                ROS_INFO("Experiment Success");
```

```
156                    gzdbg << "Experiment␣Success␣\n";
157                    //ROS_INFO(modelend.pos.z);
158                    this->grabPhase = 3;
159                }
160
161        }
162   }
163
164   void TiltGrabPlugin::Reset() {
165        if (this->joint1 != nullptr) {
166            this->BreakJoint();
167        }
168        if (this->joint2 != nullptr) {
169            this->joint2->Detach();
170            this->joint2 = nullptr;
171            this->joint3->Detach();
172            this->joint3 = nullptr;
173
174            // Enable gravity on the childLink
175            this->parentLink->SetGravityMode(true);
176
177            event::Events::DisconnectWorldUpdateBegin(this->updateConnection);
178            this->updateConnection = nullptr;
179        }
180   }
181
182   void TiltGrabPlugin::CreateFirstJoint() {
183        this->joint1 = this->physics->CreateJoint("fixed", this->model);
184        // Bullet physics needs accurate joint position
185        // ODE does't care
186        this->joint1->Load(this->parentLink, this->childLink1, this->parentLink->
                GetWorldPose() - this->childLink1->GetWorldPose());
187        this->joint1->Init();
188        this->joint1->SetProvideFeedback(true);
189        this->joint1->SetName("tilt_joint1_" + this->parentLink->GetScopedName() + "
                _" + this->childLink1->GetScopedName());
190
191        // Disable gravity on the butter link
192        this->parentLink->SetGravityMode(false);
193        this->grabPhase = 1;
194
195        this->updateConnection = event::Events::ConnectWorldUpdateBegin(
196                boost::bind(&TiltGrabPlugin::OnUpdate, this, _1));
197   }
198
199   void TiltGrabPlugin::CreateSecondJoints() {
200        this->joint2 = this->physics->CreateJoint("fixed", this->model);
201        // Bullet physics needs accurate joint position
202        // ODE does't care
203        this->joint2->Load(this->parentLink, this->childLink2, this->parentLink->
                GetWorldPose() - this->childLink2->GetWorldPose());
204        this->joint2->Init();
205        this->joint2->SetProvideFeedback(true);
206        this->joint2->SetName("grab_joint2_" + this->parentLink->GetScopedName() + "
                _" + this->childLink2->GetScopedName());
207
208        this->joint3 = this->physics->CreateJoint("fixed", this->model);
```

```
209        // Bullet physics needs accurate joint position
210        // ODE does't care
211        this->joint3->Load(this->parentLink, this->childLink3, this->parentLink->
               GetWorldPose() - this->childLink3->GetWorldPose());
212        this->joint3->Init();
213        this->joint3->SetProvideFeedback(true);
214        this->joint3->SetName("grab_joint3_" + this->parentLink->GetScopedName() + "
               _" + this->childLink3->GetScopedName());
215
216        // Disable gravity on the butter link
217        this->parentLink->SetGravityMode(false);
218        this->grabPhase = 2;
219
220        this->updateConnection = event::Events::ConnectWorldUpdateBegin(
221              boost::bind(&TiltGrabPlugin::OnUpdate, this, _1));
222    }
223
224    void TiltGrabPlugin::BreakJoint() {
225        this->joint1->Detach();
226        this->joint1 = nullptr;
227
228        // Enable gravity on the childLink
229        this->parentLink->SetGravityMode(true);
230
231        event::Events::DisconnectWorldUpdateBegin(this->updateConnection);
232        this->updateConnection = nullptr;
233    }
```

91   test.sh

```
1         #!/bin/bash
2
3
4         #worlds=(grabbing_book2 grabbing_book2 grabbing_book2 grabbing_book2
              grabbing_book2 grabbing_book2 grabbing_book2 grabbing_book2
              grabbing_book2 grabbing_book2
5                 #freezer_box freezer_box freezer_box freezer_box freezer_box
                      freezer_box freezer_box freezer_box freezer_box freezer_box
                      freezer_box
6                 #freezer_box2 freezer_box2 freezer_box2 freezer_box2
                      freezer_box2 freezer_box2 freezer_box2 freezer_box2
                      freezer_box2 freezer_box2 freezer_box2
7                 #freezer_box3 freezer_box3 freezer_box3 freezer_box3
                      freezer_box3 freezer_box3 freezer_box3 freezer_box3
                      freezer_box3 freezer_box3 freezer_box3
8                 #freezer_box4 freezer_box4 freezer_box4 freezer_box4
                      freezer_box4 freezer_box4 freezer_box4 freezer_box4
                      freezer_box4 freezer_box4 freezer_box4
9                 #freezer_box5 freezer_box5 freezer_box5 freezer_box5
                      freezer_box5 freezer_box5 freezer_box5 freezer_box5
                      freezer_box5 freezer_box5 freezer_box5
10                #freezer_box6 freezer_box6 freezer_box6 freezer_box6
                      freezer_box6 freezer_box6 freezer_box6 freezer_box6
                      freezer_box6 freezer_box6 freezer_box6
11                #freezer_box7 freezer_box7 freezer_box7 freezer_box7
                      freezer_box7 freezer_box7 freezer_box7 freezer_box7
                      freezer_box7 freezer_box7 freezer_box7 )
12        worlds=(grabbing_book grabbing_book grabbing_book grabbing_book
              grabbing_book grabbing_book grabbing_book grabbing_book grabbing_book
               grabbing_book grabbing_book
13                grabbing_book2 grabbing_book2 grabbing_book2 grabbing_book2
                      grabbing_book2 grabbing_book2 grabbing_book2 grabbing_book2
                      grabbing_book2 grabbing_book2 grabbing_book2
14                grabbing_book3 grabbing_book3 grabbing_book3 grabbing_book3
                      grabbing_book3 grabbing_book3 grabbing_book3 grabbing_book3
                      grabbing_book3 grabbing_book3 grabbing_book3
15                grabbing_book4 grabbing_book4 grabbing_book4 grabbing_book4
                      grabbing_book4 grabbing_book4 grabbing_book4 grabbing_book4
                      grabbing_book4 grabbing_book4 grabbing_book4
16                grabbing_book5 grabbing_book5 grabbing_book5 grabbing_book5
                      grabbing_book5 grabbing_book5 grabbing_book5 grabbing_book5
                      grabbing_book5 grabbing_book5 grabbing_book5
17                grabbing_book6 grabbing_book6 grabbing_book6 grabbing_book6
                      grabbing_book6 grabbing_book6 grabbing_book6 grabbing_book6
                      grabbing_book6 grabbing_book6 grabbing_book6
18                grabbing_book7 grabbing_book7 grabbing_book7 grabbing_book7
                      grabbing_book7 grabbing_book7 grabbing_book7 grabbing_book7
                      grabbing_book7 grabbing_book7 grabbing_book7
19                grabbing_book8 grabbing_book8 grabbing_book8 grabbing_book8
                      grabbing_book8 grabbing_book8 grabbing_book8 grabbing_book8
                      grabbing_book8 grabbing_book8 grabbing_book8 )
20
21
22        #experiments=(book_on_shelf book_on_shelf book_on_shelf book_on_shelf
              book_on_shelf book_on_shelf book_on_shelf book_on_shelf book_on_shelf
```

```
                      book_on_shelf  book_on_shelf  freezer_box  freezer_box  freezer_box
                   freezer_box  freezer_box  freezer_box  freezer_box  freezer_box
                   freezer_box  freezer_box  freezer_box
23                     #freezer_box2  freezer_box2  freezer_box2  freezer_box2
                           freezer_box2  freezer_box2  freezer_box2  freezer_box2
                           freezer_box2  freezer_box2  freezer_box2
24                     #freezer_box3  freezer_box3  freezer_box3  freezer_box3
                           freezer_box3  freezer_box3  freezer_box3  freezer_box3
                           freezer_box3  freezer_box3  freezer_box3
25                     #freezer_box4  freezer_box4  freezer_box4  freezer_box4
                           freezer_box4  freezer_box4  freezer_box4  freezer_box4
                           freezer_box4  freezer_box4  freezer_box4
26                     #freezer_box5  freezer_box5  freezer_box5  freezer_box5
                           freezer_box5  freezer_box5  freezer_box5  freezer_box5
                           freezer_box5  freezer_box5  freezer_box5
27                     #freezer_box6  freezer_box6  freezer_box6  freezer_box6
                           freezer_box6  freezer_box6  freezer_box6  freezer_box6
                           freezer_box6  freezer_box6  freezer_box6
28                     #freezer_box7  freezer_box7  freezer_box7  freezer_box7
                           freezer_box7  freezer_box7  freezer_box7  freezer_box7
                           freezer_box7  freezer_box7  freezer_box7 )
29           experiments=(book_on_shelf  book_on_shelf  book_on_shelf  book_on_shelf
                   book_on_shelf  book_on_shelf  book_on_shelf  book_on_shelf  book_on_shelf
                    book_on_shelf  book_on_shelf
30                     book_on_shelf2  book_on_shelf2  book_on_shelf2  book_on_shelf2
                           book_on_shelf2  book_on_shelf2  book_on_shelf2  book_on_shelf2
                           book_on_shelf2  book_on_shelf2  book_on_shelf2
31                     book_on_shelf3  book_on_shelf3  book_on_shelf3  book_on_shelf3
                           book_on_shelf3  book_on_shelf3  book_on_shelf3  book_on_shelf3
                           book_on_shelf3  book_on_shelf3  book_on_shelf3
32                     book_on_shelf4  book_on_shelf4  book_on_shelf4  book_on_shelf4
                           book_on_shelf4  book_on_shelf4  book_on_shelf4  book_on_shelf4
                           book_on_shelf4  book_on_shelf4  book_on_shelf4
33                     book_on_shelf5  book_on_shelf5  book_on_shelf5  book_on_shelf5
                           book_on_shelf5  book_on_shelf5  book_on_shelf5  book_on_shelf5
                           book_on_shelf5  book_on_shelf5  book_on_shelf5
34                     book_on_shelf6  book_on_shelf6  book_on_shelf6  book_on_shelf6
                           book_on_shelf6  book_on_shelf6  book_on_shelf6  book_on_shelf6
                           book_on_shelf6  book_on_shelf6  book_on_shelf6
35                     book_on_shelf7  book_on_shelf7  book_on_shelf7  book_on_shelf7
                           book_on_shelf7  book_on_shelf7  book_on_shelf7  book_on_shelf7
                           book_on_shelf7  book_on_shelf7  book_on_shelf7
36                     book_on_shelf8  book_on_shelf8  book_on_shelf8  book_on_shelf8
                           book_on_shelf8  book_on_shelf8  book_on_shelf8  book_on_shelf8
                           book_on_shelf8  book_on_shelf8  book_on_shelf8 )
37           index=0
38
39
40           while [ $index -lt 88 ]; do
41
42           gnome-terminal -e "timeout␣180s␣roslaunch␣skill_transfer␣simulation.
                   launch␣world:=${worlds[$index]}" #kill node?
43           sleep 10s;
44           gnome-terminal -e "timeout␣100s␣roslaunch␣skill_transfer␣experiment.
                   launch␣task:=tiltgrabbing␣robot:=free_ees␣setup:=${experiments[$index
                   ]}"
45           sleep 190;
```

```
46
47            echo -e " $index : \n" >>output.txt
48            echo -e " ${worlds[$index]} : \n" >>bookoutput.txt
49            echo -e " ${experiments[$index]} : \n" >>bookoutput.txt
50            while read -r row; do
51            echo -e "$row \n" >>output.txt #depends on the format
52            done < ~/.gazebo/server-11345/default.log
53            echo -e "
                  ***************************************************************************************\
                  n " >>output.txt
54            echo -e "\n\n\n " >>output.txt
55            index=$((index+1))
56
57   #        echo "Trial NO.$index accomplished"
58   #        sleep 5s;
59            done
```

92 package.xml

```xml
1  <?xml version="1.0"?>
2  <package>
3    <name>skill_transfer</name>
4    <version>0.0.0</version>
5    <description>The skill_transfer package</description>
6
7    <maintainer email="lubiluk@todo.todo">lubiluk</maintainer>
8
9    <license>TODO</license>
10
11   <buildtool_depend>catkin</buildtool_depend>
12
13   <build_depend>roscpp</build_depend>
14   <build_depend>std_msgs</build_depend>
15   <build_depend>gazebo_msgs</build_depend>
16   <build_depend>giskard_core</build_depend>
17   <build_depend>giskard_ros_utils</build_depend>
18   <build_depend>kdl_conversions</build_depend>
19   <build_depend>visualization_msgs</build_depend>
20   <build_depend>actionlib</build_depend>
21   <build_depend>actionlib_msgs</build_depend>
22   <build_depend>message_generation</build_depend>
23   <build_depend>gazebo_ros</build_depend>
24   <build_depend>yaml-cpp</build_depend>
25   <build_depend>sensor_msgs</build_depend>
26   <build_depend>tf2_ros</build_depend>
27
28   <run_depend>roscpp</run_depend>
29   <run_depend>std_msgs</run_depend>
30   <run_depend>gazebo_msgs</run_depend>
31   <run_depend>gazebo_plugins</run_depend>
32   <run_depend>gazebo_ros</run_depend>
33   <run_depend>giskard_core</run_depend>
34   <run_depend>giskard_ros_utils</run_depend>
35   <run_depend>kdl_conversions</run_depend>
36   <run_depend>visualization_msgs</run_depend>
37   <run_depend>actionlib</run_depend>
38   <run_depend>actionlib_msgs</run_depend>
39   <run_depend>message_runtime</run_depend>
40   <run_depend>gazebo_ros</run_depend>
41   <run_depend>yaml-cpp</run_depend>
42   <run_depend>sensor_msgs</run_depend>
43   <run_depend>tf2_ros</run_depend>
44
45   <export>
46     <gazebo_ros plugin_path="${prefix}/lib" gazebo_model_path="${prefix}/models"
         />
47   </export>
48  </package>
```

```yaml
 1  scope:
 2    # weights
 3    - controllable-weight: 0.001 # mu * 1
 4    - constraint-weight: 10.001 # mu + 10
 5
 6    # definition of object frames
 7    - target-object-frame:
 8        frame-mul:
 9          - right_ee
10          - target-object-grasp # This has to be provided
11
12    - tool-frame:
13        frame-mul:
14          - left_ee
15          - tool-grasp # This has to be provided
16
17    # definition of features
18    - tool-point:
19        transform-vector: [tool-frame, tool-heel]
20    - target-object-point:
21        transform-vector: [target-object-frame, edge-point]
22
23    # distance definition
24    - distance: {vector-sub: [target-object-point, tool-point]}
25
26    # rotation definition
27    - l_goal_rot:
28        rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
29    - l_rot: {orientation-of: tool-frame}
30    - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
          l_rot}, l_goal_rot]}}}
31    - l_rot_scaling:
32        double-if:
33        - {double-sub: [rot_thresh, l_rot_error]}
34        - 1
35        - {double-div: [rot_thresh, l_rot_error]}
36    - l_intermediate_goal_rot:
37        slerp:
38        - l_rot
39        - l_goal_rot
40        - l_rot_scaling
41    - l_rot_control:
42        scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
            mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
43
44  soft-constraints:
45    - soft-constraint:
46        - {double-sub: [-0.007, {x-coord: distance}]} # control law for lower
            boundary
47        - {double-sub: [0.007, {x-coord: distance}]} # control law for upper
            boundary
48        - constraint-weight # weight of this constraint
49        - {x-coord: distance} # expression used for Jacobian calcuation
50        - contact_x # name of expression reported
51    - soft-constraint:
```

```
52              - {double-sub: [-0.007, {y-coord: distance}]} # control law for lower
                     boundary
53              - {double-sub: [0.007, {y-coord: distance}]} # control law for upper
                     boundary
54              - constraint-weight # weight of this constraint
55              - {y-coord: distance} # expression used for Jacobian calcuation
56              - contact_y # name of expression reported
57         - soft-constraint:
58              - {double-sub: [-0.007, {z-coord: distance}]} # control law for lower
                     boundary
59              - {double-sub: [0.007, {z-coord: distance}]} # control law for upper
                     boundary
60              - constraint-weight # weight of this constraint
61              - {z-coord: distance} # expression used for Jacobian calcuation
62              - contact_z # name of expression reported
63         - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
                weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
                slack]
64         - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
                weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
                slack]
65         - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
                weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
                slack]
```

94 motions/cutting$_p$ull.yaml

```
1  scope:
2    # weights
3    - controllable-weight: 0.001 # mu * 1
4    - constraint-weight: 10.001 # mu + 10
5
6    # definition of object frames
7    - target-object-frame:
8        frame:
9          - quaternion: [0, 0, 0, 1]
10         - vector3: [0, 0, 1.03]
11
12   - tool-frame:
13       frame-mul:
14         - left_ee
15         - tool-grasp # This has to be provided
16
17   # definition of features
18   - tool-point:
19       transform-vector: [tool-frame, blade-point]
20   - target-object-point:
21       transform-vector:
22         - target-object-frame
23         - {vector3: [-0.30, 0, -0.01]} # 20 cm above the object
24
25   # expressions used in constraints
26   - distance: {vector-sub: [target-object-point, tool-point]}
27
28   - l_goal_rot:
29       rotation-mul:
30         - {axis-angle: [unit-z, 3.14]}
31         - {axis-angle: [unit-y, 0]}
32         - {axis-angle: [unit-x, 1.57]}
33   - l_rot: {orientation-of: tool-frame}
34   - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
          l_rot}, l_goal_rot]}}}
35   - l_rot_scaling:
36       double-if:
37       - {double-sub: [rot_thresh, l_rot_error]}
38       - 1
39       - {double-div: [rot_thresh, l_rot_error]}
40   - l_intermediate_goal_rot:
41       slerp:
42       - l_rot
43       - l_goal_rot
44       - l_rot_scaling
45   - l_rot_control:
46       scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
          mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
47
48 soft-constraints:
49   - soft-constraint:
50       - {double-sub: [-0.005, {x-coord: distance}]} # control law for lower
            boundary
51       - {double-sub: [0.005, {x-coord: distance}]} # control law for upper
            boundary
```

```
52          - constraint-weight # weight of this constraint
53          - {x-coord: distance} # expression used for Jacobian calcuation
54          - contact_x # name of expression reported
55      - soft-constraint:
56          - {double-sub: [-0.005, {y-coord: distance}]} # control law for lower
                boundary
57          - {double-sub: [0.005, {y-coord: distance}]} # control law for upper
                boundary
58          - constraint-weight # weight of this constraint
59          - {y-coord: distance} # expression used for Jacobian calcuation
60          - contact_y # name of expression reported
61      - soft-constraint:
62          - {double-sub: [-0.005, {z-coord: distance}]} # control law for lower
                boundary
63          - {double-sub: [0.005, {z-coord: distance}]} # control law for upper
                boundary
64          - constraint-weight # weight of this constraint
65          - {z-coord: distance} # expression used for Jacobian calcuation
66          - contact_z # name of expression reported
67      - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
            weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
            slack]
68      - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
            weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
            slack]
69      - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
            weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
            slack]
```

```
1   scope:
2     # weights
3     - controllable-weight: 0.001 # mu * 1
4     - constraint-weight: 10.001 # mu + 10
5
6     # definition of object frames
7     - target-object-frame:
8         frame-mul:
9           - target-object-grasp # This has to be provided
10
11    - tool-frame:
12        frame-mul:
13          - left_ee
14          - tool-grasp # This has to be provided
15
16    # definition of features
17    - tool-point:
18        transform-vector: [tool-frame, {vector3: [0, 0, 0.025]}]
19    - target-object-point:
20        vector-add:
21          - transform-vector: [target-object-frame, {vector3: [0.05, 0, 0.0]}]
22          - {vector3: [0.0, 0, 0.0]} # 5 cm beneath the edge
23
24    # expressions used in constraints
25    - distance: {vector-sub: [target-object-point, tool-point]}
26
27    - l_goal_rot:
28        rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
29    - l_rot: {orientation-of: tool-frame}
30    - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
          l_rot}, l_goal_rot]}}}
31    - l_rot_scaling:
32        double-if:
33        - {double-sub: [rot_thresh, l_rot_error]}
34        - 1
35        - {double-div: [rot_thresh, l_rot_error]}
36    - l_intermediate_goal_rot:
37        slerp:
38        - l_rot
39        - l_goal_rot
40        - l_rot_scaling
41    - l_rot_control:
42        scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
            mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
43
44  soft-constraints:
45    - soft-constraint:
46        - {double-sub: [-0.007, {x-coord: distance}]} # control law for lower
            boundary
47        - {double-sub: [0.007, {x-coord: distance}]} # control law for upper
            boundary
48        - constraint-weight # weight of this constraint
49        - {x-coord: distance} # expression used for Jacobian calcuation
50        - contact_x # name of expression reported
51    - soft-constraint:
```

```
52          - {double-sub: [-0.007, {y-coord: distance}]} # control law for lower
                  boundary
53          - {double-sub: [0.007, {y-coord: distance}]} # control law for upper
                  boundary
54          - constraint-weight # weight of this constraint
55          - {y-coord: distance} # expression used for Jacobian calcuation
56          - contact_y # name of expression reported
57      - soft-constraint:
58          - {double-sub: [-0.007, {z-coord: distance}]} # control law for lower
                  boundary
59          - {double-sub: [0.007, {z-coord: distance}]} # control law for upper
                  boundary
60          - constraint-weight # weight of this constraint
61          - {z-coord: distance} # expression used for Jacobian calcuation
62          - contact_z # name of expression reported
63      - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
            weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
            slack]
64      - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
            weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
            slack]
65      - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
            weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
            slack]
```

```yaml
1   scope:
2     # weights
3     - controllable-weight: 0.001 # mu * 1
4     - constraint-weight: 10.001 # mu + 10
5
6     # definition of object frames
7     - target-object-frame:
8         frame-mul:
9           - right_ee
10          - tool-grasp # This has to be provided
11
12    - tool-frame:
13        frame-mul:
14          - left_ee
15          - target-object-grasp # This has to be provided
16
17    # definition of features
18    - tool-point:
19        transform-vector: [tool-frame, {vector3: [-0.1149, -0.005, -0.0118]}]
20    - target-object-point:
21        transform-vector: [target-object-frame, {vector3: [0.018, 0.02, 0.0]}]
22
23    # expressions used in constraints
24    - distance: {vector-sub: [target-object-point, tool-point]}
25
26    - l_goal_rot:
27        rotation-mul:
28          - {axis-angle: [unit-z, 0]}
29          - {axis-angle: [unit-y, -1.57]}
30          - {axis-angle: [unit-x, -1.57]}
31    - l_rot: {orientation-of: tool-frame}
32    - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
          l_rot}, l_goal_rot]}}}
33    - l_rot_scaling:
34        double-if:
35        - {double-sub: [rot_thresh, l_rot_error]}
36        - 1
37        - {double-div: [rot_thresh, l_rot_error]}
38    - l_intermediate_goal_rot:
39        slerp:
40        - l_rot
41        - l_goal_rot
42        - l_rot_scaling
43    - l_rot_control:
44        scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
            mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
45
46  soft-constraints:
47    - soft-constraint:
48        - {double-sub: [-0.005, {x-coord: distance}]} # control law for lower
            boundary
49        - {double-sub: [0.005, {x-coord: distance}]} # control law for upper
            boundary
50        - constraint-weight # weight of this constraint
51        - {x-coord: distance} # expression used for Jacobian calcuation
```

```
52            - contact_x # name of expression reported
53      - soft-constraint:
54            - {double-sub: [-0.005, {y-coord: distance}]} # control law for lower
                    boundary
55            - {double-sub: [0.005, {y-coord: distance}]} # control law for upper
                    boundary
56            - constraint-weight # weight of this constraint
57            - {y-coord: distance} # expression used for Jacobian calcuation
58            - contact_y # name of expression reported
59      - soft-constraint:
60            - {double-sub: [-0.005, {z-coord: distance}]} # control law for lower
                    boundary
61            - {double-sub: [0.005, {z-coord: distance}]} # control law for upper
                    boundary
62            - constraint-weight # weight of this constraint
63            - {z-coord: distance} # expression used for Jacobian calcuation
64            - contact_z # name of expression reported
65      - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
            weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
            slack]
66      - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
            weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
            slack]
67      - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
            weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
            slack]
```

```yaml
1  scope:
2    # weights
3    - controllable-weight: 0.001 # mu * 1
4    - constraint-weight: 10.001 # mu + 10
5
6    # definition of object frames
7    - target-object-frame:
8        frame-mul:
9          - target-object-grasp # This has to be provided
10
11   - tool-frame:
12       frame-mul:
13         - right_ee_2
14         - tool-grasp # This has to be provided
15
16   # definition of features
17   - tool-point:
18       transform-vector: [tool-frame, {vector3: [0, 0, 0.025]}]
19   - target-object-point:
20       vector-add:
21         - transform-vector: [target-object-frame, {vector3: [0.02, object-width
               -2, -0.02]}]
22         - {vector3: [0.0, 0.0, 0.0]} # 20 cm above the edge
23
24   # expressions used in constraints
25   - distance: {vector-sub: [target-object-point, tool-point]}
26
27   - r_2_goal_rot:
28       rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
29   - r_2_rot: {orientation-of: tool-frame}
30   - r_2_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
         r_2_rot}, r_2_goal_rot]}}}
31   - r_2_rot_scaling:
32       double-if:
33       - {double-sub: [rot_thresh, r_2_rot_error]}
34       - 1
35       - {double-div: [rot_thresh, r_2_rot_error]}
36   - r_2_intermediate_goal_rot:
37       slerp:
38       - r_2_rot
39       - r_2_goal_rot
40       - r_2_rot_scaling
41   - r_2_rot_control:
42       scale-vector: [rot_p_gain, {rotate-vector: [r_2_rot, {rot-vector: {
             rotation-mul: [{inverse-rotation: r_2_rot}, r_2_intermediate_goal_rot
             ]}}]}]
43
44 soft-constraints:
45   - soft-constraint:
46       - {double-sub: [-0.007, {x-coord: distance}]} # control law for lower
             boundary
47       - {double-sub: [0.007, {x-coord: distance}]} # control law for upper
             boundary
48       - constraint-weight # weight of this constraint
49       - {x-coord: distance} # expression used for Jacobian calcuation
```

```
50              - contact_x # name of expression reported
51      - soft-constraint:
52          - {double-sub: [-0.007, {y-coord: distance}]} # control law for lower
                    boundary
53          - {double-sub: [0.007, {y-coord: distance}]} # control law for upper
                    boundary
54          - constraint-weight # weight of this constraint
55          - {y-coord: distance} # expression used for Jacobian calcuation
56          - contact_y # name of expression reported
57      - soft-constraint:
58          - {double-sub: [-0.007, {z-coord: distance}]} # control law for lower
                    boundary
59          - {double-sub: [0.007, {z-coord: distance}]} # control law for upper
                    boundary
60          - constraint-weight # weight of this constraint
61          - {z-coord: distance} # expression used for Jacobian calcuation
62          - contact_z # name of expression reported
63      - soft-constraint: [{x-coord: r_2_rot_control}, {x-coord: r_2_rot_control},
            weight_rot_control, {x-coord: {rot-vector: r_2_rot}}, right_2 EE x-rot
            control slack]
64      - soft-constraint: [{y-coord: r_2_rot_control}, {y-coord: r_2_rot_control},
            weight_rot_control, {y-coord: {rot-vector: r_2_rot}}, right_2 EE y-rot
            control slack]
65      - soft-constraint: [{z-coord: r_2_rot_control}, {z-coord: r_2_rot_control},
            weight_rot_control, {z-coord: {rot-vector: r_2_rot}}, right_2 EE z-rot
            control slack]
```

```
1  scope:
2    # weights
3    - controllable-weight: 0.001 # mu * 1
4    - constraint-weight: 10.001 # mu + 10
5
6    # definition of object frames
7    - target-object-frame:
8        frame-mul:
9          - target-object-grasp # This has to be provided
10
11   - tool-frame:
12       frame-mul:
13         - right_ee
14         - tool-grasp # This has to be provided
15   - tool-frame-2:
16       frame-mul:
17         - right_ee_2
18         - tool-grasp # This has to be provided
19
20   # definition of features
21   - tool-point:
22       transform-vector: [tool-frame, {vector3: [0, 0, 0.025]}]
23   - tool-point-2:
24       transform-vector: [tool-frame-2, {vector3: [0, 0, 0.025]}]
25   - target-object-point:
26       vector-add:
27         - transform-vector: [target-object-frame, {vector3: [0.6, 0.0, 0.6]}]
28         - {vector3: [0.0, 0.0, 0.0]} # 20 cm above the edge
29
30   # expressions used in constraints
31   - distance: {vector-sub: [target-object-point, tool-point]}
32   - distance-2: {vector-sub: [target-object-point, tool-point-2]}
33
34   - r_goal_rot:
35       rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
36   - r_rot: {orientation-of: tool-frame}
37   - r_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
         r_rot}, r_goal_rot]}}}
38   - r_rot_scaling:
39       double-if:
40       - {double-sub: [rot_thresh, r_rot_error]}
41       - 1
42       - {double-div: [rot_thresh, r_rot_error]}
43   - r_intermediate_goal_rot:
44       slerp:
45       - r_rot
46       - r_goal_rot
47       - r_rot_scaling
48   - r_rot_control:
49       scale-vector: [rot_p_gain, {rotate-vector: [r_rot, {rot-vector: {rotation-
           mul: [{inverse-rotation: r_rot}, r_intermediate_goal_rot]}}]}]
50   - r_2_goal_rot:
51       rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
52   - r_2_rot: {orientation-of: tool-frame-2}
53   - r_2_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
```

```
          r_2_rot}, r_2_goal_rot]}}}
54    - r_2_rot_scaling:
55        double-if:
56        - {double-sub: [rot_thresh, r_2_rot_error]}
57        - 1
58        - {double-div: [rot_thresh, r_2_rot_error]}
59    - r_2_intermediate_goal_rot:
60        slerp:
61        - r_2_rot
62        - r_2_goal_rot
63        - r_2_rot_scaling
64    - r_2_rot_control:
65        scale-vector: [rot_p_gain, {rotate-vector: [r_2_rot, {rot-vector: {
              rotation-mul: [{inverse-rotation: r_2_rot}, r_2_intermediate_goal_rot
              ]}}]}]
66
67  soft-constraints:
68    - soft-constraint:
69        - {double-sub: [-0.007, {x-coord: distance}]} # control law for lower
              boundary
70        - {double-sub: [0.007, {x-coord: distance}]} # control law for upper
              boundary
71        - constraint-weight # weight of this constraint
72        - {x-coord: distance} # expression used for Jacobian calcuation
73        - contact_x # name of expression reported
74    - soft-constraint:
75        - {double-sub: [-0.007, {y-coord: distance}]} # control law for lower
              boundary
76        - {double-sub: [0.007, {y-coord: distance}]} # control law for upper
              boundary
77        - constraint-weight # weight of this constraint
78        - {y-coord: distance} # expression used for Jacobian calcuation
79        - contact_y # name of expression reported
80    - soft-constraint:
81        - {double-sub: [-0.007, {z-coord: distance}]} # control law for lower
              boundary
82        - {double-sub: [0.007, {z-coord: distance}]} # control law for upper
              boundary
83        - constraint-weight # weight of this constraint
84        - {z-coord: distance} # expression used for Jacobian calcuation
85        - contact_z # name of expression reported
86    - soft-constraint: [{x-coord: r_rot_control}, {x-coord: r_rot_control},
          weight_rot_control, {x-coord: {rot-vector: r_rot}}, right EE x-rot control
          slack]
87    - soft-constraint: [{y-coord: r_rot_control}, {y-coord: r_rot_control},
          weight_rot_control, {y-coord: {rot-vector: r_rot}}, right EE y-rot control
          slack]
88    - soft-constraint: [{z-coord: r_rot_control}, {z-coord: r_rot_control},
          weight_rot_control, {z-coord: {rot-vector: r_rot}}, right EE z-rot control
          slack]
89
90
91    - soft-constraint:
92        - {double-sub: [-0.007, {x-coord: distance-2}]} # control law for lower
              boundary
93        - {double-sub: [0.007, {x-coord: distance-2}]} # control law for upper
              boundary
```

```yaml
 94          - constraint-weight # weight of this constraint
 95          - {x-coord: distance-2} # expression used for Jacobian calcuation
 96          - contact_x # name of expression reported
 97      - soft-constraint:
 98          - {double-sub: [-0.007, {y-coord: distance-2}]} # control law for lower
                  boundary
 99          - {double-sub: [0.007, {y-coord: distance-2}]} # control law for upper
                  boundary
100          - constraint-weight # weight of this constraint
101          - {y-coord: distance-2} # expression used for Jacobian calcuation
102          - contact_y # name of expression reported
103      - soft-constraint:
104          - {double-sub: [-0.007, {z-coord: distance-2}]} # control law for lower
                  boundary
105          - {double-sub: [0.007, {z-coord: distance-2}]} # control law for upper
                  boundary
106          - constraint-weight # weight of this constraint
107          - {z-coord: distance-2} # expression used for Jacobian calcuation
108          - contact_z # name of expression reported
109      - soft-constraint: [{x-coord: r_2_rot_control}, {x-coord: r_2_rot_control},
              weight_rot_control, {x-coord: {rot-vector: r_2_rot}}, right_2 EE x-rot
              control slack]
110      - soft-constraint: [{y-coord: r_2_rot_control}, {y-coord: r_2_rot_control},
              weight_rot_control, {y-coord: {rot-vector: r_2_rot}}, right_2 EE y-rot
              control slack]
111      - soft-constraint: [{z-coord: r_2_rot_control}, {z-coord: r_2_rot_control},
              weight_rot_control, {z-coord: {rot-vector: r_2_rot}}, right_2 EE z-rot
              control slack]
```

```
 1  scope:
 2    # weights
 3    - controllable-weight: 0.001 # mu * 1
 4    - constraint-weight: 10.001 # mu + 10
 5
 6    # definition of object frames
 7    - target-object-frame:
 8        frame-mul:
 9          - target-object-grasp # This has to be provided
10
11    - tool-frame:
12        frame-mul:
13          - left_ee
14          - tool-grasp # This has to be provided
15
16    # definition of features
17    - tool-point:
18        transform-vector: [tool-frame, {vector3: [0, 0, 0.025]}]
19    - target-object-point:
20        vector-add:
21          - transform-vector: [target-object-frame, {vector3: [-0.05, 0, 0.1]}]
22          - {vector3: [0.0, 0.0, 0.0]} # 20 cm above the edge
23
24    # expressions used in constraints
25    - distance: {vector-sub: [target-object-point, tool-point]}
26
27    - l_goal_rot:
28        rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
29    - l_rot: {orientation-of: tool-frame}
30    - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
         l_rot}, l_goal_rot]}}}
31    - l_rot_scaling:
32        double-if:
33        - {double-sub: [rot_thresh, l_rot_error]}
34        - 1
35        - {double-div: [rot_thresh, l_rot_error]}
36    - l_intermediate_goal_rot:
37        slerp:
38        - l_rot
39        - l_goal_rot
40        - l_rot_scaling
41    - l_rot_control:
42        scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
           mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
43
44  soft-constraints:
45    - soft-constraint:
46        - {double-sub: [-0.007, {x-coord: distance}]} # control law for lower
             boundary
47        - {double-sub: [0.007, {x-coord: distance}]} # control law for upper
             boundary
48        - constraint-weight # weight of this constraint
49        - {x-coord: distance} # expression used for Jacobian calcuation
50        - contact_x # name of expression reported
51    - soft-constraint:
```

```
52          - {double-sub: [-0.007, {y-coord: distance}]} # control law for lower
                boundary
53          - {double-sub: [0.007, {y-coord: distance}]} # control law for upper
                boundary
54          - constraint-weight # weight of this constraint
55          - {y-coord: distance} # expression used for Jacobian calcuation
56          - contact_y # name of expression reported
57      - soft-constraint:
58          - {double-sub: [-0.007, {z-coord: distance}]} # control law for lower
                boundary
59          - {double-sub: [0.007, {z-coord: distance}]} # control law for upper
                boundary
60          - constraint-weight # weight of this constraint
61          - {z-coord: distance} # expression used for Jacobian calcuation
62          - contact_z # name of expression reported
63      - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
            weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
            slack]
64      - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
            weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
            slack]
65      - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
            weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
            slack]
```

```yaml
 1  scope:
 2    # weights
 3    - controllable-weight: 0.001 # mu * 1
 4    - constraint-weight: 10.001 # mu + 10
 5
 6    # definition of object frames
 7    - target-object-frame:
 8        frame-mul:
 9          - target-object-grasp # This has to be provided
10
11    - tool-frame:
12        frame-mul:
13          - left_ee
14          - tool-grasp # This has to be provided
15
16    # definition of features
17    - tool-point:
18        transform-vector: [tool-frame, {vector3: [0, 0, 0.025]}]
19    - target-object-point:
20        vector-add:
21          - transform-vector: [target-object-frame, {vector3: [-0.05, 0, 0.0]}]
22          - {vector3: [0.0, 0, 0.0]} # 0 cm beneath the edge
23
24    # expressions used in constraints
25    - distance: {vector-sub: [target-object-point, tool-point]}
26
27    - l_goal_rot:
28        rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
29    - l_rot: {orientation-of: tool-frame}
30    - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
        l_rot}, l_goal_rot]}}}
31    - l_rot_scaling:
32        double-if:
33        - {double-sub: [rot_thresh, l_rot_error]}
34        - 1
35        - {double-div: [rot_thresh, l_rot_error]}
36    - l_intermediate_goal_rot:
37        slerp:
38        - l_rot
39        - l_goal_rot
40        - l_rot_scaling
41    - l_rot_control:
42        scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
            mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
43
44  soft-constraints:
45    - soft-constraint:
46        - {double-sub: [-0.007, {x-coord: distance}]} # control law for lower
              boundary
47        - {double-sub: [0.007, {x-coord: distance}]} # control law for upper
              boundary
48        - constraint-weight # weight of this constraint
49        - {x-coord: distance} # expression used for Jacobian calcuation
50        - contact_x # name of expression reported
51    - soft-constraint:
```

```
52          - {double-sub: [-0.007, {y-coord: distance}]} # control law for lower
                boundary
53          - {double-sub: [0.007, {y-coord: distance}]} # control law for upper
                boundary
54          - constraint-weight # weight of this constraint
55          - {y-coord: distance} # expression used for Jacobian calcuation
56          - contact_y # name of expression reported
57     - soft-constraint:
58          - {double-sub: [-0.007, {z-coord: distance}]} # control law for lower
                boundary
59          - {double-sub: [0.007, {z-coord: distance}]} # control law for upper
                boundary
60          - constraint-weight # weight of this constraint
61          - {z-coord: distance} # expression used for Jacobian calcuation
62          - contact_z # name of expression reported
63     - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
           weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
           slack]
64     - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
           weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
           slack]
65     - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
           weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
           slack]
```

101   motions/scraping$_p$osition$_a$bove.yaml

```yaml
 1  scope:
 2    # weights
 3    - controllable-weight: 0.001 # mu * 1
 4    - constraint-weight: 10.001 # mu + 10
 5
 6    # definition of object frames
 7    - target-object-frame:
 8        frame-mul:
 9          - right_ee
10          - target-object-grasp # This has to be provided
11
12    - tool-frame:
13        frame-mul:
14          - left_ee
15          - tool-grasp # This has to be provided
16
17    # definition of features
18    - tool-point:
19        transform-vector: [tool-frame, tool-heel]
20    - target-object-point:
21        vector-add:
22          - transform-vector: [target-object-frame, edge-point]
23          - {vector3: [0, 0, 0.2]} # 20 cm above the edge
24
25    # expressions used in constraints
26    - distance: {vector-sub: [target-object-point, tool-point]}
27
28    - l_goal_rot:
29        rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
30    - l_rot: {orientation-of: tool-frame}
31    - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
           l_rot}, l_goal_rot]}}}
32    - l_rot_scaling:
33        double-if:
34        - {double-sub: [rot_thresh, l_rot_error]}
35        - 1
36        - {double-div: [rot_thresh, l_rot_error]}
37    - l_intermediate_goal_rot:
38        slerp:
39        - l_rot
40        - l_goal_rot
41        - l_rot_scaling
42    - l_rot_control:
43        scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
             mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
44
45  soft-constraints:
46    - soft-constraint:
47        - {double-sub: [-0.007, {x-coord: distance}]} # control law for lower
             boundary
48        - {double-sub: [0.007, {x-coord: distance}]} # control law for upper
             boundary
49        - constraint-weight # weight of this constraint
50        - {x-coord: distance} # expression used for Jacobian calcuation
51        - contact_x # name of expression reported
```

```
52    - soft-constraint:
53        - {double-sub: [-0.007, {y-coord: distance}]} # control law for lower
                boundary
54        - {double-sub: [0.007, {y-coord: distance}]} # control law for upper
                boundary
55        - constraint-weight # weight of this constraint
56        - {y-coord: distance} # expression used for Jacobian calcuation
57        - contact_y # name of expression reported
58    - soft-constraint:
59        - {double-sub: [-0.007, {z-coord: distance}]} # control law for lower
                boundary
60        - {double-sub: [0.007, {z-coord: distance}]} # control law for upper
                boundary
61        - constraint-weight # weight of this constraint
62        - {z-coord: distance} # expression used for Jacobian calcuation
63        - contact_z # name of expression reported
64    - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
            weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
            slack]
65    - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
            weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
            slack]
66    - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
            weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
            slack]
```

102   motions/tilting$_g$rab.yaml

```yaml
1   scope:
2     # weights
3     - controllable-weight: 0.001 # mu * 1
4     - constraint-weight: 10.001 # mu + 10
5
6     # definition of object frames
7     - target-object-frame:
8         frame-mul:
9           - target-object-grasp # This has to be provided
10
11    - tool-frame:
12        frame-mul:
13          - right_ee
14          - tool-grasp # This has to be provided
15    - tool-frame-2:
16        frame-mul:
17          - right_ee_2
18          - tool-grasp # This has to be provided
19
20    # definition of features
21    - tool-point:
22        transform-vector: [tool-frame, {vector3: [0, 0, 0.025]}]
23    - tool-point-2:
24        transform-vector: [tool-frame-2, {vector3: [0, 0, 0.025]}]
25    - target-object-point:
26        vector-add:
27          - transform-vector: [target-object-frame, {vector3: [0.02, 0.00,
              -0.02]}]
28          - {vector3: [0.0, 0.0, 0.0]} # 20 cm above the edge
29
30    # expressions used in constraints
31    - distance: {vector-sub: [target-object-point, tool-point]}
32    - distance-2: {vector-sub: [target-object-point, tool-point-2]}
33
34    - r_goal_rot:
35        rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
36    - r_rot: {orientation-of: tool-frame}
37    - r_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
        r_rot}, r_goal_rot]}}}
38    - r_rot_scaling:
39        double-if:
40        - {double-sub: [rot_thresh, r_rot_error]}
41        - 1
42        - {double-div: [rot_thresh, r_rot_error]}
43    - r_intermediate_goal_rot:
44        slerp:
45        - r_rot
46        - r_goal_rot
47        - r_rot_scaling
48    - r_rot_control:
49        scale-vector: [rot_p_gain, {rotate-vector: [r_rot, {rot-vector: {rotation-
            mul: [{inverse-rotation: r_rot}, r_intermediate_goal_rot]}}]}]
50    - r_2_goal_rot:
51        rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
52    - r_2_rot: {orientation-of: tool-frame-2}
```

```
53    - r_2_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
           r_2_rot}, r_2_goal_rot]}}}
54    - r_2_rot_scaling:
55        double-if:
56        - {double-sub: [rot_thresh, r_2_rot_error]}
57        - 1
58        - {double-div: [rot_thresh, r_2_rot_error]}
59    - r_2_intermediate_goal_rot:
60        slerp:
61        - r_2_rot
62        - r_2_goal_rot
63        - r_2_rot_scaling
64    - r_2_rot_control:
65        scale-vector: [rot_p_gain, {rotate-vector: [r_2_rot, {rot-vector: {
             rotation-mul: [{inverse-rotation: r_2_rot}, r_2_intermediate_goal_rot
             ]}}]}]
66
67  soft-constraints:
68    - soft-constraint:
69        - {double-sub: [-0.007, {x-coord: distance}]} # control law for lower
             boundary
70        - {double-sub: [0.007, {x-coord: distance}]} # control law for upper
             boundary
71        - constraint-weight # weight of this constraint
72        - {x-coord: distance} # expression used for Jacobian calcuation
73        - contact_x # name of expression reported
74    - soft-constraint:
75        - {double-sub: [-0.007, {y-coord: distance}]} # control law for lower
             boundary
76        - {double-sub: [0.007, {y-coord: distance}]} # control law for upper
             boundary
77        - constraint-weight # weight of this constraint
78        - {y-coord: distance} # expression used for Jacobian calcuation
79        - contact_y # name of expression reported
80    - soft-constraint:
81        - {double-sub: [-0.007, {z-coord: distance}]} # control law for lower
             boundary
82        - {double-sub: [0.007, {z-coord: distance}]} # control law for upper
             boundary
83        - constraint-weight # weight of this constraint
84        - {z-coord: distance} # expression used for Jacobian calcuation
85        - contact_z # name of expression reported
86    - soft-constraint: [{x-coord: r_rot_control}, {x-coord: r_rot_control},
         weight_rot_control, {x-coord: {rot-vector: r_rot}}, right EE x-rot control
         slack]
87    - soft-constraint: [{y-coord: r_rot_control}, {y-coord: r_rot_control},
         weight_rot_control, {y-coord: {rot-vector: r_rot}}, right EE y-rot control
         slack]
88    - soft-constraint: [{z-coord: r_rot_control}, {z-coord: r_rot_control},
         weight_rot_control, {z-coord: {rot-vector: r_rot}}, right EE z-rot control
         slack]
89
90
91    - soft-constraint:
92        - {double-sub: [-0.007, {x-coord: distance-2}]} # control law for lower
             boundary
93        - {double-sub: [0.007, {x-coord: distance-2}]} # control law for upper
```

```
                          boundary
94          - constraint-weight # weight of this constraint
95          - {x-coord: distance-2} # expression used for Jacobian calcuation
96          - contact_x # name of expression reported
97      - soft-constraint:
98          - {double-sub: [-0.007, {y-coord: distance-2}]} # control law for lower
                          boundary
99          - {double-sub: [0.007, {y-coord: distance-2}]} # control law for upper
                          boundary
100         - constraint-weight # weight of this constraint
101         - {y-coord: distance-2} # expression used for Jacobian calcuation
102         - contact_y # name of expression reported
103     - soft-constraint:
104         - {double-sub: [-0.007, {z-coord: distance-2}]} # control law for lower
                          boundary
105         - {double-sub: [0.007, {z-coord: distance-2}]} # control law for upper
                          boundary
106         - constraint-weight # weight of this constraint
107         - {z-coord: distance-2} # expression used for Jacobian calcuation
108         - contact_z # name of expression reported
109     - soft-constraint: [{x-coord: r_2_rot_control}, {x-coord: r_2_rot_control},
            weight_rot_control, {x-coord: {rot-vector: r_2_rot}}, right_2 EE x-rot
            control slack]
110     - soft-constraint: [{y-coord: r_2_rot_control}, {y-coord: r_2_rot_control},
            weight_rot_control, {y-coord: {rot-vector: r_2_rot}}, right_2 EE y-rot
            control slack]
111     - soft-constraint: [{z-coord: r_2_rot_control}, {z-coord: r_2_rot_control},
            weight_rot_control, {z-coord: {rot-vector: r_2_rot}}, right_2 EE z-rot
            control slack]
```

103   motions/tilting$_position_front$.yaml

```
1  scope:
2    # weights
3    - controllable-weight: 0.001 # mu * 1
4    - constraint-weight: 10.001 # mu + 10
5
6    # definition of object frames
7    - target-object-frame:
8        frame-mul:
9          - target-object-grasp # This has to be provided
10
11   - tool-frame:
12       frame-mul:
13         - right_ee
14         - tool-grasp # This has to be provided
15
16   # definition of features
17   - tool-point:
18       transform-vector: [tool-frame, {vector3: [0, 0, 0.025]}]
19   - target-object-point:
20       vector-add:
21         - transform-vector: [target-object-frame, {vector3: [0.02, object-width,
             -0.02]}]
22         - {vector3: [0.0, 0.0, 0.0]} # 20 cm above the edge
23
24   # expressions used in constraints
25   - distance: {vector-sub: [target-object-point, tool-point]}
26
27   - r_goal_rot:
28       rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
29   - r_rot: {orientation-of: tool-frame}
30   - r_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
         r_rot}, r_goal_rot]}}}
31   - r_rot_scaling:
32       double-if:
33       - {double-sub: [rot_thresh, r_rot_error]}
34       - 1
35       - {double-div: [rot_thresh, r_rot_error]}
36   - r_intermediate_goal_rot:
37       slerp:
38       - r_rot
39       - r_goal_rot
40       - r_rot_scaling
41   - r_rot_control:
42       scale-vector: [rot_p_gain, {rotate-vector: [r_rot, {rot-vector: {rotation-
           mul: [{inverse-rotation: r_rot}, r_intermediate_goal_rot]}}]}]
43
44  soft-constraints:
45    - soft-constraint:
46        - {double-sub: [-0.007, {x-coord: distance}]} # control law for lower
             boundary
47        - {double-sub: [0.007, {x-coord: distance}]} # control law for upper
             boundary
48        - constraint-weight # weight of this constraint
49        - {x-coord: distance} # expression used for Jacobian calcuation
50        - contact_x # name of expression reported
```

```yaml
51    - soft-constraint:
52        - {double-sub: [-0.007, {y-coord: distance}]} # control law for lower
              boundary
53        - {double-sub: [0.007, {y-coord: distance}]} # control law for upper
              boundary
54        - constraint-weight # weight of this constraint
55        - {y-coord: distance} # expression used for Jacobian calcuation
56        - contact_y # name of expression reported
57    - soft-constraint:
58        - {double-sub: [-0.007, {z-coord: distance}]} # control law for lower
              boundary
59        - {double-sub: [0.007, {z-coord: distance}]} # control law for upper
              boundary
60        - constraint-weight # weight of this constraint
61        - {z-coord: distance} # expression used for Jacobian calcuation
62        - contact_z # name of expression reported
63  - soft-constraint: [{x-coord: r_rot_control}, {x-coord: r_rot_control},
        weight_rot_control, {x-coord: {rot-vector: r_rot}}, right EE x-rot control
        slack]
64  - soft-constraint: [{y-coord: r_rot_control}, {y-coord: r_rot_control},
        weight_rot_control, {y-coord: {rot-vector: r_rot}}, right EE y-rot control
        slack]
65  - soft-constraint: [{z-coord: r_rot_control}, {z-coord: r_rot_control},
        weight_rot_control, {z-coord: {rot-vector: r_rot}}, right EE z-rot control
        slack]
```

```
1   scope:
2     # weights
3     - controllable-weight: 0.001 # mu * 1
4     - constraint-weight: 10.001 # mu + 10
5
6     # definition of object frames
7     - target-object-frame:
8         frame:
9           - quaternion: [0, 0, 0, 1]
10          - vector3: [0, 0, 1.03]
11
12    - tool-frame:
13        frame-mul:
14          - left_ee
15          - tool-grasp # This has to be provided
16
17    # definition of features
18    - tool-point:
19        transform-vector: [tool-frame, blade-point]
20    - target-object-point:
21        transform-vector:
22          - target-object-frame
23          - {vector3: [0, 0, -0.01]} # 0 cm above the object
24
25    # expressions used in constraints
26    - distance: {vector-sub: [target-object-point, tool-point]}
27
28    - l_goal_rot:
29        rotation-mul:
30          - {axis-angle: [unit-z, 3.14]}
31          - {axis-angle: [unit-y, 0]}
32          - {axis-angle: [unit-x, 1.57]}
33    - l_rot: {orientation-of: tool-frame}
34    - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
          l_rot}, l_goal_rot]}}}
35    - l_rot_scaling:
36        double-if:
37        - {double-sub: [rot_thresh, l_rot_error]}
38        - 1
39        - {double-div: [rot_thresh, l_rot_error]}
40    - l_intermediate_goal_rot:
41        slerp:
42        - l_rot
43        - l_goal_rot
44        - l_rot_scaling
45    - l_rot_control:
46        scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
            mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
47
48  soft-constraints:
49    - soft-constraint:
50        - {double-sub: [-0.005, {x-coord: distance}]} # control law for lower
              boundary
51        - {double-sub: [0.005, {x-coord: distance}]} # control law for upper
              boundary
```

```
52          - constraint-weight # weight of this constraint
53          - {x-coord: distance} # expression used for Jacobian calcuation
54          - contact_x # name of expression reported
55      - soft-constraint:
56          - {double-sub: [-0.005, {y-coord: distance}]} # control law for lower
                  boundary
57          - {double-sub: [0.005, {y-coord: distance}]} # control law for upper
                  boundary
58          - constraint-weight # weight of this constraint
59          - {y-coord: distance} # expression used for Jacobian calcuation
60          - contact_y # name of expression reported
61      - soft-constraint:
62          - {double-sub: [-0.005, {z-coord: distance}]} # control law for lower
                  boundary
63          - {double-sub: [0.005, {z-coord: distance}]} # control law for upper
                  boundary
64          - constraint-weight # weight of this constraint
65          - {z-coord: distance} # expression used for Jacobian calcuation
66          - contact_z # name of expression reported
67    - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
          weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
          slack]
68    - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
          weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
          slack]
69    - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
          weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
          slack]
```

105 motions/scooping$_s$coop.yaml

```
1   scope:
2     # weights
3     - controllable-weight: 0.001 # mu * 1
4     - constraint-weight: 10.001 # mu + 10
5
6     # definition of object frames
7     - target-object-frame:
8         frame-mul:
9           - right_ee
10          - tool-grasp # This has to be provided
11
12    - tool-frame:
13        frame-mul:
14          - left_ee
15          - target-object-grasp # This has to be provided
16
17    # definition of features
18    - tool-point:
19        transform-vector: [tool-frame, {vector3: [-0.1149, -0.005, -0.0118]}]
20    - target-object-point:
21        transform-vector: [target-object-frame, {vector3: [0.018, -0.04, 0.0]}]
22
23    # expressions used in constraints
24    - distance: {vector-sub: [target-object-point, tool-point]}
25
26    - l_goal_rot:
27        rotation-mul:
28          - {axis-angle: [unit-z, 1.57]}
29          - {axis-angle: [unit-y, -0.3]}
30          - {axis-angle: [unit-x, 3.14]}
31    - l_rot: {orientation-of: tool-frame}
32    - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
        l_rot}, l_goal_rot]}}}
33    - l_rot_scaling:
34        double-if:
35        - {double-sub: [rot_thresh, l_rot_error]}
36        - 1
37        - {double-div: [rot_thresh, l_rot_error]}
38    - l_intermediate_goal_rot:
39        slerp:
40        - l_rot
41        - l_goal_rot
42        - l_rot_scaling
43    - l_rot_control:
44        scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
            mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
45
46  soft-constraints:
47    - soft-constraint:
48        - {double-sub: [-0.005, {x-coord: distance}]} # control law for lower
            boundary
49        - {double-sub: [0.005, {x-coord: distance}]} # control law for upper
            boundary
50        - constraint-weight # weight of this constraint
51        - {x-coord: distance} # expression used for Jacobian calcuation
```

```
52            - contact_x # name of expression reported
53      - soft-constraint:
54          - {double-sub: [-0.005, {y-coord: distance}]} # control law for lower
                 boundary
55          - {double-sub: [0.005, {y-coord: distance}]} # control law for upper
                 boundary
56          - constraint-weight # weight of this constraint
57          - {y-coord: distance} # expression used for Jacobian calcuation
58          - contact_y # name of expression reported
59      - soft-constraint:
60          - {double-sub: [-0.005, {z-coord: distance}]} # control law for lower
                 boundary
61          - {double-sub: [0.005, {z-coord: distance}]} # control law for upper
                 boundary
62          - constraint-weight # weight of this constraint
63          - {z-coord: distance} # expression used for Jacobian calcuation
64          - contact_z # name of expression reported
65      - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
            weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
            slack]
66      - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
            weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
            slack]
67      - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
            weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
            slack]
```

```yaml
 1  scope:
 2    # weights
 3    - controllable-weight: 0.001 # mu * 1
 4    - constraint-weight: 10.001 # mu + 10
 5
 6    # definition of object frames
 7    - target-object-frame:
 8        frame-mul:
 9          - right_ee
10          - target-object-grasp # This has to be provided
11
12    - tool-frame:
13        frame-mul:
14          - left_ee
15          - tool-grasp # This has to be provided
16
17    # definition of features
18    - tool-point:
19        transform-vector: [tool-frame, {vector3: [-0.1149, -0.005, -0.0118]}]
20    - target-object-point:
21        transform-vector: [target-object-frame, {vector3: [0.018, 0.02, 0.245]}]
22
23    # expressions used in constraints
24    - distance: {vector-sub: [target-object-point, tool-point]}
25
26    - l_goal_rot:
27        rotation-mul:
28          - {axis-angle: [unit-z, 0]}
29          - {axis-angle: [unit-y, -1.57]}
30          - {axis-angle: [unit-x, -1.57]}
31    - l_rot: {orientation-of: tool-frame}
32    - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
          l_rot}, l_goal_rot]}}}
33    - l_rot_scaling:
34        double-if:
35        - {double-sub: [rot_thresh, l_rot_error]}
36        - 1
37        - {double-div: [rot_thresh, l_rot_error]}
38    - l_intermediate_goal_rot:
39        slerp:
40        - l_rot
41        - l_goal_rot
42        - l_rot_scaling
43    - l_rot_control:
44        scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
            mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
45
46  soft-constraints:
47    - soft-constraint:
48        - {double-sub: [-0.005, {x-coord: distance}]} # control law for lower
            boundary
49        - {double-sub: [0.005, {x-coord: distance}]} # control law for upper
            boundary
50        - constraint-weight # weight of this constraint
51        - {x-coord: distance} # expression used for Jacobian calcuation
```

```
52            - contact_x # name of expression reported
53        - soft-constraint:
54            - {double-sub: [-0.005, {y-coord: distance}]} # control law for lower
                    boundary
55            - {double-sub: [0.005, {y-coord: distance}]} # control law for upper
                    boundary
56            - constraint-weight # weight of this constraint
57            - {y-coord: distance} # expression used for Jacobian calcuation
58            - contact_y # name of expression reported
59        - soft-constraint:
60            - {double-sub: [-0.005, {z-coord: distance}]} # control law for lower
                    boundary
61            - {double-sub: [0.005, {z-coord: distance}]} # control law for upper
                    boundary
62            - constraint-weight # weight of this constraint
63            - {z-coord: distance} # expression used for Jacobian calcuation
64            - contact_z # name of expression reported
65        - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
            weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
            slack]
66        - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
            weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
            slack]
67        - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
            weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
            slack]
```

```yaml
scope:
  # weights
  - controllable-weight: 0.001 # mu * 1
  - constraint-weight: 10.001 # mu + 10

  # definition of object frames
  - target-object-frame:
      frame-mul:
        - right_ee
        - tool-grasp # This has to be provided

  - tool-frame:
      frame-mul:
        - left_ee
        - target-object-grasp # This has to be provided

  # definition of features
  - tool-point:
      transform-vector: [tool-frame, {vector3: [-0.1149, -0.005, -0.0118]}]
  - target-object-point:
      transform-vector: [target-object-frame, {vector3: [0.018, -0.04, 0.245]}]

  # expressions used in constraints
  - distance: {vector-sub: [target-object-point, tool-point]}

  - l_goal_rot:
      rotation-mul:
        - {axis-angle: [unit-z, 1.57]}
        - {axis-angle: [unit-y, -0.3]}
        - {axis-angle: [unit-x, 3.14]}
  - l_rot: {orientation-of: tool-frame}
  - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
      l_rot}, l_goal_rot]}}}
  - l_rot_scaling:
      double-if:
      - {double-sub: [rot_thresh, l_rot_error]}
      - 1
      - {double-div: [rot_thresh, l_rot_error]}
  - l_intermediate_goal_rot:
      slerp:
      - l_rot
      - l_goal_rot
      - l_rot_scaling
  - l_rot_control:
      scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
          mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]

soft-constraints:
  - soft-constraint:
      - {double-sub: [-0.005, {x-coord: distance}]} # control law for lower
          boundary
      - {double-sub: [0.005, {x-coord: distance}]} # control law for upper
          boundary
      - constraint-weight # weight of this constraint
      - {x-coord: distance} # expression used for Jacobian calcuation
```

```
52            - contact_x # name of expression reported
53    - soft-constraint:
54        - {double-sub: [-0.005, {y-coord: distance}]} # control law for lower
              boundary
55        - {double-sub: [0.005, {y-coord: distance}]} # control law for upper
              boundary
56        - constraint-weight # weight of this constraint
57        - {y-coord: distance} # expression used for Jacobian calcuation
58        - contact_y # name of expression reported
59    - soft-constraint:
60        - {double-sub: [-0.005, {z-coord: distance}]} # control law for lower
              boundary
61        - {double-sub: [0.005, {z-coord: distance}]} # control law for upper
              boundary
62        - constraint-weight # weight of this constraint
63        - {z-coord: distance} # expression used for Jacobian calcuation
64        - contact_z # name of expression reported
65    - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
          weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
          slack]
66    - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
          weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
          slack]
67    - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
          weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
          slack]
```

```
1  scope:
2    # weights
3    - controllable-weight: 0.001 # mu * 1
4    - constraint-weight: 10.001 # mu + 10
5
6    # definition of object frames
7    - target-object-frame:
8        frame:
9          - quaternion: [0, 0, 0, 1]
10         - vector3: [0, 0, 1.03]
11
12   - tool-frame:
13       frame-mul:
14         - left_ee
15         - tool-grasp # This has to be provided
16
17   # definition of features
18   - tool-point:
19       transform-vector: [tool-frame, blade-point]
20   - target-object-point:
21       transform-vector:
22         - target-object-frame
23         - {vector3: [0, 0, 0.3]} # 20 cm above the object
24
25   # expressions used in constraints
26   - distance: {vector-sub: [target-object-point, tool-point]}
27
28   - l_goal_rot:
29       rotation-mul:
30         - {axis-angle: [unit-z, 3.14]}
31         - {axis-angle: [unit-y, 0]}
32         - {axis-angle: [unit-x, 1.57]}
33   - l_rot: {orientation-of: tool-frame}
34   - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
         l_rot}, l_goal_rot]}}}
35   - l_rot_scaling:
36       double-if:
37       - {double-sub: [rot_thresh, l_rot_error]}
38       - 1
39       - {double-div: [rot_thresh, l_rot_error]}
40   - l_intermediate_goal_rot:
41       slerp:
42       - l_rot
43       - l_goal_rot
44       - l_rot_scaling
45   - l_rot_control:
46       scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
           mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
47
48 soft-constraints:
49   - soft-constraint:
50       - {double-sub: [-0.005, {x-coord: distance}]} # control law for lower
             boundary
51       - {double-sub: [0.005, {x-coord: distance}]} # control law for upper
             boundary
```

```
52              - constraint-weight # weight of this constraint
53              - {x-coord: distance} # expression used for Jacobian calcuation
54              - contact_x # name of expression reported
55          - soft-constraint:
56              - {double-sub: [-0.005, {y-coord: distance}]} # control law for lower
                    boundary
57              - {double-sub: [0.005, {y-coord: distance}]} # control law for upper
                    boundary
58              - constraint-weight # weight of this constraint
59              - {y-coord: distance} # expression used for Jacobian calcuation
60              - contact_y # name of expression reported
61          - soft-constraint:
62              - {double-sub: [-0.005, {z-coord: distance}]} # control law for lower
                    boundary
63              - {double-sub: [0.005, {z-coord: distance}]} # control law for upper
                    boundary
64              - constraint-weight # weight of this constraint
65              - {z-coord: distance} # expression used for Jacobian calcuation
66              - contact_z # name of expression reported
67          - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
                weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
                slack]
68          - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
                weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
                slack]
69          - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
                weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
                slack]
```

```
1   scope:
2     # weights
3     - controllable-weight: 0.001 # mu * 1
4     - constraint-weight: 10.001 # mu + 10
5
6     # definition of object frames
7     - target-object-frame:
8         frame-mul:
9           - right_ee
10          - target-object-grasp # This has to be provided
11
12    - tool-frame:
13        frame-mul:
14          - left_ee
15          - tool-grasp # This has to be provided
16
17    # definition of features
18    - tool-point:
19        transform-vector: [tool-frame, tool-heel]
20    - target-object-point:
21        vector-add:
22          - transform-vector: [target-object-frame, edge-point]
23          - {vector3: [0, 0.3, 0]} # 30 cm next to the edgeI
24
25    # expressions used in constraints
26    - distance: {vector-sub: [target-object-point, tool-point]}
27
28    - l_goal_rot:
29        rotation-mul: [tool-quaternion, {orientation-of: target-object-frame}]
30    - l_rot: {orientation-of: tool-frame}
31    - l_rot_error: {vector-norm: {rot-vector: {rotation-mul: [{inverse-rotation:
           l_rot}, l_goal_rot]}}}
32    - l_rot_scaling:
33        double-if:
34        - {double-sub: [rot_thresh, l_rot_error]}
35        - 1
36        - {double-div: [rot_thresh, l_rot_error]}
37    - l_intermediate_goal_rot:
38        slerp:
39        - l_rot
40        - l_goal_rot
41        - l_rot_scaling
42    - l_rot_control:
43        scale-vector: [rot_p_gain, {rotate-vector: [l_rot, {rot-vector: {rotation-
             mul: [{inverse-rotation: l_rot}, l_intermediate_goal_rot]}}]}]
44
45  soft-constraints:
46    - soft-constraint:
47        - {double-sub: [-0.007, {x-coord: distance}]} # control law for lower
             boundary
48        - {double-sub: [0.007, {x-coord: distance}]} # control law for upper
             boundary
49        - constraint-weight # weight of this constraint
50        - {x-coord: distance} # expression used for Jacobian calcuation
51        - contact_x # name of expression reported
```

```
52      - soft-constraint:
53          - {double-sub: [-0.007, {y-coord: distance}]} # control law for lower
                  boundary
54          - {double-sub: [0.007, {y-coord: distance}]} # control law for upper
                  boundary
55          - constraint-weight # weight of this constraint
56          - {y-coord: distance} # expression used for Jacobian calcuation
57          - contact_y # name of expression reported
58      - soft-constraint:
59          - {double-sub: [-0.007, {z-coord: distance}]} # control law for lower
                  boundary
60          - {double-sub: [0.007, {z-coord: distance}]} # control law for upper
                  boundary
61          - constraint-weight # weight of this constraint
62          - {z-coord: distance} # expression used for Jacobian calcuation
63          - contact_z # name of expression reported
64      - soft-constraint: [{x-coord: l_rot_control}, {x-coord: l_rot_control},
            weight_rot_control, {x-coord: {rot-vector: l_rot}}, left EE x-rot control
            slack]
65      - soft-constraint: [{y-coord: l_rot_control}, {y-coord: l_rot_control},
            weight_rot_control, {y-coord: {rot-vector: l_rot}}, left EE y-rot control
            slack]
66      - soft-constraint: [{z-coord: l_rot_control}, {z-coord: l_rot_control},
            weight_rot_control, {z-coord: {rot-vector: l_rot}}, left EE z-rot control
            slack]
```

```
 1    2 :
 2
 3    grabbing_book :
 4
 5    book_on_shelf :
 6
 7   Gazebo multi-robot simulator, version 7.9.0
 8
 9   Copyright (C) 2012 Open Source Robotics Foundation.
10
11   Released under the Apache 2 License.
12
13   http://gazebosim.org
14
15
16
17
18
19   (1523469419 578143783) [Msg] Waiting for master.
20
21   (1523469419 579743814) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
22
23   (1523469419 579812029) [Msg] Publicized address: 10.0.2.15
24
25   (1523469420 28570479) Init world[grabbing_book_v]
26
27   (1523469455 458872148) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
28
29   (1523469455 516518125) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
30
31   ********************************************************************************
32
33
34
35
36
37    3 :
38
39    grabbing_book :
40
41    book_on_shelf :
42
43   Gazebo multi-robot simulator, version 7.9.0
44
45   Copyright (C) 2012 Open Source Robotics Foundation.
46
47   Released under the Apache 2 License.
48
49   http://gazebosim.org
50
51
52
```

```
(1523469619 974945991) [Msg] Waiting for master.

(1523469619 975451564) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523469619 975527984) [Msg] Publicized address: 10.0.2.15

(1523469620 465961174) Init world[grabbing_book_v]

(1523469644 45907222) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523469644 93950944) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

********************************************************************************




 4 :

 grabbing_book :

 book_on_shelf :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523469820 316048122) [Msg] Waiting for master.

(1523469820 317710775) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523469820 317787982) [Msg] Publicized address: 10.0.2.15

(1523469820 733020968) Init world[grabbing_book_v]

********************************************************************************




 5 :
```

```
106
107   grabbing_book :
108
109   book_on_shelf :
110
111  Gazebo multi-robot simulator, version 7.9.0
112
113  Copyright (C) 2012 Open Source Robotics Foundation.
114
115  Released under the Apache 2 License.
116
117  http://gazebosim.org
118
119
120
121
122
123  (1523470020 670302497) [Msg] Waiting for master.
124
125  (1523470020 679963792) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
126
127  (1523470020 680091299) [Msg] Publicized address: 10.0.2.15
128
129  (1523470021 108333806) Init world[grabbing_book_v]
130
131  (1523470033 209073539) [Dbg] [giskard_visualization_plugin.cpp:133] Created
       Marker: giskard_expressions/tool-point
132
133  (1523470033 258591214) [Dbg] [giskard_visualization_plugin.cpp:133] Created
       Marker: giskard_expressions/target-object-point
134
135  ********************************************************************************

136
137
138
139
140
141   6 :
142
143   grabbing_book :
144
145   book_on_shelf :
146
147  Gazebo multi-robot simulator, version 7.9.0
148
149  Copyright (C) 2012 Open Source Robotics Foundation.
150
151  Released under the Apache 2 License.
152
153  http://gazebosim.org
154
155
156
157
158
159  (1523470221 87256497) [Msg] Waiting for master.
```

```
160
161  (1523470221 89638472) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
162
163  (1523470221 89742897) [Msg] Publicized address: 10.0.2.15
164
165  (1523470221 518363567) Init world[grabbing_book_v]
166
167  (1523470231 503262569) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
168
169  (1523470231 550543336) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
170
171  ********************************************************************************
```

111   utilities/a_ply2dae.mlx

```
1  <!DOCTYPE FilterScript>
2  <FilterScript>
3   <filter name="Quadric␣Edge␣Collapse␣Decimation">
4    <Param type="RichInt" value="3000" name="TargetFaceNum"/>
5    <Param type="RichFloat" value="0" name="TargetPerc"/>
6    <Param type="RichFloat" value="0.3" name="QualityThr"/>
7    <Param type="RichBool" value="false" name="PreserveBoundary"/>
8    <Param type="RichFloat" value="1" name="BoundaryWeight"/>
9    <Param type="RichBool" value="false" name="PreserveNormal"/>
10   <Param type="RichBool" value="false" name="PreserveTopology"/>
11   <Param type="RichBool" value="true" name="OptimalPlacement"/>
12   <Param type="RichBool" value="false" name="PlanarQuadric"/>
13   <Param type="RichBool" value="false" name="QualityWeight"/>
14   <Param type="RichBool" value="true" name="AutoClean"/>
15   <Param type="RichBool" value="false" name="Selected"/>
16  </filter>
17  <filter name="Surface␣Reconstruction:␣Ball␣Pivoting">
18   <Param type="RichAbsPerc" value="0" min="0" name="BallRadius" max="0.296284"/>
19   <Param type="RichFloat" value="20" name="Clustering"/>
20   <Param type="RichFloat" value="90" name="CreaseThr"/>
21   <Param type="RichBool" value="false" name="DeleteFaces"/>
22  </filter>
23  </FilterScript>
```

112 msg/StopCondition.msg

```
1  float64 measured_velocity_min
2  float64 desired_velocity_min
3  bool contact
4  float64 activation_distance
```

113   src2pdf.sh

```bash
#!/usr/bin/env bash

tex_file=$(mktemp) ## Random temp file name

cat<<EOF >$tex_file    ## Print the tex file header
\documentclass{article}
\usepackage{listings}
\usepackage[usenames,dvipsnames]{color}  %% Allow color names
\lstdefinestyle{customasm}{
  belowcaptionskip=1\baselineskip,
  xleftmargin=\parindent,
  language=C++,    %% Change this to whatever you write in
  breaklines=true, %% Wrap long lines
  numbers=left,
  basicstyle=\footnotesize\ttfamily,
  commentstyle=\itshape\color{Gray},
  stringstyle=\color{Black},
  keywordstyle=\bfseries\color{OliveGreen},
  identifierstyle=\color{blue},
  xleftmargin=-8em,
}
\usepackage[colorlinks=true,linkcolor=blue]{hyperref}
\begin{document}
\tableofcontents

EOF

find . -type f ! -regex ".*/\..*" ! -name ".*" ! -name "*~" ! -name 'src2pdf' !
    -name "*.ply" ! -name "*.dae" ! -name "*.stl" ! -name "*.png" ! -name "*.mkv"
    ! -name "*.mat"|
sed 's/^\..//' |                 ## Change ./foo/bar.src to foo/bar.src

while read  i; do                ## Loop through each file
    name=${i//_/\\_}             ## escape underscores
    echo "\newpage" >> $tex_file   ## start each section on a new page
    echo "\section{$i}" >> $tex_file  ## Create a section for each filename

   ## This command will include the file in the PDF
    echo "\lstinputlisting[style=customasm]{$i}" >>$tex_file
done &&
echo "\end{document}" >> $tex_file &&
pdflatex $tex_file -output-directory . &&
pdflatex $tex_file -output-directory .  ## This needs to be run twice
                                        ## for the TOC to be generated
```

114   models/b$_r$ed$_b$owl/model.sdf

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3          <model name='b_red_bowl'>
4                  <static>false</static>
5                  <pose>0 0 0 0 0 0</pose>
6
7                  <link name='link'>
8                          <inertial>
9                          <mass>0.4</mass>
10                         <pose>8.6337e-05 -2.0434e-06 0.00068192 0 0 0</pose>
11                                 <inertia>
12                                         <ixx>1.8603e-07</ixx>
13                                         <ixy>0</ixy>
14                                         <ixz>0</ixz>
15                                         <iyy>1.8901e-07</iyy>
16                                         <iyz>0</iyz>
17                                         <izz>3.0046e-09</izz>
18                                 </inertia>
19                         </inertial>
20                         <collision name='collision'>
21                                 <geometry>
22                                         <mesh>
23                                                 <uri>model://b_red_bowl/
                                                        b_red_bowl.dae</uri>
24                                         </mesh>
25                                 </geometry>
26                                 <surface>
27                                         <friction>
28                                                 <ode>
29                                                         <mu>0.2</mu>
30                                                         <mu2>0.2</mu2>
31                                                 </ode>
32                                         </friction>
33                                 </surface>
34                         </collision>
35                         <visual name='visual'>
36                                 <geometry>
37                                         <mesh>
38                                                 <uri>model://b_red_bowl/
                                                        b_red_bowl.dae</uri>
39                                         </mesh>
40                                 </geometry>
41                         </visual>
42                 </link>
43         </model>
44  </sdf>
```

115 models/b$_r$ed$_b$owl/model.config

```
1  <?xml version="1.0"?>
2
3  <model>
4    <name>b_red_bowl</name>
5    <version>1.0</version>
6    <sdf version="1.6">model.sdf</sdf>
7
8    <author>
9      <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
           name>
10     <email>bryanwang1992@outlook.com</email>
11   </author>
12
13   <description>
14     b_red_bowl
15   </description>
16
17 </model>
```

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3       <model name='butter_box'>
4           <static>false</static>
5           <pose>0 0 0 0 0 0</pose>
6           <link name='link'>
7               <pose>0 0 0 0 0 0</pose>
8               <inertial>
9                   <mass>0.001</mass>
10                  <pose>0 0 0 0 0 0</pose>
11                  <inertia>
12                      <ixx>0.00000004167</ixx>
13                      <iyy>0.00000008333</iyy>
14                      <izz>0.00000010833</izz>
15                      <ixy>0</ixy>
16                      <ixz>0</ixz>
17                      <iyz>0</iyz>
18                  </inertia>
19              </inertial>
20              <collision name='collision'>
21                  <geometry>
22                      <box>
23                          <size>0.03 0.02 0.01</size>
24                      </box>
25                  </geometry>
26                  <surface>
27                      <friction>
28                          <ode>
29                              <mu>0.2</mu>
30                              <mu2>0.2</mu2>
31                          </ode>
32                      </friction>
33                  </surface>
34              </collision>
35              <visual name='visual'>
36                  <geometry>
37                      <box>
38                          <size>0.03 0.02 0.01</size>
39                      </box>
40                  </geometry>
41                  <material>
42                      <script>
43                          <name>Gazebo/Yellow</name>
44                          <uri>file://media/materials/scripts/gazebo.material</uri
                                >
45                      </script>
46                  </material>
47              </visual>
48          </link>
49      </model>
50  </sdf>
```

117 models/butter$_b$ox/model.config

```
1  <?xml version='1.0'?>
2
3  <model>
4    <name>butter_box</name>
5    <version>1.0</version>
6    <sdf version='1.6'>model.sdf</sdf>
7
8    <author>
9      <name>me</name>
10     <email>somebody@somewhere.com</email>
11   </author>
12
13   <description>
14     A simple box butter.
15   </description>
16 </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3      <model name='a_forkbig'>
4          <static>false</static>
5          <pose>0 0 0 0 0 0</pose>
6
7          <link name='link'>
8              <inertial>
9              <mass>0.071</mass>
10             <pose>0.0027688 8.3438e-05 -2.608e-05 0 0 0</pose>
11                 <inertia>
12                     <ixx>2.6672e-07</ixx>
13                     <ixy>0</ixy>
14                     <ixz>0</ixz>
15                     <iyy>8.0767e-07</iyy>
16                     <iyz>0</iyz>
17                     <izz>5.5867e-07</izz>
18                 </inertia>
19             </inertial>
20             <sensor name="tool_contact_sensor" type="contact">
21                 <always_on>true</always_on>
22                 <update_rate>30.0</update_rate>
23                 <contact>
24                     <collision>collision</collision>
25                 </contact>
26                 <plugin name="tool_bumper" filename="
                        libgazebo_ros_bumper.so">
27                         <bumperTopicName>
                                tool_contact_sensor_state</
                                bumperTopicName>
28                         <frameName>world</frameName>
29                 </plugin>
30             </sensor>
31             <collision name='collision'>
32                 <geometry>
33                     <mesh>
34                         <uri>model://a_forkbig/a_forkbig
                                .dae</uri>
35                     </mesh>
36                 </geometry>
37                 <surface>
38                     <friction>
39                         <ode>
40                             <mu>0.2</mu>
41                             <mu2>0.2</mu2>
42                         </ode>
43                     </friction>
44                 </surface>
45             </collision>
46             <visual name='visual'>
47                 <geometry>
48                     <mesh>
49                         <uri>model://a_forkbig/a_forkbig
                                .dae</uri>
50                     </mesh>
```

```
51                                                      </geometry>
52                                     </visual>
53                        </link>
54              </model>
55     </sdf>
```

119 models/a_forkbig/model.config

```
 1  <?xml version="1.0"?>
 2
 3  <model>
 4    <name>a_forkbig</name>
 5    <version>1.0</version>
 6    <sdf version="1.6">model.sdf</sdf>
 7
 8    <description>
 9      a_forkbig
10    </description>
11
12  </model>
```

120   models/a_siliconespatula/model.sdf

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3        <model name='a_siliconespatula'>
4            <static>false</static>
5            <pose>0 0 0 0 0 0</pose>
6
7            <link name='link'>
8                <inertial>
9                <mass>0.122</mass>
10               <pose>-0.016557 -0.0017901 -5.52e-05 0 0 0</pose>
11                   <inertia>
12                       <ixx>1.004e-06</ixx>
13                       <ixy>0</ixy>
14                       <ixz>0</ixz>
15                       <iyy>3.4e-05</iyy>
16                       <iyz>0</iyz>
17                       <izz>3.3851e-05</izz>
18                   </inertia>
19                </inertial>
20                <sensor name="tool_contact_sensor" type="contact">
21                    <always_on>true</always_on>
22                    <update_rate>30.0</update_rate>
23                    <contact>
24                        <collision>collision</collision>
25                    </contact>
26                    <plugin name="tool_bumper" filename="
                         libgazebo_ros_bumper.so">
27                        <bumperTopicName>
                             tool_contact_sensor_state</
                             bumperTopicName>
28                        <frameName>world</frameName>
29                    </plugin>
30                </sensor>
31                <collision name='collision'>
32                    <geometry>
33                        <mesh>
34                            <uri>model://a_siliconespatula/
                                 a_siliconespatula.dae</uri>
35                        </mesh>
36                    </geometry>
37                    <surface>
38                        <friction>
39                            <ode>
40                                <mu>0.2</mu>
41                                <mu2>0.2</mu2>
42                            </ode>
43                        </friction>
44                    </surface>
45                </collision>
46                <visual name='visual'>
47                    <geometry>
48                        <mesh>
49                            <uri>model://a_siliconespatula/
                                 a_siliconespatula.dae</uri>
50                        </mesh>
```

```
51                                    </geometry>
52                              </visual>
53                    </link>
54          </model>
55  </sdf>
```

121 models/a$_s$iliconespatula/model.config

```
 1  <?xml version="1.0"?>
 2
 3  <model>
 4    <name>a_siliconespatula</name>
 5    <version>1.0</version>
 6    <sdf version="1.6">model.sdf</sdf>
 7
 8    <description>
 9      a_siliconespatula
10    </description>
11
12  </model>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version='1.6'>
 3          <model name='a_bowl'>
 4                  <static>false</static>
 5                  <pose>0 0 0 0 0 0</pose>
 6
 7                  <link name='link'>
 8                          <inertial>
 9                          <mass>0.407</mass>
10                          <pose>0.0002088 0.00026134 -0.00023605 0 0 0</pose>
11                                  <inertia>
12                                          <ixx>7.6228e-06</ixx>
13                                          <ixy>0</ixy>
14                                          <ixz>0</ixz>
15                                          <iyy>3.2294e-06</iyy>
16                                          <iyz>0</iyz>
17                                          <izz>1.6555e-06</izz>
18                                  </inertia>
19                          </inertial>
20                          <collision name='collision'>
21                                  <geometry>
22                                          <mesh>
23                                                  <uri>model://a_bowl/a_bowl.dae</
                                                         uri>
24                                          </mesh>
25                                  </geometry>
26                                  <surface>
27                                          <friction>
28                                                  <ode>
29                                                          <mu>0.2</mu>
30                                                          <mu2>0.2</mu2>
31                                                  </ode>
32                                          </friction>
33                                  </surface>
34                          </collision>
35                          <visual name='visual'>
36                                  <geometry>
37                                          <mesh>
38                                                  <uri>model://a_bowl/a_bowl.dae</
                                                         uri>
39                                          </mesh>
40                                  </geometry>
41                          </visual>
42                  </link>
43          </model>
44  </sdf>
```

123 models/a$_b$owl/model.config

```xml
1  <?xml version="1.0"?>
2
3  <model>
4    <name>a_bowl</name>
5    <version>1.0</version>
6    <sdf version="1.6">model.sdf</sdf>
7
8    <author>
9      <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
            name>
10     <email>bryanwang1992@outlook.com</email>
11   </author>
12
13   <description>
14     a_bowl
15   </description>
16
17 </model>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version='1.6'>
 3        <model name='a_chineseknife'>
 4              <static>false</static>
 5              <pose>0 0 0 0 0 0</pose>
 6
 7              <link name='link'>
 8                    <inertial>
 9                    <mass>0.276</mass>
10                    <pose>0.00069033 -0.0012369 -0.00043514 0 0 0</pose>
11                          <inertia>
12                                <ixx>4.5353e-06</ixx>
13                                <ixy>0</ixy>
14                                <ixz>0</ixz>
15                                <iyy>3.0548e-06</iyy>
16                                <iyz>0</iyz>
17                                <izz>8.4999e-07</izz>
18                          </inertia>
19                    </inertial>
20                    <sensor name="tool_contact_sensor" type="contact">
21                          <always_on>true</always_on>
22                          <update_rate>30.0</update_rate>
23                          <contact>
24                                <collision>collision</collision>
25                          </contact>
26                          <plugin name="tool_bumper" filename="
                                  libgazebo_ros_bumper.so">
27                                <bumperTopicName>
                                        tool_contact_sensor_state</
                                        bumperTopicName>
28                                <frameName>world</frameName>
29                          </plugin>
30                    </sensor>
31                    <collision name='collision'>
32                          <geometry>
33                                <mesh>
34                                      <uri>model://a_chineseknife/
                                            a_chineseknife.dae</uri>
35                                </mesh>
36                          </geometry>
37                          <surface>
38                                <friction>
39                                      <ode>
40                                            <mu>0.2</mu>
41                                            <mu2>0.2</mu2>
42                                      </ode>
43                                </friction>
44                          </surface>
45                    </collision>
46                    <visual name='visual'>
47                          <geometry>
48                                <mesh>
49                                      <uri>model://a_chineseknife/
                                            a_chineseknife.dae</uri>
50                                </mesh>
```

```
51                                      </geometry>
52                                  </visual>
53                          </link>
54                  </model>
55          </sdf>
```

125 models/a$_c$hineseknife/model.config

```
 1  <?xml version="1.0"?>
 2
 3  <model>
 4    <name>a_chineseknife</name>
 5    <version>1.0</version>
 6    <sdf version="1.6">model.sdf</sdf>
 7
 8    <description>
 9      a_chineseknife
10    </description>
11
12  </model>
```

126   models/b$_p$ot/model.sdf

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3      <model name='b_pot'>
4          <static>false</static>
5          <pose>0 0 0 0 0 0</pose>
6
7          <link name='link'>
8              <inertial>
9                  <mass>0.40</mass>
10                 <pose>0.000382297035518770      -0.000149204207528814
                        0.00495379249275721 0 0 0</pose>
11                 <inertia>
12                     <ixx>7.972462473661376e-05</ixx>
13                     <ixy>0.0</ixy>
14                     <ixz>0.0</ixz>
15                     <iyy>9.743942735555959e-05</iyy>
16                     <iyz>0.0</iyz>
17                     <izz>3.897022921041362e-05</izz>
18                 </inertia>
19             </inertial>
20
21             <collision name='collision'>
22                 <geometry>
23                     <mesh>
24                         <uri>model://b_pot/b_pot.dae</uri>
25                     </mesh>
26                 </geometry>
27                 <surface>
28                     <friction>
29                         <ode>
30                             <mu>0.2</mu>
31                             <mu2>0.2</mu2>
32                         </ode>
33                     </friction>
34                 </surface>
35             </collision>
36             <visual name='visual'>
37                 <geometry>
38                     <mesh>
39                         <uri>model://b_pot/b_pot.dae</uri>
40                     </mesh>
41                 </geometry>
42             </visual>
43         </link>
44     </model>
45  </sdf>
```

127 models/b$_p$ot/model.config

```xml
1  <?xml version="1.0"?>
2
3  <model>
4      <name>b_pot</name>
5      <version>1.0</version>
6      <sdf version='1.6'>model.sdf</sdf>
7
8      <author>
9          <name>Pawel Gajewski</name>
10         <email>pawel.gajewski@agh.edu.pl</email>
11     </author>
12
13     <description>
14         IAI lab pot.
15     </description>
16 </model>
```

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3     <model name='bookshelf_'>
4       <model name='shelf'>
5         <link name='link_0'>
6           <pose frame=''>-0.007971 1.02332 0.68125 0 -0 0</pose>
7           <inertial>
8             <mass>1</mass>
9             <inertia>
10              <ixx>0.166667</ixx>
11              <ixy>0</ixy>
12              <ixz>0</ixz>
13              <iyy>0.166667</iyy>
14              <iyz>0</iyz>
15              <izz>0.166667</izz>
16            </inertia>
17            <pose frame=''>0 0 0 0 -0 0</pose>
18          </inertial>
19          <gravity>1</gravity>
20          <self_collide>0</self_collide>
21          <kinematic>0</kinematic>
22          <visual name='visual'>
23            <pose frame=''>0 0 0 0 -0 0</pose>
24            <geometry>
25              <box>
26                <size>0.05 1 0.5</size>
27              </box>
28            </geometry>
29            <material>
30              <lighting>1</lighting>
31              <script>
32                <uri>file://media/materials/scripts/gazebo.material</uri>
33                <name>Gazebo/Grey</name>
34              </script>
35              <ambient>0.3 0.3 0.3 1</ambient>
36              <diffuse>0.7 0.7 0.7 1</diffuse>
37              <specular>0.01 0.01 0.01 1</specular>
38              <emissive>0 0 0 1</emissive>
39              <shader type='vertex'>
40                <normal_map>__default__</normal_map>
41              </shader>
42            </material>
43            <transparency>0</transparency>
44            <cast_shadows>1</cast_shadows>
45          </visual>
46          <collision name='collision'>
47            <laser_retro>0</laser_retro>
48            <max_contacts>10</max_contacts>
49            <pose frame=''>0 0 0 0 -0 0</pose>
50            <geometry>
51              <box>
52                <size>0.05 1 0.5</size>
53              </box>
54            </geometry>
```

```xml
55                <surface>
56                  <friction>
57                    <ode>
58                      <mu>1</mu>
59                      <mu2>1</mu2>
60                      <fdir1>0 0 0</fdir1>
61                      <slip1>0</slip1>
62                      <slip2>0</slip2>
63                    </ode>
64                    <torsional>
65                      <coefficient>1</coefficient>
66                      <patch_radius>0</patch_radius>
67                      <surface_radius>0</surface_radius>
68                      <use_patch_radius>1</use_patch_radius>
69                      <ode>
70                        <slip>0</slip>
71                      </ode>
72                    </torsional>
73                  </friction>
74                  <bounce>
75                    <restitution_coefficient>0</restitution_coefficient>
76                    <threshold>1e+06</threshold>
77                  </bounce>
78                  <contact>
79                    <collide_without_contact>0</collide_without_contact>
80                    <collide_without_contact_bitmask>1</
                          collide_without_contact_bitmask>
81                    <collide_bitmask>1</collide_bitmask>
82                    <ode>
83                      <soft_cfm>0</soft_cfm>
84                      <soft_erp>0.2</soft_erp>
85                      <kp>1e+13</kp>
86                      <kd>1</kd>
87                      <max_vel>0.01</max_vel>
88                      <min_depth>0</min_depth>
89                    </ode>
90                    <bullet>
91                      <split_impulse>1</split_impulse>
92                      <split_impulse_penetration_threshold>-0.01</
                            split_impulse_penetration_threshold>
93                      <soft_cfm>0</soft_cfm>
94                      <soft_erp>0.2</soft_erp>
95                      <kp>1e+13</kp>
96                      <kd>1</kd>
97                    </bullet>
98                  </contact>
99                </surface>
100           </collision>
101         </link>
102         <link name='link_0_clone'>
103           <pose frame=''>0.167029 1.02332 0.45625 0 -0 0</pose>
104           <inertial>
105             <mass>1</mass>
106             <inertia>
107               <ixx>0.166667</ixx>
108               <ixy>0</ixy>
109               <ixz>0</ixz>
```

```
110                    <iyy>0.166667</iyy>
111                    <iyz>0</iyz>
112                    <izz>0.166667</izz>
113                  </inertia>
114                  <pose frame=''>0 0 0 0 -0 0</pose>
115                </inertial>
116                <self_collide>0</self_collide>
117                <kinematic>0</kinematic>
118                <gravity>1</gravity>
119                <visual name='visual'>
120                  <pose frame=''>0 0 0 0 -0 0</pose>
121                  <geometry>
122                    <box>
123                      <size>0.3 1 0.05</size>
124                    </box>
125                  </geometry>
126                  <material>
127                    <lighting>1</lighting>
128                    <script>
129                      <uri>file://media/materials/scripts/gazebo.material</uri>
130                      <name>Gazebo/Grey</name>
131                    </script>
132                    <ambient>0.3 0.3 0.3 1</ambient>
133                    <diffuse>0.7 0.7 0.7 1</diffuse>
134                    <specular>0.01 0.01 0.01 1</specular>
135                    <emissive>0 0 0 1</emissive>
136                    <shader type='vertex'>
137                      <normal_map>__default__</normal_map>
138                    </shader>
139                  </material>
140                  <transparency>0</transparency>
141                  <cast_shadows>1</cast_shadows>
142                </visual>
143                <collision name='collision'>
144                  <laser_retro>0</laser_retro>
145                  <max_contacts>10</max_contacts>
146                  <pose frame=''>0 0 0 0 -0 0</pose>
147                  <geometry>
148                    <box>
149                      <size>0.3 1 0.05</size>
150                    </box>
151                  </geometry>
152                  <surface>
153                    <friction>
154                      <ode>
155                        <mu>1</mu>
156                        <mu2>1</mu2>
157                        <fdir1>0 0 0</fdir1>
158                        <slip1>0</slip1>
159                        <slip2>0</slip2>
160                      </ode>
161                      <torsional>
162                        <coefficient>1</coefficient>
163                        <patch_radius>0</patch_radius>
164                        <surface_radius>0</surface_radius>
165                        <use_patch_radius>1</use_patch_radius>
166                        <ode>
```

```
167                      <slip>0</slip>
168                    </ode>
169                  </torsional>
170                </friction>
171                <bounce>
172                  <restitution_coefficient>0</restitution_coefficient>
173                  <threshold>1e+06</threshold>
174                </bounce>
175                <contact>
176                  <collide_without_contact>0</collide_without_contact>
177                  <collide_without_contact_bitmask>1</
                        collide_without_contact_bitmask>
178                  <collide_bitmask>1</collide_bitmask>
179                  <ode>
180                    <soft_cfm>0</soft_cfm>
181                    <soft_erp>0.2</soft_erp>
182                    <kp>1e+13</kp>
183                    <kd>1</kd>
184                    <max_vel>0.01</max_vel>
185                    <min_depth>0</min_depth>
186                  </ode>
187                  <bullet>
188                    <split_impulse>1</split_impulse>
189                    <split_impulse_penetration_threshold>-0.01</
                        split_impulse_penetration_threshold>
190                    <soft_cfm>0</soft_cfm>
191                    <soft_erp>0.2</soft_erp>
192                    <kp>1e+13</kp>
193                    <kd>1</kd>
194                  </bullet>
195                </contact>
196              </surface>
197            </collision>
198          </link>
199          <link name='link_0_clone_0'>
200            <pose frame=''>0.142029 1.54832 0.68125 0 -0 0</pose>
201            <inertial>
202              <mass>1</mass>
203              <inertia>
204                <ixx>0.166667</ixx>
205                <ixy>0</ixy>
206                <ixz>0</ixz>
207                <iyy>0.166667</iyy>
208                <iyz>0</iyz>
209                <izz>0.166667</izz>
210              </inertia>
211              <pose frame=''>0 0 0 0 -0 0</pose>
212            </inertial>
213            <self_collide>0</self_collide>
214            <kinematic>0</kinematic>
215            <gravity>1</gravity>
216            <visual name='visual'>
217              <pose frame=''>0 0 0 0 -0 0</pose>
218              <geometry>
219                <box>
220                  <size>0.35 0.05 0.5</size>
221                </box>
```

```
222                </geometry>
223                <material>
224                  <lighting>1</lighting>
225                  <script>
226                    <uri>file://media/materials/scripts/gazebo.material</uri>
227                    <name>Gazebo/Grey</name>
228                  </script>
229                  <ambient>0.3 0.3 0.3 1</ambient>
230                  <diffuse>0.7 0.7 0.7 1</diffuse>
231                  <specular>0.01 0.01 0.01 1</specular>
232                  <emissive>0 0 0 1</emissive>
233                  <shader type='vertex'>
234                    <normal_map>__default__</normal_map>
235                  </shader>
236                </material>
237                <transparency>0</transparency>
238                <cast_shadows>1</cast_shadows>
239              </visual>
240              <collision name='collision'>
241                <laser_retro>0</laser_retro>
242                <max_contacts>10</max_contacts>
243                <pose frame=''>0 0 0 0 -0 0</pose>
244                <geometry>
245                  <box>
246                    <size>0.35 0.05 0.5</size>
247                  </box>
248                </geometry>
249                <surface>
250                  <friction>
251                    <ode>
252                      <mu>1</mu>
253                      <mu2>1</mu2>
254                      <fdir1>0 0 0</fdir1>
255                      <slip1>0</slip1>
256                      <slip2>0</slip2>
257                    </ode>
258                    <torsional>
259                      <coefficient>1</coefficient>
260                      <patch_radius>0</patch_radius>
261                      <surface_radius>0</surface_radius>
262                      <use_patch_radius>1</use_patch_radius>
263                      <ode>
264                        <slip>0</slip>
265                      </ode>
266                    </torsional>
267                  </friction>
268                  <bounce>
269                    <restitution_coefficient>0</restitution_coefficient>
270                    <threshold>1e+06</threshold>
271                  </bounce>
272                  <contact>
273                    <collide_without_contact>0</collide_without_contact>
274                    <collide_without_contact_bitmask>1</
                         collide_without_contact_bitmask>
275                    <collide_bitmask>1</collide_bitmask>
276                    <ode>
277                      <soft_cfm>0</soft_cfm>
```

```
278                     <soft_erp>0.2</soft_erp>
279                     <kp>1e+13</kp>
280                     <kd>1</kd>
281                     <max_vel>0.01</max_vel>
282                     <min_depth>0</min_depth>
283                   </ode>
284                   <bullet>
285                     <split_impulse>1</split_impulse>
286                     <split_impulse_penetration_threshold>-0.01</
                             split_impulse_penetration_threshold>
287                     <soft_cfm>0</soft_cfm>
288                     <soft_erp>0.2</soft_erp>
289                     <kp>1e+13</kp>
290                     <kd>1</kd>
291                   </bullet>
292                 </contact>
293               </surface>
294             </collision>
295           </link>
296           <link name='link_0_clone_0_clone'>
297             <pose frame=''>0.142028 0.498323 0.68125 0 -0 0</pose>
298             <inertial>
299               <mass>1</mass>
300               <inertia>
301                 <ixx>0.166667</ixx>
302                 <ixy>0</ixy>
303                 <ixz>0</ixz>
304                 <iyy>0.166667</iyy>
305                 <iyz>0</iyz>
306                 <izz>0.166667</izz>
307               </inertia>
308               <pose frame=''>0 0 0 0 -0 0</pose>
309             </inertial>
310             <self_collide>0</self_collide>
311             <kinematic>0</kinematic>
312             <gravity>1</gravity>
313             <visual name='visual'>
314               <pose frame=''>0 0 0 0 -0 0</pose>
315               <geometry>
316                 <box>
317                   <size>0.35 0.05 0.5</size>
318                 </box>
319               </geometry>
320               <material>
321                 <lighting>1</lighting>
322                 <script>
323                   <uri>file://media/materials/scripts/gazebo.material</uri>
324                   <name>Gazebo/Grey</name>
325                 </script>
326                 <ambient>0.3 0.3 0.3 1</ambient>
327                 <diffuse>0.7 0.7 0.7 1</diffuse>
328                 <specular>0.01 0.01 0.01 1</specular>
329                 <emissive>0 0 0 1</emissive>
330                 <shader type='vertex'>
331                   <normal_map>__default__</normal_map>
332                 </shader>
333               </material>
```

```
334            <transparency>0</transparency>
335            <cast_shadows>1</cast_shadows>
336          </visual>
337          <collision name='collision'>
338            <laser_retro>0</laser_retro>
339            <max_contacts>10</max_contacts>
340            <pose frame=''>0 0 0 0 -0 0</pose>
341            <geometry>
342              <box>
343                <size>0.35 0.05 0.5</size>
344              </box>
345            </geometry>
346            <surface>
347              <friction>
348                <ode>
349                  <mu>1</mu>
350                  <mu2>1</mu2>
351                  <fdir1>0 0 0</fdir1>
352                  <slip1>0</slip1>
353                  <slip2>0</slip2>
354                </ode>
355                <torsional>
356                  <coefficient>1</coefficient>
357                  <patch_radius>0</patch_radius>
358                  <surface_radius>0</surface_radius>
359                  <use_patch_radius>1</use_patch_radius>
360                  <ode>
361                    <slip>0</slip>
362                  </ode>
363                </torsional>
364              </friction>
365              <bounce>
366                <restitution_coefficient>0</restitution_coefficient>
367                <threshold>1e+06</threshold>
368              </bounce>
369              <contact>
370                <collide_without_contact>0</collide_without_contact>
371                <collide_without_contact_bitmask>1</
                      collide_without_contact_bitmask>
372                <collide_bitmask>1</collide_bitmask>
373                <ode>
374                  <soft_cfm>0</soft_cfm>
375                  <soft_erp>0.2</soft_erp>
376                  <kp>1e+13</kp>
377                  <kd>1</kd>
378                  <max_vel>0.01</max_vel>
379                  <min_depth>0</min_depth>
380                </ode>
381                <bullet>
382                  <split_impulse>1</split_impulse>
383                  <split_impulse_penetration_threshold>-0.01</
                      split_impulse_penetration_threshold>
384                  <soft_cfm>0</soft_cfm>
385                  <soft_erp>0.2</soft_erp>
386                  <kp>1e+13</kp>
387                  <kd>1</kd>
388                </bullet>
```

```
389                </contact>
390              </surface>
391            </collision>
392          </link>
393          <joint name='link_0_clone_JOINT_0' type='fixed'>
394            <parent>link_0_clone</parent>
395            <child>link_0</child>
396            <pose frame=''>0 0 0 0 -0 0</pose>
397            <physics>
398              <ode>
399                <limit>
400                  <cfm>0</cfm>
401                  <erp>0.2</erp>
402                </limit>
403                <suspension>
404                  <cfm>0</cfm>
405                  <erp>0.2</erp>
406                </suspension>
407              </ode>
408            </physics>
409          </joint>
410          <joint name='link_0_clone_JOINT_1' type='fixed'>
411            <parent>link_0_clone</parent>
412            <child>link_0_clone_0_clone</child>
413            <pose frame=''>0 0 0 0 -0 0</pose>
414            <physics>
415              <ode>
416                <limit>
417                  <cfm>0</cfm>
418                  <erp>0.2</erp>
419                </limit>
420                <suspension>
421                  <cfm>0</cfm>
422                  <erp>0.2</erp>
423                </suspension>
424              </ode>
425            </physics>
426          </joint>
427          <joint name='link_0_clone_JOINT_2' type='fixed'>
428            <parent>link_0_clone</parent>
429            <child>link_0_clone_0</child>
430            <pose frame=''>0 0 0 0 -0 0</pose>
431            <physics>
432              <ode>
433                <limit>
434                  <cfm>0</cfm>
435                  <erp>0.2</erp>
436                </limit>
437                <suspension>
438                  <cfm>0</cfm>
439                  <erp>0.2</erp>
440                </suspension>
441              </ode>
442            </physics>
443          </joint>
444          <static>1</static>
445          <allow_auto_disable>1</allow_auto_disable>
```

```
446          <pose frame=''>0 -2e-06 0 0 -0 0</pose>
447        </model>
448        <static>1</static>
449        <allow_auto_disable>1</allow_auto_disable>
450      </model>
451    </sdf>
```

129   models/bookshelf/model.config

```xml
1   <?xml version="1.0" ?>
2   <model>
3       <name>bookshelf</name>
4       <version>1.0</version>
5       <sdf version="1.6">model.sdf</sdf>
6       <author>
7           <name></name>
8           <email></email>
9       </author>
10      <description></description>
11  </model>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version='1.6'>
 3          <model name='b_red_mug'>
 4                  <static>false</static>
 5                  <pose>0 0 0 0 0 0</pose>
 6
 7                  <link name='link'>
 8                          <inertial>
 9                          <mass>0.096</mass>
10                          <pose>-0.00011045 0.0017861 0.0028209 0 0 0</pose>
11                                  <inertia>
12                                          <ixx>1.66e-06</ixx>
13                                          <ixy>0</ixy>
14                                          <ixz>0</ixz>
15                                          <iyy>1.357e-06</iyy>
16                                          <iyz>0</iyz>
17                                          <izz>7.1669e-07</izz>
18                                  </inertia>
19                          </inertial>
20                          <collision name='collision'>
21                                  <geometry>
22                                          <mesh>
23                                                  <uri>model://b_red_mug/b_red_mug
                                                        .dae</uri>
24                                          </mesh>
25                                  </geometry>
26                                  <surface>
27                                          <friction>
28                                                  <ode>
29                                                          <mu>0.2</mu>
30                                                          <mu2>0.2</mu2>
31                                                  </ode>
32                                          </friction>
33                                  </surface>
34                          </collision>
35                          <visual name='visual'>
36                                  <geometry>
37                                          <mesh>
38                                                  <uri>model://b_red_mug/b_red_mug
                                                        .dae</uri>
39                                          </mesh>
40                                  </geometry>
41                          </visual>
42                  </link>
43          </model>
44  </sdf>
```

131 models/b$_red_m$ug/model.config

```
 1  <?xml version="1.0"?>
 2
 3  <model>
 4    <name>b_red_mug</name>
 5    <version>1.0</version>
 6    <sdf version="1.6">model.sdf</sdf>
 7
 8    <author>
 9      <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
          name>
10      <email>bryanwang1992@outlook.com</email>
11    </author>
12
13    <description>
14      b_red_mug
15    </description>
16
17  </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3       <model name='a_choppingboard'>
4            <static>false</static>
5            <pose>0 0 0 0 0 0</pose>
6
7            <link name='link'>
8                 <inertial>
9                 <mass>0.765</mass>
10                <pose>0.00010961 -0.0013907 6.2505e-05 0 0 0</pose>
11                     <inertia>
12                          <ixx>4.7457e-06</ixx>
13                          <ixy>0</ixy>
14                          <ixz>0</ixz>
15                          <iyy>7.247e-06</iyy>
16                          <iyz>0</iyz>
17                          <izz>1.4229e-05</izz>
18                     </inertia>
19                </inertial>
20                <collision name='collision'>
21                     <geometry>
22                          <mesh>
23                               <uri>model://a_choppingboard/
                                    a_choppingboard.dae</uri>
24                          </mesh>
25                     </geometry>
26                     <surface>
27                          <friction>
28                               <ode>
29                                    <mu>0.2</mu>
30                                    <mu2>0.2</mu2>
31                               </ode>
32                          </friction>
33                     </surface>
34                </collision>
35                <visual name='visual'>
36                     <geometry>
37                          <mesh>
38                               <uri>model://a_choppingboard/
                                    a_choppingboard.dae</uri>
39                          </mesh>
40                     </geometry>
41                </visual>
42           </link>
43      </model>
44  </sdf>
```

133   models/a_choppingboard/model.config

```
1   <?xml version="1.0"?>
2
3   <model>
4     <name>a_choppingboard</name>
5     <version>1.0</version>
6     <sdf version="1.6">model.sdf</sdf>
7
8     <description>
9       a_choppingboard
10    </description>
11
12  </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3        <model name='a_spatulawoodgap2'>
4              <static>false</static>
5              <pose>0 0 0 0 0 0</pose>
6
7              <link name='link'>
8                    <inertial>
9                    <mass>0.12</mass>
10                   <pose>-0.040624 -0.010626 5.3115e-05 0 0 0</pose>
11                         <inertia>
12                               <ixx>1.3576e-05</ixx>
13                               <ixy>0</ixy>
14                               <ixz>0</ixz>
15                               <iyy>0.00019859</iyy>
16                               <iyz>0</iyz>
17                               <izz>0.00021235</izz>
18                         </inertia>
19                   </inertial>
20                   <sensor name="tool_contact_sensor" type="contact">
21                         <always_on>true</always_on>
22                         <update_rate>30.0</update_rate>
23                         <contact>
24                               <collision>collision</collision>
25                         </contact>
26                         <plugin name="tool_bumper" filename="
                                libgazebo_ros_bumper.so">
27                               <bumperTopicName>
                                       tool_contact_sensor_state</
                                       bumperTopicName>
28                               <frameName>world</frameName>
29                         </plugin>
30                   </sensor>
31                   <collision name='collision'>
32                         <geometry>
33                               <mesh>
34                                     <uri>model://a_spatulawoodgap2/
                                            a_spatulawoodgap2.dae</uri>
35                               </mesh>
36                         </geometry>
37                         <surface>
38                               <friction>
39                                     <ode>
40                                           <mu>0.2</mu>
41                                           <mu2>0.2</mu2>
42                                     </ode>
43                               </friction>
44                         </surface>
45                   </collision>
46                   <visual name='visual'>
47                         <geometry>
48                               <mesh>
49                                     <uri>model://a_spatulawoodgap2/
                                            a_spatulawoodgap2.dae</uri>
50                               </mesh>
```

```
51                                    </geometry>
52                                </visual>
53                         </link>
54              </model>
55     </sdf>
```

135　models/a$_s$*patulawoodgap2/model.config*

```
 1  <?xml version="1.0"?>
 2
 3  <model>
 4    <name>a_spatulawoodgap2</name>
 5    <version>1.0</version>
 6    <sdf version="1.6">model.sdf</sdf>
 7
 8    <description>
 9      a_spatulawoodgap2
10    </description>
11
12  </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3      <model name='b_knife'>
4          <static>false</static>
5          <pose>0 0 0 0 0 0</pose>
6
7          <link name='link'>
8              <inertial>
9                  <mass>0.40</mass>
10                 <pose>0.000382297035518770        -0.000149204207528814
                       0.00495379249275721 0 0 0</pose>
11                 <inertia>
12                     <ixx>7.972462473661376e-05</ixx>
13                     <ixy>0.0</ixy>
14                     <ixz>0.0</ixz>
15                     <iyy>9.743942735555959e-05</iyy>
16                     <iyz>0.0</iyz>
17                     <izz>3.897022921041362e-05</izz>
18                 </inertia>
19             </inertial>
20             <sensor name="tool_contact_sensor" type="contact">
21                             <always_on>true</always_on>
22                             <update_rate>30.0</update_rate>
23                             <contact>
24                                     <collision>collision</collision>
25                             </contact>
26                             <plugin name="tool_bumper" filename="
                                   libgazebo_ros_bumper.so">
27                                     <bumperTopicName>
                                           tool_contact_sensor_state</
                                           bumperTopicName>
28                                     <frameName>world</frameName>
29                             </plugin>
30                 </sensor>
31             <collision name='collision'>
32                 <geometry>
33                     <mesh>
34                         <uri>model://b_knife/b_knife.dae</uri>
35                     </mesh>
36                 </geometry>
37                 <surface>
38                     <friction>
39                         <ode>
40                             <mu>0.2</mu>
41                             <mu2>0.2</mu2>
42                         </ode>
43                     </friction>
44                 </surface>
45             </collision>
46             <visual name='visual'>
47                 <geometry>
48                     <mesh>
49                         <uri>model://b_knife/b_knife.dae</uri>
50                     </mesh>
51                 </geometry>
```

```
52                </visual>
53            </link>
54        </model>
55    </sdf>
```

137 models/b$_k$*nife/model.config*

```
1   <?xml version="1.0"?>
2
3   <model>
4       <name>b_knife</name>
5       <version>1.0</version>
6       <sdf version='1.6'>model.sdf</sdf>
7
8       <author>
9           <name>Pawel Gajewski</name>
10          <email>pawel.gajewski@agh.edu.pl</email>
11      </author>
12
13      <description>
14          IAI lab knife.
15      </description>
16  </model>
```

```
 1  <?xml version="1.0" ?>
 2  <sdf version="1.5">
 3    <model name="table">
 4      <static>true</static>
 5      <link name="link">
 6        <collision name="surface">
 7          <pose>0 0 1.0 0 0 0</pose>
 8          <geometry>
 9            <box>
10              <size>1.5 0.8 0.03</size>
11            </box>
12          </geometry>
13          <surface>
14            <friction>
15              <ode>
16                <mu>0.6</mu>
17                <mu2>0.6</mu2>
18              </ode>
19            </friction>
20          </surface>
21        </collision>
22        <visual name="visual1">
23          <pose>0 0 1.0 0 0 0</pose>
24          <geometry>
25            <box>
26              <size>1.5 0.8 0.03</size>
27            </box>
28          </geometry>
29          <material>
30            <script>
31              <uri>file://media/materials/scripts/gazebo.material</uri>
32              <name>Gazebo/Wood</name>
33            </script>
34          </material>
35        </visual>
36        <collision name="front_left_leg">
37          <pose>0.68 0.38 0.5 0 0 0</pose>
38          <geometry>
39            <cylinder>
40              <radius>0.02</radius>
41              <length>1.0</length>
42            </cylinder>
43          </geometry>
44        </collision>
45        <visual name="front_left_leg">
46          <pose>0.68 0.38 0.5 0 0 0</pose>
47          <geometry>
48            <cylinder>
49              <radius>0.02</radius>
50              <length>1.0</length>
51            </cylinder>
52          </geometry>
53          <material>
54            <script>
55              <uri>file://media/materials/scripts/gazebo.material</uri>
```

```
56          <name>Gazebo/Grey</name>
57        </script>
58      </material>
59    </visual>
60    <collision name="front_right_leg">
61      <pose>0.68 -0.38 0.5 0 0 0</pose>
62      <geometry>
63        <cylinder>
64          <radius>0.02</radius>
65          <length>1.0</length>
66        </cylinder>
67      </geometry>
68    </collision>
69    <visual name="front_right_leg">
70      <pose>0.68 -0.38 0.5 0 0 0</pose>
71      <geometry>
72        <cylinder>
73          <radius>0.02</radius>
74          <length>1.0</length>
75        </cylinder>
76      </geometry>
77      <material>
78        <script>
79          <uri>file://media/materials/scripts/gazebo.material</uri>
80          <name>Gazebo/Grey</name>
81        </script>
82      </material>
83    </visual>
84    <collision name="back_right_leg">
85      <pose>-0.68 -0.38 0.5 0 0 0</pose>
86      <geometry>
87        <cylinder>
88          <radius>0.02</radius>
89          <length>1.0</length>
90        </cylinder>
91      </geometry>
92    </collision>
93    <visual name="back_right_leg">
94      <pose>-0.68 -0.38 0.5 0 0 0</pose>
95      <geometry>
96        <cylinder>
97          <radius>0.02</radius>
98          <length>1.0</length>
99        </cylinder>
100     </geometry>
101     <material>
102       <script>
103         <uri>file://media/materials/scripts/gazebo.material</uri>
104         <name>Gazebo/Grey</name>
105       </script>
106     </material>
107   </visual>
108   <collision name="back_left_leg">
109     <pose>-0.68 0.38 0.5 0 0 0</pose>
110     <geometry>
111       <cylinder>
112         <radius>0.02</radius>
```

```
113              <length>1.0</length>
114            </cylinder>
115          </geometry>
116        </collision>
117        <visual name="back_left_leg">
118          <pose>-0.68 0.38 0.5 0 0 0</pose>
119          <geometry>
120            <cylinder>
121              <radius>0.02</radius>
122              <length>1.0</length>
123            </cylinder>
124          </geometry>
125          <material>
126            <script>
127              <uri>file://media/materials/scripts/gazebo.material</uri>
128              <name>Gazebo/Grey</name>
129            </script>
130          </material>
131        </visual>
132      </link>
133    </model>
134  </sdf>
```

139 models/table/model.config

```xml
1  <?xml version="1.0"?>
2
3  <model>
4    <name>table</name>
5    <version>1.0</version>
6    <sdf version="1.6">model.sdf</sdf>
7
8    <author>
9      <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</name>
10     <email>bryanwang1992@outlook.com</email>
11   </author>
12
13   <description>
14     a table
15   </description>
16
17 </model>
```

140   models/gripper/model.sdf

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3      <model name='gripper'>
4          <static>false</static>
5          <allow_auto_disable>false</allow_auto_disable>
6
7          <pose>0 0 0 0 0 0</pose>
8
9          <link name='link'>
10             <pose>0 0 0 0 0 0</pose>
11
12             <!-- <inertial>
13                 <mass>5.0</mass>
14                 <pose>0 0 0 0 0 0</pose>
15                 <inertia>
16                     <ixx>0.0008</ixx>
17                     <iyy>0.0008</iyy>
18                     <izz>0.0008</izz>
19                 </inertia>
20             </inertial> -->
21
22             <gravity>false</gravity>
23
24 <!--            <collision name='collision'>-->
25 <!--                <geometry>-->
26 <!--                    <sphere>-->
27 <!--                        <radius>0.02</radius>-->
28 <!--                    </sphere>-->
29 <!--                </geometry>-->
30 <!--            </collision>-->
31
32             <visual name='visual'>
33                 <geometry>
34                     <sphere>
35                         <radius>0.02</radius>
36                     </sphere>
37                 </geometry>
38             </visual>
39
40         </link>
41     </model>
42  </sdf>
```

141   models/gripper/model.config

```
1  <?xml version='1.0'?>
2
3  <model>
4    <name>gripper</name>
5    <version>1.0</version>
6    <sdf version='1.6'>model.sdf</sdf>
7
8    <author>
9      <name>me</name>
10     <email>somebody@somewhere.com</email>
11   </author>
12
13   <description>
14     A simple gripper.
15   </description>
16 </model>
```

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3       <model name='b_serving_spoon'>
4           <static>false</static>
5           <pose>0 0 0 0 0 0</pose>
6
7           <link name='link'>
8               <inertial>
9                   <mass>0.15</mass>
10                  <pose>0.0019638 -6.1791e-05 0.00018857 0 0 0</pose>
11                  <inertia>
12                      <ixx>0.0000075</ixx>
13                      <iyy>0.00112875</iyy>
14                      <izz>0.00112875</izz>
15                  </inertia>
16              </inertial>
17              <sensor name="tool_contact_sensor" type="contact">
18                  <always_on>true</always_on>
19                  <update_rate>30.0</update_rate>
20                  <contact>
21                      <collision>collision</collision>
22                  </contact>
23                  <plugin name="tool_bumper" filename="
                        libgazebo_ros_bumper.so">
24                      <bumperTopicName>
                            tool_contact_sensor_state</
                            bumperTopicName>
25                      <frameName>world</frameName>
26                  </plugin>
27              </sensor>
28              <collision name='collision'>
29                  <geometry>
30                      <mesh>
31                          <uri>model://b_serving_spoon/
                                b_serving_spoon.dae</uri>
32                      </mesh>
33                  </geometry>
34                  <surface>
35                      <friction>
36                          <ode>
37                              <mu>0.2</mu>
38                              <mu2>0.2</mu2>
39                          </ode>
40                      </friction>
41                  </surface>
42              </collision>
43              <visual name='visual'>
44                  <geometry>
45                      <mesh>
46                          <uri>model://b_serving_spoon/
                                b_serving_spoon.dae</uri>
47                      </mesh>
48                  </geometry>
49              </visual>
50          </link>
```

```
51            </model>
52    </sdf>
```

143   models/b$_s$erving$_s$poon/model.config

```xml
<?xml version="1.0"?>

<model>
  <name>b_serving_spoon</name>
  <version>1.0</version>
  <sdf version="1.6">model.sdf</sdf>

  <author>
    <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</name>
    <email>bryanwang1992@outlook.com</email>
  </author>

  <description>
    b_serving_spoon
  </description>

</model>
```

144 models/b$_c$offee_cup/model.sdf

```
 1  <?xml version='1.0'?>
 2  <sdf version='1.6'>
 3      <model name='b_coffee_cup'>
 4          <static>false</static>
 5          <pose>0 0 0 0 0 0</pose>
 6
 7          <link name='link'>
 8              <inertial>
 9                  <mass>0.1</mass>
10                  <pose>-2.03e-05 0.001225 -0.00019831 0 0 0</pose>
11                  <inertia>
12                      <ixx>7.571e-07</ixx>
13                      <ixy>0</ixy>
14                      <ixz>0</ixz>
15                      <iyy>6.1374e-07</iyy>
16                      <iyz>0</iyz>
17                      <izz>6.0131e-07</izz>
18                  </inertia>
19              </inertial>
20              <collision name='collision'>
21                  <geometry>
22                      <mesh>
23                          <uri>model://b_coffee_cup/
                                 b_coffee_cup.dae</uri>
24                      </mesh>
25                  </geometry>
26                  <surface>
27                      <friction>
28                          <ode>
29                              <mu>0.2</mu>
30                              <mu2>0.2</mu2>
31                          </ode>
32                      </friction>
33                  </surface>
34              </collision>
35              <visual name='visual'>
36                  <geometry>
37                      <mesh>
38                          <uri>model://b_coffee_cup/
                                 b_coffee_cup.dae</uri>
39                      </mesh>
40                  </geometry>
41              </visual>
42          </link>
43      </model>
44  </sdf>
```

145   models/b$_coffee_cup$/model.config

```
1  <?xml version="1.0"?>
2
3  <model>
4    <name>b_coffee_cup</name>
5    <version>1.0</version>
6    <sdf version="1.6">model.sdf</sdf>
7
8    <author>
9      <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
          name>
10     <email>bryanwang1992@outlook.com</email>
11   </author>
12
13   <description>
14     b_coffeecup
15   </description>
16
17  </model>
```

146   models/b$_w$ildo$_b$owl/model.sdf

```xml
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3      <model name='b_wildo_bowl'>
4          <static>false</static>
5          <pose>0 0 0 0 0 0</pose>
6
7          <link name='link'>
8              <inertial>
9                  <mass>0.40</mass>
10                 <pose>0.000382297035518770       -0.000149204207528814
                       0.00495379249275721 0 0 0</pose>
11                 <inertia>
12                     <ixx>7.972462473661376e-05</ixx>
13                     <ixy>0.0</ixy>
14                     <ixz>0.0</ixz>
15                     <iyy>9.743942735555959e-05</iyy>
16                     <iyz>0.0</iyz>
17                     <izz>3.897022921041362e-05</izz>
18                 </inertia>
19             </inertial>
20
21             <collision name='collision'>
22                 <geometry>
23                     <mesh>
24                         <uri>model://b_wildo_bowl/b_wildo_bowl.dae</uri>
25                     </mesh>
26                 </geometry>
27                 <surface>
28                     <friction>
29                         <ode>
30                             <mu>0.2</mu>
31                             <mu2>0.2</mu2>
32                         </ode>
33                     </friction>
34                 </surface>
35             </collision>
36             <visual name='visual'>
37                 <geometry>
38                     <mesh>
39                         <uri>model://b_wildo_bowl/b_wildo_bowl.dae</uri>
40                     </mesh>
41                 </geometry>
42             </visual>
43         </link>
44     </model>
45 </sdf>
```

147   models/b$_w$ildo$_b$owl/model.config

```
1   <?xml version="1.0"?>
2
3   <model>
4       <name>b_wildo_bowl</name>
5       <version>1.0</version>
6       <sdf version='1.6'>model.sdf</sdf>
7
8       <author>
9           <name>Pawel Gajewski</name>
10          <email>pawel.gajewski@agh.edu.pl</email>
11      </author>
12
13      <description>
14          IAI lab wildo bowl.
15      </description>
16  </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3    <model name='freezer_box'>
4      <link name='link'>
5        <pose frame=''>0 0 0 0 -0 0</pose>
6        <inertial>
7          <mass>1</mass>
8          <inertia>
9            <ixx>0.166667</ixx>
10           <ixy>0</ixy>
11           <ixz>0</ixz>
12           <iyy>0.166667</iyy>
13           <iyz>0</iyz>
14           <izz>0.166667</izz>
15         </inertia>
16         <pose frame=''>0 0 0 0 -0 0</pose>
17       </inertial>
18       <self_collide>0</self_collide>
19       <kinematic>0</kinematic>
20       <gravity>1</gravity>
21       <visual name='visual'>
22         <geometry>
23           <box>
24             <size>1 1 0.01</size>
25           </box>
26         </geometry>
27         <material>
28           <script>
29             <name>Gazebo/Grey</name>
30             <uri>file://media/materials/scripts/gazebo.material</uri>
31           </script>
32           <ambient>0.3 0.3 0.3 1</ambient>
33           <diffuse>0.7 0.7 0.7 1</diffuse>
34           <specular>0.01 0.01 0.01 1</specular>
35           <emissive>0 0 0 1</emissive>
36           <shader type='vertex'>
37             <normal_map>__default__</normal_map>
38           </shader>
39         </material>
40         <pose frame=''>0 0 0 0 -0 0</pose>
41         <transparency>0</transparency>
42         <cast_shadows>1</cast_shadows>
43       </visual>
44       <collision name='collision'>
45         <laser_retro>0</laser_retro>
46         <max_contacts>10</max_contacts>
47         <pose frame=''>0 0 0 0 -0 0</pose>
48         <geometry>
49           <box>
50             <size>1 1 0.01</size>
51           </box>
52         </geometry>
53         <surface>
54           <friction>
55             <ode>
```

```
56              <mu>1</mu>
57              <mu2>1</mu2>
58              <fdir1>0 0 0</fdir1>
59              <slip1>0</slip1>
60              <slip2>0</slip2>
61            </ode>
62            <torsional>
63              <coefficient>1</coefficient>
64              <patch_radius>0</patch_radius>
65              <surface_radius>0</surface_radius>
66              <use_patch_radius>1</use_patch_radius>
67              <ode>
68                <slip>0</slip>
69              </ode>
70            </torsional>
71          </friction>
72          <bounce>
73            <restitution_coefficient>0</restitution_coefficient>
74            <threshold>1e+06</threshold>
75          </bounce>
76          <contact>
77            <collide_without_contact>0</collide_without_contact>
78            <collide_without_contact_bitmask>1</collide_without_contact_bitmask>
79            <collide_bitmask>1</collide_bitmask>
80            <ode>
81              <soft_cfm>0</soft_cfm>
82              <soft_erp>0.2</soft_erp>
83              <kp>1e+13</kp>
84              <kd>1</kd>
85              <max_vel>0.01</max_vel>
86              <min_depth>0</min_depth>
87            </ode>
88            <bullet>
89              <split_impulse>1</split_impulse>
90              <split_impulse_penetration_threshold>-0.01</
                   split_impulse_penetration_threshold>
91              <soft_cfm>0</soft_cfm>
92              <soft_erp>0.2</soft_erp>
93              <kp>1e+13</kp>
94              <kd>1</kd>
95            </bullet>
96          </contact>
97        </surface>
98      </collision>
99    </link>
100   <link name='link_0'>
101     <pose frame=''>0 -0.493 0.243 0 -0 1.5708</pose>
102     <inertial>
103       <mass>1</mass>
104       <inertia>
105         <ixx>0.166667</ixx>
106         <ixy>0</ixy>
107         <ixz>0</ixz>
108         <iyy>0.166667</iyy>
109         <iyz>0</iyz>
110         <izz>0.166667</izz>
111       </inertia>
```

```xml
112            <pose frame=''>0 0 0 0 -0 0</pose>
113          </inertial>
114          <gravity>1</gravity>
115          <self_collide>0</self_collide>
116          <kinematic>0</kinematic>
117          <visual name='visual'>
118            <pose frame=''>0 0 0 0 -0 0</pose>
119            <geometry>
120              <box>
121                <size>0.01 1 0.5</size>
122              </box>
123            </geometry>
124            <material>
125              <lighting>1</lighting>
126              <script>
127                <uri>file://media/materials/scripts/gazebo.material</uri>
128                <name>Gazebo/Grey</name>
129              </script>
130              <ambient>0.3 0.3 0.3 1</ambient>
131              <diffuse>0.7 0.7 0.7 1</diffuse>
132              <specular>0.01 0.01 0.01 1</specular>
133              <emissive>0 0 0 1</emissive>
134              <shader type='vertex'>
135                <normal_map>__default__</normal_map>
136              </shader>
137            </material>
138            <transparency>0</transparency>
139            <cast_shadows>1</cast_shadows>
140          </visual>
141          <collision name='collision'>
142            <laser_retro>0</laser_retro>
143            <max_contacts>10</max_contacts>
144            <pose frame=''>0 0 0 0 -0 0</pose>
145            <geometry>
146              <box>
147                <size>0.01 1 0.5</size>
148              </box>
149            </geometry>
150            <surface>
151              <friction>
152                <ode>
153                  <mu>1</mu>
154                  <mu2>1</mu2>
155                  <fdir1>0 0 0</fdir1>
156                  <slip1>0</slip1>
157                  <slip2>0</slip2>
158                </ode>
159                <torsional>
160                  <coefficient>1</coefficient>
161                  <patch_radius>0</patch_radius>
162                  <surface_radius>0</surface_radius>
163                  <use_patch_radius>1</use_patch_radius>
164                  <ode>
165                    <slip>0</slip>
166                  </ode>
167                </torsional>
168              </friction>
```

```
169              <bounce>
170                <restitution_coefficient>0</restitution_coefficient>
171                <threshold>1e+06</threshold>
172              </bounce>
173              <contact>
174                <collide_without_contact>0</collide_without_contact>
175                <collide_without_contact_bitmask>1</collide_without_contact_bitmask>
176                <collide_bitmask>1</collide_bitmask>
177                <ode>
178                  <soft_cfm>0</soft_cfm>
179                  <soft_erp>0.2</soft_erp>
180                  <kp>1e+13</kp>
181                  <kd>1</kd>
182                  <max_vel>0.01</max_vel>
183                  <min_depth>0</min_depth>
184                </ode>
185                <bullet>
186                  <split_impulse>1</split_impulse>
187                  <split_impulse_penetration_threshold>-0.01</
                        split_impulse_penetration_threshold>
188                  <soft_cfm>0</soft_cfm>
189                  <soft_erp>0.2</soft_erp>
190                  <kp>1e+13</kp>
191                  <kd>1</kd>
192                </bullet>
193              </contact>
194            </surface>
195          </collision>
196        </link>
197        <link name='link_0_clone'>
198          <pose frame=''>0.495 0 0.243 0 -0 0</pose>
199          <inertial>
200            <mass>1</mass>
201            <inertia>
202              <ixx>0.166667</ixx>
203              <ixy>0</ixy>
204              <ixz>0</ixz>
205              <iyy>0.166667</iyy>
206              <iyz>0</iyz>
207              <izz>0.166667</izz>
208            </inertia>
209            <pose frame=''>0 0 0 0 -0 0</pose>
210          </inertial>
211          <self_collide>0</self_collide>
212          <kinematic>0</kinematic>
213          <visual name='visual'>
214            <pose frame=''>0 0 0 0 -0 0</pose>
215            <geometry>
216              <box>
217                <size>0.01 1 0.5</size>
218              </box>
219            </geometry>
220            <material>
221              <lighting>1</lighting>
222              <script>
223                <uri>file://media/materials/scripts/gazebo.material</uri>
224                <name>Gazebo/Grey</name>
```

```
225            </script>
226            <ambient>0.3 0.3 0.3 1</ambient>
227            <diffuse>0.7 0.7 0.7 1</diffuse>
228            <specular>0.01 0.01 0.01 1</specular>
229            <emissive>0 0 0 1</emissive>
230            <shader type='vertex'>
231              <normal_map>__default__</normal_map>
232            </shader>
233          </material>
234          <transparency>0</transparency>
235          <cast_shadows>1</cast_shadows>
236        </visual>
237        <collision name='collision'>
238          <laser_retro>0</laser_retro>
239          <max_contacts>10</max_contacts>
240          <pose frame=''>0 0 0 0 -0 0</pose>
241          <geometry>
242            <box>
243              <size>0.01 1 0.5</size>
244            </box>
245          </geometry>
246          <surface>
247            <friction>
248              <ode>
249                <mu>1</mu>
250                <mu2>1</mu2>
251                <fdir1>0 0 0</fdir1>
252                <slip1>0</slip1>
253                <slip2>0</slip2>
254              </ode>
255              <torsional>
256                <coefficient>1</coefficient>
257                <patch_radius>0</patch_radius>
258                <surface_radius>0</surface_radius>
259                <use_patch_radius>1</use_patch_radius>
260                <ode>
261                  <slip>0</slip>
262                </ode>
263              </torsional>
264            </friction>
265            <bounce>
266              <restitution_coefficient>0</restitution_coefficient>
267              <threshold>1e+06</threshold>
268            </bounce>
269            <contact>
270              <collide_without_contact>0</collide_without_contact>
271              <collide_without_contact_bitmask>1</collide_without_contact_bitmask>
272              <collide_bitmask>1</collide_bitmask>
273              <ode>
274                <soft_cfm>0</soft_cfm>
275                <soft_erp>0.2</soft_erp>
276                <kp>1e+13</kp>
277                <kd>1</kd>
278                <max_vel>0.01</max_vel>
279                <min_depth>0</min_depth>
280              </ode>
281              <bullet>
```

```
282                    <split_impulse>1</split_impulse>
283                    <split_impulse_penetration_threshold>-0.01</
                          split_impulse_penetration_threshold>
284                    <soft_cfm>0</soft_cfm>
285                    <soft_erp>0.2</soft_erp>
286                    <kp>1e+13</kp>
287                    <kd>1</kd>
288                  </bullet>
289                </contact>
290              </surface>
291            </collision>
292          </link>
293          <link name='link_0_clone_0'>
294            <pose frame=''>-0.495 0 0.243 0 -0 0</pose>
295            <inertial>
296              <mass>1</mass>
297              <inertia>
298                <ixx>0.166667</ixx>
299                <ixy>0</ixy>
300                <ixz>0</ixz>
301                <iyy>0.166667</iyy>
302                <iyz>0</iyz>
303                <izz>0.166667</izz>
304              </inertia>
305              <pose frame=''>0 0 0 0 -0 0</pose>
306            </inertial>
307            <self_collide>0</self_collide>
308            <kinematic>0</kinematic>
309            <visual name='visual'>
310              <pose frame=''>0 0 0 0 -0 0</pose>
311              <geometry>
312                <box>
313                  <size>0.01 1 0.5</size>
314                </box>
315              </geometry>
316              <material>
317                <lighting>1</lighting>
318                <script>
319                  <uri>file://media/materials/scripts/gazebo.material</uri>
320                  <name>Gazebo/Grey</name>
321                </script>
322                <ambient>0.3 0.3 0.3 1</ambient>
323                <diffuse>0.7 0.7 0.7 1</diffuse>
324                <specular>0.01 0.01 0.01 1</specular>
325                <emissive>0 0 0 1</emissive>
326                <shader type='vertex'>
327                  <normal_map>__default__</normal_map>
328                </shader>
329              </material>
330              <transparency>0</transparency>
331              <cast_shadows>1</cast_shadows>
332            </visual>
333            <collision name='collision'>
334              <laser_retro>0</laser_retro>
335              <max_contacts>10</max_contacts>
336              <pose frame=''>0 0 0 0 -0 0</pose>
337              <geometry>
```

```
338                <box>
339                  <size>0.01 1 0.5</size>
340                </box>
341            </geometry>
342            <surface>
343              <friction>
344                <ode>
345                  <mu>1</mu>
346                  <mu2>1</mu2>
347                  <fdir1>0 0 0</fdir1>
348                  <slip1>0</slip1>
349                  <slip2>0</slip2>
350                </ode>
351                <torsional>
352                  <coefficient>1</coefficient>
353                  <patch_radius>0</patch_radius>
354                  <surface_radius>0</surface_radius>
355                  <use_patch_radius>1</use_patch_radius>
356                  <ode>
357                    <slip>0</slip>
358                  </ode>
359                </torsional>
360              </friction>
361              <bounce>
362                <restitution_coefficient>0</restitution_coefficient>
363                <threshold>1e+06</threshold>
364              </bounce>
365              <contact>
366                <collide_without_contact>0</collide_without_contact>
367                <collide_without_contact_bitmask>1</collide_without_contact_bitmask>
368                <collide_bitmask>1</collide_bitmask>
369                <ode>
370                  <soft_cfm>0</soft_cfm>
371                  <soft_erp>0.2</soft_erp>
372                  <kp>1e+13</kp>
373                  <kd>1</kd>
374                  <max_vel>0.01</max_vel>
375                  <min_depth>0</min_depth>
376                </ode>
377                <bullet>
378                  <split_impulse>1</split_impulse>
379                  <split_impulse_penetration_threshold>-0.01</
                        split_impulse_penetration_threshold>
380                  <soft_cfm>0</soft_cfm>
381                  <soft_erp>0.2</soft_erp>
382                  <kp>1e+13</kp>
383                  <kd>1</kd>
384                </bullet>
385              </contact>
386            </surface>
387          </collision>
388        </link>
389        <link name='link_0_clone_1'>
390          <pose frame=''>-0 0.495 0.243 0 -0 -1.5708</pose>
391          <inertial>
392            <mass>1</mass>
393            <inertia>
```

```
394            <ixx>0.166667</ixx>
395            <ixy>0</ixy>
396            <ixz>0</ixz>
397            <iyy>0.166667</iyy>
398            <iyz>0</iyz>
399            <izz>0.166667</izz>
400          </inertia>
401          <pose frame=''>0 0 0 0 -0 0</pose>
402        </inertial>
403        <self_collide>0</self_collide>
404        <kinematic>0</kinematic>
405        <visual name='visual'>
406          <pose frame=''>0 0 0 0 -0 0</pose>
407          <geometry>
408            <box>
409              <size>0.01 1 0.5</size>
410            </box>
411          </geometry>
412          <material>
413            <lighting>1</lighting>
414            <script>
415              <uri>file://media/materials/scripts/gazebo.material</uri>
416              <name>Gazebo/Grey</name>
417            </script>
418            <ambient>0.3 0.3 0.3 1</ambient>
419            <diffuse>0.7 0.7 0.7 1</diffuse>
420            <specular>0.01 0.01 0.01 1</specular>
421            <emissive>0 0 0 1</emissive>
422            <shader type='vertex'>
423              <normal_map>__default__</normal_map>
424            </shader>
425          </material>
426          <transparency>0</transparency>
427          <cast_shadows>1</cast_shadows>
428        </visual>
429        <collision name='collision'>
430          <laser_retro>0</laser_retro>
431          <max_contacts>10</max_contacts>
432          <pose frame=''>0 0 0 0 -0 0</pose>
433          <geometry>
434            <box>
435              <size>0.01 1 0.5</size>
436            </box>
437          </geometry>
438          <surface>
439            <friction>
440              <ode>
441                <mu>1</mu>
442                <mu2>1</mu2>
443                <fdir1>0 0 0</fdir1>
444                <slip1>0</slip1>
445                <slip2>0</slip2>
446              </ode>
447              <torsional>
448                <coefficient>1</coefficient>
449                <patch_radius>0</patch_radius>
450                <surface_radius>0</surface_radius>
```

```xml
451                    <use_patch_radius>1</use_patch_radius>
452                    <ode>
453                      <slip>0</slip>
454                    </ode>
455                  </torsional>
456                </friction>
457                <bounce>
458                  <restitution_coefficient>0</restitution_coefficient>
459                  <threshold>1e+06</threshold>
460                </bounce>
461                <contact>
462                  <collide_without_contact>0</collide_without_contact>
463                  <collide_without_contact_bitmask>1</collide_without_contact_bitmask>
464                  <collide_bitmask>1</collide_bitmask>
465                  <ode>
466                    <soft_cfm>0</soft_cfm>
467                    <soft_erp>0.2</soft_erp>
468                    <kp>1e+13</kp>
469                    <kd>1</kd>
470                    <max_vel>0.01</max_vel>
471                    <min_depth>0</min_depth>
472                  </ode>
473                  <bullet>
474                    <split_impulse>1</split_impulse>
475                    <split_impulse_penetration_threshold>-0.01</
                          split_impulse_penetration_threshold>
476                    <soft_cfm>0</soft_cfm>
477                    <soft_erp>0.2</soft_erp>
478                    <kp>1e+13</kp>
479                    <kd>1</kd>
480                  </bullet>
481                </contact>
482              </surface>
483            </collision>
484          </link>
485          <joint name='link_JOINT_1' type='fixed'>
486            <parent>link</parent>
487            <child>link_0_clone_0</child>
488            <pose frame=''>0 0 0 0 -0 0</pose>
489            <physics>
490              <ode>
491                <limit>
492                  <cfm>0</cfm>
493                  <erp>0.2</erp>
494                </limit>
495                <suspension>
496                  <cfm>0</cfm>
497                  <erp>0.2</erp>
498                </suspension>
499              </ode>
500            </physics>
501          </joint>
502          <joint name='link_JOINT_5' type='fixed'>
503            <parent>link</parent>
504            <child>link_0_clone</child>
505            <pose frame=''>0 0 0 0 -0 0</pose>
506            <physics>
```

```
507              <ode >
508                <limit >
509                  <cfm >0 </cfm >
510                  <erp >0.2 </erp >
511                </limit >
512                <suspension >
513                  <cfm >0 </cfm >
514                  <erp >0.2 </erp >
515                </suspension >
516              </ode >
517            </physics >
518          </joint >
519          <joint name ='link_JOINT_6 ' type ='fixed '>
520            <parent >link </parent >
521            <child >link_0 </child >
522            <pose frame =''>0 0 0 0 -0 0</pose >
523            <physics >
524              <ode >
525                <limit >
526                  <cfm >0 </cfm >
527                  <erp >0.2 </erp >
528                </limit >
529                <suspension >
530                  <cfm >0 </cfm >
531                  <erp >0.2 </erp >
532                </suspension >
533              </ode >
534            </physics >
535          </joint >
536          <joint name ='link_JOINT_7 ' type ='fixed '>
537            <parent >link </parent >
538            <child >link_0_clone_1 </child >
539            <pose frame =''>0 0 0 0 -0 0</pose >
540            <physics >
541              <ode >
542                <limit >
543                  <cfm >0 </cfm >
544                  <erp >0.2 </erp >
545                </limit >
546                <suspension >
547                  <cfm >0 </cfm >
548                  <erp >0.2 </erp >
549                </suspension >
550              </ode >
551            </physics >
552          </joint >
553          <static >1 </static >
554          <allow_auto_disable >1 </allow_auto_disable >
555        </model >
556    </sdf >
```

149   models/freezer$_b$ox/model.config

```
1   <?xml version="1.0" ?>
2   <model>
3       <name>freezer_box</name>
4       <version>1.0</version>
5       <sdf version="1.6">model.sdf</sdf>
6       <author>
7            <name></name>
8            <email></email>
9       </author>
10      <description></description>
11  </model>
```

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3           <model name='b_big_bowl'>
4                   <static>false</static>
5                   <pose>0 0 0 0 0 0</pose>
6
7                   <link name='link'>
8                           <inertial>
9                           <mass>0.35</mass>
10                          <pose>-0.0022966 -0.0039142 0.0041527 0 0 0</pose>
11                                  <inertia>
12                                          <ixx>0.0009479167</ixx>
13                                          <iyy>0.0009479167</iyy>
14                                          <izz>0.00175</izz>
15                                  </inertia>
16                          </inertial>
17                          <collision name='collision'>
18                                  <geometry>
19                                          <mesh>
20                                                  <uri>model://b_big_bowl/
                                                        b_big_bowl.dae</uri>
21                                          </mesh>
22                                  </geometry>
23                                  <surface>
24                                          <friction>
25                                                  <ode>
26                                                          <mu>0.2</mu>
27                                                          <mu2>0.2</mu2>
28                                                  </ode>
29                                          </friction>
30                                  </surface>
31                          </collision>
32                          <visual name='visual'>
33                                  <geometry>
34                                          <mesh>
35                                                  <uri>model://b_big_bowl/
                                                        b_big_bowl.dae</uri>
36                                          </mesh>
37                                  </geometry>
38                          </visual>
39                  </link>
40          </model>
41  </sdf>
```

151 models/b$_b$ig$_b$owl/model.config

```
1   <?xml version="1.0"?>
2
3   <model>
4     <name>b_big_bowl</name>
5     <version>1.0</version>
6     <sdf version="1.6">model.sdf</sdf>
7
8     <author>
9       <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
            name>
10      <email>bryanwang1992@outlook.com</email>
11    </author>
12
13    <description>
14      b_big_bowl
15    </description>
16
17  </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3          <model name='a_platebowl'>
4                  <static>false</static>
5                  <pose>0 0 0 0 0 0</pose>
6
7                  <link name='link'>
8                          <inertial>
9                          <mass>0.425</mass>
10                         <pose>0.00041553 -0.00077162 9.9512e-05 0 0 0</pose>
11                                 <inertia>
12                                         <ixx>2.1909e-05</ixx>
13                                         <ixy>0</ixy>
14                                         <ixz>0</ixz>
15                                         <iyy>4.3318e-06</iyy>
16                                         <iyz>0</iyz>
17                                         <izz>3.9495e-06</izz>
18                                 </inertia>
19                         </inertial>
20                         <collision name='collision'>
21                                 <geometry>
22                                         <mesh>
23                                                 <uri>model://a_platebowl/
                                                         a_platebowl.dae</uri>
24                                         </mesh>
25                                 </geometry>
26                                 <surface>
27                                         <friction>
28                                                 <ode>
29                                                         <mu>0.2</mu>
30                                                         <mu2>0.2</mu2>
31                                                 </ode>
32                                         </friction>
33                                 </surface>
34                         </collision>
35                         <visual name='visual'>
36                                 <geometry>
37                                         <mesh>
38                                                 <uri>model://a_platebowl/
                                                         a_platebowl.dae</uri>
39                                         </mesh>
40                                 </geometry>
41                         </visual>
42                 </link>
43          </model>
44  </sdf>
```

153 models/a$_p$latebowl/model.config

```xml
1  <?xml version="1.0"?>
2
3  <model>
4    <name>a_platebowl</name>
5    <version>1.0</version>
6    <sdf version="1.6">model.sdf</sdf>
7
8    <author>
9      <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
            name>
10     <email>bryanwang1992@outlook.com</email>
11   </author>
12
13   <description>
14     a_platebowl
15   </description>
16
17 </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3      <model name='b_thin_spatula'>
4          <static>false</static>
5          <pose>0 0 0 0 0 0</pose>
6
7          <link name='link'>
8              <inertial>
9                  <mass>0.11</mass>
10                 <pose>2.3574e-18 -4.8479e-20 1.6546e-18 0 0 0</pose>
11                     <inertia>
12                         <ixx>1.7189e-07</ixx>
13                         <ixy>0</ixy>
14                         <ixz>0</ixz>
15                         <iyy>1.904e-07</iyy>
16                         <iyz>0</iyz>
17                         <izz>3.3856e-08</izz>
18                     </inertia>
19             </inertial>
20             <sensor name="tool_contact_sensor" type="contact">
21                 <always_on>true</always_on>
22                 <update_rate>30.0</update_rate>
23                 <contact>
24                     <collision>collision</collision>
25                 </contact>
26                 <plugin name="tool_bumper" filename="
                        libgazebo_ros_bumper.so">
27                     <bumperTopicName>
                            tool_contact_sensor_state</
                            bumperTopicName>
28                     <frameName>world</frameName>
29                 </plugin>
30             </sensor>
31             <collision name='collision'>
32                 <geometry>
33                     <mesh>
34                         <uri>model://b_thin_spatula/
                                b_thin_spatula.dae</uri>
35                     </mesh>
36                 </geometry>
37                 <surface>
38                     <friction>
39                         <ode>
40                             <mu>0.2</mu>
41                             <mu2>0.2</mu2>
42                         </ode>
43                     </friction>
44                 </surface>
45             </collision>
46             <visual name='visual'>
47                 <geometry>
48                     <mesh>
49                         <uri>model://b_thin_spatula/
                                b_thin_spatula.dae</uri>
50                     </mesh>
```

```
51                                          </geometry>
52                              </visual>
53                  </link>
54          </model>
55  </sdf>
```

155 models/b$_t hin_s patula$/model.config

```xml
1   <?xml version="1.0"?>
2
3   <model>
4     <name>b_thin_spatula</name>
5     <version>1.0</version>
6     <sdf version="1.6">model.sdf</sdf>
7
8     <author>
9       <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
            name>
10      <email>bryanwang1992@outlook.com</email>
11    </author>
12
13    <description>
14      b_thin_spatula
15    </description>
16
17  </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3      <model name='a_scraper'>
4          <static>false</static>
5          <pose>0 0 0 0 0 0</pose>
6
7          <link name='link'>
8              <inertial>
9              <mass>0.1</mass>
10             <pose>-0.0078947 5.2477e-05 -9.0654e-05 0 0 0</pose>
11                 <inertia>
12                     <ixx>4.3449e-07</ixx>
13                     <ixy>0</ixy>
14                     <ixz>0</ixz>
15                     <iyy>6.6601e-06</iyy>
16                     <iyz>0</iyz>
17                     <izz>6.2495e-06</izz>
18                 </inertia>
19             </inertial>
20             <sensor name="tool_contact_sensor" type="contact">
21                 <always_on>true</always_on>
22                 <update_rate>30.0</update_rate>
23                 <contact>
24                     <collision>collision</collision>
25                 </contact>
26                 <plugin name="tool_bumper" filename="
                       libgazebo_ros_bumper.so">
27                     <bumperTopicName>
                           tool_contact_sensor_state</
                           bumperTopicName>
28                     <frameName>world</frameName>
29                 </plugin>
30             </sensor>
31             <collision name='collision'>
32                 <geometry>
33                     <mesh>
34                         <uri>model://a_scraper/a_scraper
                               .dae</uri>
35                     </mesh>
36                 </geometry>
37                 <surface>
38                     <friction>
39                         <ode>
40                             <mu>0.2</mu>
41                             <mu2>0.2</mu2>
42                         </ode>
43                     </friction>
44                 </surface>
45             </collision>
46             <visual name='visual'>
47                 <geometry>
48                     <mesh>
49                         <uri>model://a_scraper/a_scraper
                               .dae</uri>
50                     </mesh>
```

```
51                                        </geometry>
52                               </visual>
53                     </link>
54           </model>
55    </sdf>
```

157   models/a$_s$craper/model.config

```
1   <?xml version="1.0"?>
2
3   <model>
4     <name>a_scraper</name>
5     <version>1.0</version>
6     <sdf version="1.6">model.sdf</sdf>
7
8     <description>
9       a_scraper
10    </description>
11
12  </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3      <model name='b_table_knife'>
4          <static>false</static>
5          <pose>0 0 0 0 0 0</pose>
6
7          <link name='link'>
8              <inertial>
9                <mass>0.1</mass>
10               <pose>-8.8541e-06  -4.0274e-05  -0.00010513 0 0 0</pose>
11               <inertia>
12                      <ixx>0.000005</ixx>
13                      <iyy>0.0002433333</iyy>
14                      <izz>0.0002433333</izz>
15               </inertia>
16             </inertial>
17             <sensor name="tool_contact_sensor" type="contact">
18                     <always_on>true</always_on>
19                     <update_rate>30.0</update_rate>
20                     <contact>
21                             <collision>collision</collision>
22                     </contact>
23                     <plugin name="tool_bumper" filename="
                          libgazebo_ros_bumper.so">
24                             <bumperTopicName>
                                    tool_contact_sensor_state</
                                    bumperTopicName>
25                             <frameName>world</frameName>
26                     </plugin>
27             </sensor>
28             <collision name='collision'>
29                     <geometry>
30                             <mesh>
31                                     <uri>model://b_table_knife/
                                            b_table_knife.dae</uri>
32                             </mesh>
33                     </geometry>
34                     <surface>
35                             <friction>
36                                     <ode>
37                                             <mu>0.2</mu>
38                                             <mu2>0.2</mu2>
39                                     </ode>
40                             </friction>
41                     </surface>
42             </collision>
43             <visual name='visual'>
44                     <geometry>
45                             <mesh>
46                                     <uri>model://b_table_knife/
                                            b_table_knife.dae</uri>
47                             </mesh>
48                     </geometry>
49             </visual>
50         </link>
```

```
51              </model>
52      </sdf>
```

```
1   <?xml version="1.0"?>
2
3   <model>
4     <name>b_table_knife</name>
5     <version>1.0</version>
6     <sdf version="1.6">model.sdf</sdf>
7
8     <author>
9       <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
          name>
10      <email>bryanwang1992@outlook.com</email>
11    </author>
12
13    <description>
14      b_table_knife
15    </description>
16
17  </model>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version='1.6'>
 3      <model name='jenga_block'>
 4          <static>false</static>
 5          <allow_auto_disable>false</allow_auto_disable>
 6
 7          <pose>0 0 0 0 0 0</pose>
 8
 9          <link name='link'>
10              <pose>0 0 0 0 0 0</pose>
11
12              <inertial>
13                  <mass>0.0107</mass>
14                  <pose>0 0 0 0 0 0</pose>
15                  <inertia>
16                      <ixx>0.000060745</ixx>
17                      <iyy>0.000025078</iyy>
18                      <izz>0.000020620</izz>
19                  </inertia>
20              </inertial>
21
22              <gravity>true</gravity>
23
24              <collision name='collision'>
25                <geometry>
26                  <box>
27                    <size>0.015 0.025 0.075</size>
28                  </box>
29                </geometry>
30                <surface>
31                  <friction>
32                    <ode>
33                      <mu>1</mu>
34                      <mu2>1</mu2>
35                    </ode>
36                  </friction>
37                </surface>
38              </collision>
39
40              <visual name='visual'>
41                  <geometry>
42                    <box>
43                      <size>0.015 0.025 0.075</size>
44                    </box>
45                  </geometry>
46              </visual>
47
48          </link>
49      </model>
50  </sdf>
```

161 models/jenga$_b$lock/model.config

```xml
1  <?xml version="1.0" ?>
2  <model>
3      <name>finger</name>
4      <version>1.0</version>
5      <sdf version="1.6">model.sdf</sdf>
6      <author>
7          <name></name>
8          <email></email>
9      </author>
10     <description></description>
11 </model>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version='1.6'>
 3      <model name='a_knifekitchen3'>
 4          <static>false</static>
 5          <pose>0 0 0 0 0 0</pose>
 6
 7          <link name='link'>
 8              <inertial>
 9              <mass>0.22</mass>
10              <pose>0.027414 0.0018516 0.006439 0 0 0</pose>
11                  <inertia>
12                      <ixx>1.4524e-05</ixx>
13                      <ixy>0</ixy>
14                      <ixz>0</ixz>
15                      <iyy>0.00017907</iyy>
16                      <iyz>0</iyz>
17                      <izz>0.00016613</izz>
18                  </inertia>
19              </inertial>
20              <sensor name="tool_contact_sensor" type="contact">
21                  <always_on>true</always_on>
22                  <update_rate>30.0</update_rate>
23                  <contact>
24                      <collision>collision</collision>
25                  </contact>
26                  <plugin name="tool_bumper" filename="
                        libgazebo_ros_bumper.so">
27                      <bumperTopicName>
                            tool_contact_sensor_state</
                            bumperTopicName>
28                      <frameName>world</frameName>
29                  </plugin>
30              </sensor>
31              <collision name='collision'>
32                  <geometry>
33                      <mesh>
34                          <uri>model://a_knifekitchen3/
                                a_knifekitchen3.dae</uri>
35                      </mesh>
36                  </geometry>
37                  <surface>
38                      <friction>
39                          <ode>
40                              <mu>0.2</mu>
41                              <mu2>0.2</mu2>
42                          </ode>
43                      </friction>
44                  </surface>
45              </collision>
46              <visual name='visual'>
47                  <geometry>
48                      <mesh>
49                          <uri>model://a_knifekitchen3/
                                a_knifekitchen3.dae</uri>
50                      </mesh>
```

```
51                                                      </geometry>
52                                  </visual>
53                          </link>
54              </model>
55      </sdf>
```

163 models/a_knifekitchen3/model.config

```
1  <?xml version="1.0"?>
2
3  <model>
4    <name>a_knifekitchen3</name>
5    <version>1.0</version>
6    <sdf version="1.6">model.sdf</sdf>
7
8    <description>
9      a_knifekitchen3
10   </description>
11
12 </model>
```

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3       <model name='a_bowlchild'>
4           <static>false</static>
5           <pose>0 0 0 0 0 0</pose>
6
7           <link name='link'>
8               <inertial>
9                   <mass>0.051</mass>
10                  <pose>0.00062327 -0.00082628 9.9469e-05 0 0 0</pose>
11                  <inertia>
12                      <ixx>1.0588e-06</ixx>
13                      <ixy>0</ixy>
14                      <ixz>0</ixz>
15                      <iyy>6.0902e-07</iyy>
16                      <iyz>0</iyz>
17                      <izz>6.8437e-07</izz>
18                  </inertia>
19              </inertial>
20              <collision name='collision'>
21                  <geometry>
22                      <mesh>
23                          <uri>model://a_bowlchild/
                                a_bowlchild.dae</uri>
24                      </mesh>
25                  </geometry>
26                  <surface>
27                      <friction>
28                          <ode>
29                              <mu>0.2</mu>
30                              <mu2>0.2</mu2>
31                          </ode>
32                      </friction>
33                  </surface>
34              </collision>
35              <visual name='visual'>
36                  <geometry>
37                      <mesh>
38                          <uri>model://a_bowlchild/
                                a_bowlchild.dae</uri>
39                      </mesh>
40                  </geometry>
41              </visual>
42          </link>
43      </model>
44  </sdf>
```

165   models/a$_b$owlchild/model.config

```
1  <?xml version="1.0"?>
2
3  <model>
4    <name>a_bowlchild</name>
5    <version>1.0</version>
6    <sdf version="1.6">model.sdf</sdf>
7
8    <author>
9      <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
              name>
10     <email>bryanwang1992@outlook.com</email>
11   </author>
12
13   <description>
14     a_bowlchild
15   </description>
16
17 </model>
```

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3     <model name='book'>
4       <static>false</static>
5       <pose>-0.031125 0 0.010809 1e-06 -0 0</pose>
6
7       <link name='book_link'>
8         <pose frame='link'>-0.031125 0 0.010809 1e-06 -0 0</pose>
9         <inertial>
10          <mass>1</mass>
11          <pose frame='link'>0.03 0 0.18 0 -0 0</pose>
12          <inertia>
13            <ixx>.01495105</ixx><!--  1/12 * m * (h^2 + d^2)  -->
14            <ixy>0</ixy>
15            <ixz>0</ixz>
16            <iyy>0.01270166</iyy>
17            <iyz>0</iyz>
18            <izz>0.00247143</izz>
19          </inertia>
20        </inertial>
21        <collision name='book_collision'>
22          <geometry>
23            <mesh>
24              <uri>model://book/book.stl</uri>
25            </mesh>
26          </geometry>
27          <pose frame=''>0.26 0 -0.32 0 -0 0</pose>
28          <surface>
29            <friction>
30              <ode>
31                <mu>0.2</mu>
32                <mu2>0.2</mu2>
33              </ode>
34            </friction>
35          </surface>
36        </collision>
37        <visual name='book_visual'>
38          <geometry>
39            <mesh>
40              <uri>model://book/book.stl</uri>
41            </mesh>
42          </geometry>
43          <pose frame=''>0.26 0 -0.32 0 -0 0</pose>
44        </visual>
45      </link>
46    </model>
47  </sdf>
```

167   models/book/model.config

```
1  <?xml version="1.0" ?>
2  <model>
3      <name>book</name>
4      <version>1.0</version>
5      <sdf version="1.6">model.sdf</sdf>
6      <author>
7          <name></name>
8          <email></email>
9      </author>
10     <description></description>
11 </model>
```

168   models/finger/model.sdf

```xml
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3      <model name='gripper'>
4          <static>false</static>
5          <allow_auto_disable>false</allow_auto_disable>
6
7          <pose>0 0 0 0 0 0</pose>
8
9          <link name='link'>
10             <pose>0 0 0 0 0 0</pose>
11
12             <!-- <inertial>
13                 <mass>5.0</mass>
14                 <pose>0 0 0 0 0 0</pose>
15                 <inertia>
16                     <ixx>0.0008</ixx>
17                     <iyy>0.0008</iyy>
18                     <izz>0.0008</izz>
19                 </inertia>
20             </inertial> -->
21
22             <gravity>false</gravity>
23
24             <collision name='collision'>
25               <geometry>
26                 <box>
27                   <size>0.01 0.01 0.06</size>
28                 </box>
29               </geometry>
30               <surface>
31                 <friction>
32                   <ode>
33                     <mu>999</mu>
34                     <mu2>999</mu2>
35                   </ode>
36                 </friction>
37               </surface>
38             </collision>
39
40             <visual name='visual'>
41                 <geometry>
42                   <box>
43                     <size>0.01 0.01 0.06</size>
44                   </box>
45                 </geometry>
46             </visual>
47
48         </link>
49     </model>
50  </sdf>
```

169 models/finger/model.config

```xml
1  <?xml version="1.0" ?>
2  <model>
3      <name>finger</name>
4      <version>1.0</version>
5      <sdf version="1.6">model.sdf</sdf>
6      <author>
7          <name></name>
8          <email></email>
9      </author>
10     <description></description>
11 </model>
```

170   models/a$_m$ug2/model.sdf

```xml
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3          <model name='a_mug2'>
4                  <static>false</static>
5                  <pose>0 0 0 0 0 0</pose>
6
7                  <link name='link'>
8                          <inertial>
9                          <mass>0.329</mass>
10                         <pose>0.0010025 -0.00022342 -0.00040089 0 0 0</pose>
11                                 <inertia>
12                                         <ixx>1.3761e-06</ixx>
13                                         <ixy>0</ixy>
14                                         <ixz>0</ixz>
15                                         <iyy>1.227e-06</iyy>
16                                         <iyz>0</iyz>
17                                         <izz>8.7996e-07</izz>
18                                 </inertia>
19                         </inertial>
20                         <collision name='collision'>
21                                 <geometry>
22                                         <mesh>
23                                                 <uri>model://a_mug2/a_mug2.dae</
                                                      uri>
24                                         </mesh>
25                                 </geometry>
26                                 <surface>
27                                         <friction>
28                                                 <ode>
29                                                         <mu>0.2</mu>
30                                                         <mu2>0.2</mu2>
31                                                 </ode>
32                                         </friction>
33                                 </surface>
34                         </collision>
35                         <visual name='visual'>
36                                 <geometry>
37                                         <mesh>
38                                                 <uri>model://a_mug2/a_mug2.dae</
                                                      uri>
39                                         </mesh>
40                                 </geometry>
41                         </visual>
42                 </link>
43         </model>
44  </sdf>
```

171   models/a$_m$ug2/model.config

```
 1  <?xml version="1.0"?>
 2
 3  <model>
 4    <name>a_mug2</name>
 5    <version>1.0</version>
 6    <sdf version="1.6">model.sdf</sdf>
 7
 8    <description>
 9      a_mug2
10    </description>
11
12  </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3       <model name='a_knifekitchen2'>
4            <static>false</static>
5            <pose>0 0 0 0 0 0</pose>
6
7            <link name='link'>
8                 <inertial>
9                 <mass>0.18</mass>
10                <pose>0.0020611 -0.0005695 0.00029406 0 0 0</pose>
11                     <inertia>
12                          <ixx>9.051e-06</ixx>
13                          <ixy>0</ixy>
14                          <ixz>0</ixz>
15                          <iyy>8.8029e-06</iyy>
16                          <iyz>0</iyz>
17                          <izz>1.0704e-06</izz>
18                     </inertia>
19                </inertial>
20                <sensor name="tool_contact_sensor" type="contact">
21                     <always_on>true</always_on>
22                     <update_rate>30.0</update_rate>
23                     <contact>
24                          <collision>collision</collision>
25                     </contact>
26                     <plugin name="tool_bumper" filename="
                           libgazebo_ros_bumper.so">
27                          <bumperTopicName>
                                tool_contact_sensor_state</
                                bumperTopicName>
28                          <frameName>world</frameName>
29                     </plugin>
30                </sensor>
31                <collision name='collision'>
32                     <geometry>
33                          <mesh>
34                               <uri>model://a_knifekitchen2/
                                    a_knifekitchen2.dae</uri>
35                          </mesh>
36                     </geometry>
37                     <surface>
38                          <friction>
39                               <ode>
40                                    <mu>0.2</mu>
41                                    <mu2>0.2</mu2>
42                               </ode>
43                          </friction>
44                     </surface>
45                </collision>
46                <visual name='visual'>
47                     <geometry>
48                          <mesh>
49                               <uri>model://a_knifekitchen2/
                                    a_knifekitchen2.dae</uri>
50                          </mesh>
```

```
51                                              </geometry>
52                                      </visual>
53                              </link>
54                      </model>
55              </sdf>
```

173 models/a$_k$$nifekitchen2/model.config$

```
1   <?xml version="1.0"?>
2
3   <model>
4     <name>a_knifekitchen2</name>
5     <version>1.0</version>
6     <sdf version="1.6">model.sdf</sdf>
7
8     <description>
9       a_knifekitchen2
10    </description>
11
12  </model>
```

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3        <model name='a_woodenspoon1'>
4              <static>false</static>
5              <pose>0 0 0 0 0 0</pose>
6
7              <link name='link'>
8                   <inertial>
9                   <mass>0.06</mass>
10                  <pose>-0.001351 0.00053629 -0.00033412 0 0 0</pose>
11                       <inertia>
12                            <ixx>1.1283e-06</ixx>
13                            <ixy>0</ixy>
14                            <ixz>0</ixz>
15                            <iyy>1.0655e-06</iyy>
16                            <iyz>0</iyz>
17                            <izz>1.6291e-07</izz>
18                       </inertia>
19                  </inertial>
20                  <sensor name="tool_contact_sensor" type="contact">
21                       <always_on>true</always_on>
22                       <update_rate>30.0</update_rate>
23                       <contact>
24                            <collision>collision</collision>
25                       </contact>
26                       <plugin name="tool_bumper" filename="
                              libgazebo_ros_bumper.so">
27                            <bumperTopicName>
                                   tool_contact_sensor_state</
                                   bumperTopicName>
28                            <frameName>world</frameName>
29                       </plugin>
30                  </sensor>
31                  <collision name='collision'>
32                       <geometry>
33                            <mesh>
34                                 <uri>model://a_woodenspoon1/
                                        a_woodenspoon1.dae</uri>
35                            </mesh>
36                       </geometry>
37                       <surface>
38                            <friction>
39                                 <ode>
40                                      <mu>0.2</mu>
41                                      <mu2>0.2</mu2>
42                                 </ode>
43                            </friction>
44                       </surface>
45                  </collision>
46                  <visual name='visual'>
47                       <geometry>
48                            <mesh>
49                                 <uri>model://a_woodenspoon1/
                                        a_woodenspoon1.dae</uri>
50                            </mesh>
```

```
51                                              </geometry>
52                                    </visual>
53                         </link>
54              </model>
55    </sdf>
```

175 models/a$_w$oodenspoon1/model.config

```
 1  <?xml version="1.0"?>
 2
 3  <model>
 4    <name>a_woodenspoon1</name>
 5    <version>1.0</version>
 6    <sdf version="1.6">model.sdf</sdf>
 7
 8    <description>
 9      a_woodenspoon1
10    </description>
11
12  </model>
```

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3           <model name='a_fryingpan'>
4                   <static>false</static>
5                   <pose>0 0 0 0 0 0</pose>
6
7                   <link name='link'>
8                           <inertial>
9                           <mass>0.861</mass>
10                          <pose>0.0010123 0.00011913 0.00017042 0 0 0</pose>
11                                  <inertia>
12                                          <ixx>9.7907e-05</ixx>
13                                          <ixy>0</ixy>
14                                          <ixz>0</ixz>
15                                          <iyy>0.00026237</iyy>
16                                          <iyz>0</iyz>
17                                          <izz>0.00019284</izz>
18                                  </inertia>
19                          </inertial>
20                          <collision name='collision'>
21                                  <geometry>
22                                          <mesh>
23                                                  <uri>model://a_fryingpan/
                                                        a_fryingpan.dae</uri>
24                                          </mesh>
25                                  </geometry>
26                                  <surface>
27                                          <friction>
28                                                  <ode>
29                                                          <mu>0.2</mu>
30                                                          <mu2>0.2</mu2>
31                                                  </ode>
32                                          </friction>
33                                  </surface>
34                          </collision>
35                          <visual name='visual'>
36                                  <geometry>
37                                          <mesh>
38                                                  <uri>model://a_fryingpan/
                                                        a_fryingpan.dae</uri>
39                                          </mesh>
40                                  </geometry>
41                          </visual>
42                  </link>
43          </model>
44  </sdf>
```

177 models/a$_frying pan/model.config$

```xml
1   <?xml version="1.0"?>
2
3   <model>
4     <name>a_fryingpan</name>
5     <version>1.0</version>
6     <sdf version="1.6">model.sdf</sdf>
7
8     <author>
9       <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
            name>
10      <email>bryanwang1992@outlook.com</email>
11    </author>
12
13    <description>
14      a_fryingpan
15    </description>
16
17  </model>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version='1.6'>
 3      <model name='b_bucket'>
 4          <static>false</static>
 5          <pose>0 0 0 0 0 0</pose>
 6
 7          <link name='link'>
 8              <inertial>
 9                  <mass>0.40</mass>
10                  <pose>0.000382297035518770        -0.000149204207528814
                        0.00495379249275721 0 0 0</pose>
11                  <inertia>
12                      <ixx>7.972462473661376e-05</ixx>
13                      <ixy>0.0</ixy>
14                      <ixz>0.0</ixz>
15                      <iyy>9.743942735555959e-05</iyy>
16                      <iyz>0.0</iyz>
17                      <izz>3.897022921041362e-05</izz>
18                  </inertia>
19              </inertial>
20
21              <collision name='collision'>
22                  <geometry>
23                      <mesh>
24                          <uri>model://b_bucket/b_bucket.dae</uri>
25                      </mesh>
26                  </geometry>
27                  <surface>
28                      <friction>
29                          <ode>
30                              <mu>0.2</mu>
31                              <mu2>0.2</mu2>
32                          </ode>
33                      </friction>
34                  </surface>
35              </collision>
36              <visual name='visual'>
37                  <geometry>
38                      <mesh>
39                          <uri>model://b_bucket/b_bucket.dae</uri>
40                      </mesh>
41                  </geometry>
42              </visual>
43          </link>
44      </model>
45  </sdf>
```

179　models/b$_b$ucket/model.config

```xml
1  <?xml version="1.0"?>
2
3  <model>
4      <name>b_bucket</name>
5      <version>1.0</version>
6      <sdf version='1.6'>model.sdf</sdf>
7
8      <author>
9          <name>Pawel Gajewski</name>
10         <email>pawel.gajewski@agh.edu.pl</email>
11     </author>
12
13     <description>
14         IAI lab bucket.
15     </description>
16 </model>
```

```
1   <?xml version='1.0'?>
2   <sdf version='1.6'>
3        <model name='b_small_knife'>
4              <static>false</static>
5              <pose>0 0 0 0 0 0</pose>
6
7              <link name='link'>
8                    <inertial>
9                    <mass>0.15</mass>
10                   <pose>1.6078e-05 -1.0847e-05 -1.9891e-07 0 0 0</pose>
11                        <inertia>
12                             <ixx>6.914e-10</ixx>
13                             <ixy>0</ixy>
14                             <ixz>0</ixz>
15                             <iyy>1.0684e-09</iyy>
16                             <iyz>0</iyz>
17                             <izz>1.5341e-09</izz>
18                        </inertia>
19                   </inertial>
20                   <sensor name="tool_contact_sensor" type="contact">
21                        <always_on>true</always_on>
22                        <update_rate>30.0</update_rate>
23                        <contact>
24                             <collision>collision</collision>
25                        </contact>
26                        <plugin name="tool_bumper" filename="
                                libgazebo_ros_bumper.so">
27                             <bumperTopicName>
                                     tool_contact_sensor_state</
                                     bumperTopicName>
28                             <frameName>world</frameName>
29                        </plugin>
30                   </sensor>
31                   <collision name='collision'>
32                        <geometry>
33                             <mesh>
34                                  <uri>model://b_small_knife/
                                          b_small_knife.dae</uri>
35                             </mesh>
36                        </geometry>
37                        <surface>
38                             <friction>
39                                  <ode>
40                                       <mu>0.2</mu>
41                                       <mu2>0.2</mu2>
42                                  </ode>
43                             </friction>
44                        </surface>
45                   </collision>
46                   <visual name='visual'>
47                        <geometry>
48                             <mesh>
49                                  <uri>model://b_small_knife/
                                          b_small_knife.dae</uri>
50                             </mesh>
```

```
51                                        </geometry>
52                                   </visual>
53                         </link>
54             </model>
55     </sdf>
```

181   models/b$_s$mall$_k$nife/model.config

```xml
1  <?xml version="1.0"?>
2
3  <model>
4    <name>b_small_knife</name>
5    <version>1.0</version>
6    <sdf version="1.6">model.sdf</sdf>
7
8    <author>
9      <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
            name>
10     <email>bryanwang1992@outlook.com</email>
11   </author>
12
13   <description>
14     b_small_blue_knife
15   </description>
16
17 </model>
```

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3       <model name='b_spatula'>
4            <static>false</static>
5            <pose>0 0 0 0 0 0</pose>
6
7            <link name='link'>
8                 <inertial>
9                 <mass>0.11</mass>
10                <pose>0.00088072 -6.5132e-05 0.00086388 0 0 0</pose>
11                     <inertia>
12                          <ixx>8.1404e-07</ixx>
13                          <ixy>0</ixy>
14                          <ixz>0</ixz>
15                          <iyy>1.1521e-06</iyy>
16                          <iyz>0</iyz>
17                          <izz>5.3661e-07</izz>
18                     </inertia>
19                </inertial>
20
21                <sensor name="tool_contact_sensor" type="contact">
22                     <always_on>true</always_on>
23                     <update_rate>30.0</update_rate>
24                     <contact>
25                          <collision>collision</collision>
26                     </contact>
27                     <plugin name="tool_bumper" filename="
                            libgazebo_ros_bumper.so">
28                          <bumperTopicName>
                                   tool_contact_sensor_state</
                                   bumperTopicName>
29                          <frameName>world</frameName>
30                     </plugin>
31                </sensor>
32
33                <collision name='collision'>
34                     <geometry>
35                          <mesh>
36                               <uri>model://b_spatula/b_spatula
                                    .dae</uri>
37                          </mesh>
38                     </geometry>
39                     <surface>
40                          <friction>
41                               <ode>
42                                    <mu>0.2</mu>
43                                    <mu2>0.2</mu2>
44                               </ode>
45                          </friction>
46                     </surface>
47                </collision>
48                <visual name='visual'>
49                     <geometry>
50                          <mesh>
51                               <uri>model://b_spatula/b_spatula
```

```
                                                                    .dae</uri>
52                                             </mesh>
53                                        </geometry>
54                              </visual>
55                    </link>
56            </model>
57    </sdf>
```

183   models/b$_s$patula/model.config

```
1  <?xml version="1.0"?>
2
3  <model>
4    <name>b_spatula</name>
5    <version>1.0</version>
6    <sdf version="1.6">model.sdf</sdf>
7
8    <author>
9      <name>Frank Guerin, Pawel Gajewski, Paulo A. Ferreira and Wang Chaozheng</
           name>
10     <email>bryanwang1992@outlook.com</email>
11   </author>
12
13   <description>
14     b_spatula
15   </description>
16
17  </model>
```

184 models/b$_f$rying$_p$an/model.sdf

```
1  <?xml version='1.0'?>
2  <sdf version='1.6'>
3      <model name='b_frying_pan'>
4          <static>false</static>
5          <pose>0 0 0 0 0 0</pose>
6
7          <link name='link'>
8              <inertial>
9                  <mass>1</mass>
10                 <pose>0.002625 0.0 0.01465 0 0 0</pose>
11                 <inertia>
12                     <ixx>0.007971675</ixx>
13                     <iyy>0.008713309</iyy>
14                     <izz>0.016311566</izz>
15                     <ixy>-1.69694542e-019</ixy>
16                     <ixz>-0.000025788</ixz>
17                     <iyz>-6.28650663e-021</iyz>
18                 </inertia>
19             </inertial>t
20
21             <collision name='collision'>
22                 <geometry>
23                     <mesh>
24                         <uri>model://b_frying_pan/b_frying_pan.dae</uri>
25                     </mesh>
26                 </geometry>
27                 <surface>
28                     <friction>
29                         <ode>
30                             <mu>0.2</mu>
31                             <mu2>0.2</mu2>
32                         </ode>
33                     </friction>
34                 </surface>
35             </collision>
36             <visual name='visual'>
37                 <geometry>
38                     <mesh>
39                         <uri>model://b_frying_pan/b_frying_pan.dae</uri>
40                     </mesh>
41                 </geometry>
42             </visual>
43         </link>
44     </model>
45 </sdf>
```

185   models/b$_frying_pan$/model.config

```xml
1   <?xml version="1.0"?>
2
3   <model>
4       <name>b_frying_pan</name>
5       <version>1.0</version>
6       <sdf version='1.6'>model.sdf</sdf>
7
8       <author>
9           <name>Pawel Gajewski</name>
10          <email>pawel.gajewski@agh.edu.pl</email>
11      </author>
12
13      <description>
14          IAI lab frying pan.
15      </description>
16  </model>
```

```
 1  simulated_joints:
 2    - head_pan_joint
 3    - head_tilt_joint
 4    - torso_lift_joint
 5    - l_elbow_flex_joint
 6    - l_forearm_roll_joint
 7    - l_shoulder_lift_joint
 8    - l_shoulder_pan_joint
 9    - l_upper_arm_roll_joint
10    - l_wrist_flex_joint
11    - l_wrist_roll_joint
12    - r_elbow_flex_joint
13    - r_forearm_roll_joint
14    - r_shoulder_lift_joint
15    - r_shoulder_pan_joint
16    - r_upper_arm_roll_joint
17    - r_wrist_flex_joint
18    - r_wrist_roll_joint
19    - laser_tilt_mount_joint
20    - r_gripper_l_finger_joint
21    - r_gripper_r_finger_joint
22    - l_gripper_l_finger_joint
23    - l_gripper_r_finger_joint
24    - l_gripper_l_finger_tip_joint
25    - l_gripper_r_finger_tip_joint
26    - r_gripper_l_finger_tip_joint
27    - r_gripper_r_finger_tip_joint
28    - l_gripper_joint
29    - r_gripper_joint
30    - l_gripper_motor_screw_joint
31    - r_gripper_motor_screw_joint
32    - r_gripper_motor_slider_joint
33    - l_gripper_motor_slider_joint
34    - fl_caster_l_wheel_joint
35    - fl_caster_r_wheel_joint
36    - fr_caster_l_wheel_joint
37    - fr_caster_r_wheel_joint
38    - bl_caster_l_wheel_joint
39    - bl_caster_r_wheel_joint
40    - br_caster_l_wheel_joint
41    - br_caster_r_wheel_joint
42    - fl_caster_rotation_joint
43    - fr_caster_rotation_joint
44    - bl_caster_rotation_joint
45    - br_caster_rotation_joint
46    - torso_lift_motor_screw_joint
47
48  controlled_joints:
49    - head_pan_joint
50    - head_tilt_joint
51    - torso_lift_joint
52    - l_elbow_flex_joint
53    - l_forearm_roll_joint
54    - l_shoulder_lift_joint
55    - l_shoulder_pan_joint
```

```
56        - l_upper_arm_roll_joint
57        - l_wrist_flex_joint
58        - l_wrist_roll_joint
59        - r_elbow_flex_joint
60        - r_forearm_roll_joint
61        - r_shoulder_lift_joint
62        - r_shoulder_pan_joint
63        - r_upper_arm_roll_joint
64        - r_wrist_flex_joint
65        - r_wrist_roll_joint
66        - r_gripper_l_finger_joint
67        - r_gripper_r_finger_joint
68        - l_gripper_l_finger_joint
69        - l_gripper_r_finger_joint
70    start_config:
71        torso_lift_joint: 0.3007849430842053
72        head_pan_joint: -0.016552842705291115
73        head_tilt_joint: 0.7287556667322448
74        r_upper_arm_roll_joint: -1.3351230294970737
75        r_shoulder_pan_joint: -1.0489713192626062
76        r_shoulder_lift_joint: -0.0337662888586017
77        r_forearm_roll_joint: 4.954040580711836
78        r_elbow_flex_joint: -1.6954641064176876
79        r_wrist_flex_joint: -1.5742733400117634
80        r_wrist_roll_joint: -2.398480044745123
81        l_elbow_flex_joint: -1.1000206816083982
82        l_forearm_roll_joint: 0.8018847264145844
83        l_shoulder_lift_joint: 0.09913986734189655
84        l_shoulder_pan_joint: 0.5244532801685695
85        l_upper_arm_roll_joint: 0.5151343804663929
86        l_wrist_flex_joint: -0.6394288886084176
87        l_wrist_roll_joint: 6.7505988913485035
88    projection_mode: false
89    sim_frequency: 100
90    watchdog_period: 0.1
```

```
1   simulated_joints:
2     - head_pan_joint
3     - head_tilt_joint
4     - torso_lift_joint
5     - l_elbow_flex_joint
6     - l_forearm_roll_joint
7     - l_shoulder_lift_joint
8     - l_shoulder_pan_joint
9     - l_upper_arm_roll_joint
10    - l_wrist_flex_joint
11    - l_wrist_roll_joint
12    - r_elbow_flex_joint
13    - r_forearm_roll_joint
14    - r_shoulder_lift_joint
15    - r_shoulder_pan_joint
16    - r_upper_arm_roll_joint
17    - r_wrist_flex_joint
18    - r_wrist_roll_joint
19    - laser_tilt_mount_joint
20    - r_gripper_l_finger_joint
21    - r_gripper_r_finger_joint
22    - l_gripper_l_finger_joint
23    - l_gripper_r_finger_joint
24    - l_gripper_l_finger_tip_joint
25    - l_gripper_r_finger_tip_joint
26    - r_gripper_l_finger_tip_joint
27    - r_gripper_r_finger_tip_joint
28    - l_gripper_joint
29    - r_gripper_joint
30    - l_gripper_motor_screw_joint
31    - r_gripper_motor_screw_joint
32    - r_gripper_motor_slider_joint
33    - l_gripper_motor_slider_joint
34    - fl_caster_l_wheel_joint
35    - fl_caster_r_wheel_joint
36    - fr_caster_l_wheel_joint
37    - fr_caster_r_wheel_joint
38    - bl_caster_l_wheel_joint
39    - bl_caster_r_wheel_joint
40    - br_caster_l_wheel_joint
41    - br_caster_r_wheel_joint
42    - fl_caster_rotation_joint
43    - fr_caster_rotation_joint
44    - bl_caster_rotation_joint
45    - br_caster_rotation_joint
46    - torso_lift_motor_screw_joint
47
48  controlled_joints:
49    - head_pan_joint
50    - head_tilt_joint
51    - torso_lift_joint
52    - l_elbow_flex_joint
53    - l_forearm_roll_joint
54    - l_shoulder_lift_joint
55    - l_shoulder_pan_joint
```

```
56      - l_upper_arm_roll_joint
57      - l_wrist_flex_joint
58      - l_wrist_roll_joint
59      - r_elbow_flex_joint
60      - r_forearm_roll_joint
61      - r_shoulder_lift_joint
62      - r_shoulder_pan_joint
63      - r_upper_arm_roll_joint
64      - r_wrist_flex_joint
65      - r_wrist_roll_joint
66      - r_gripper_l_finger_joint
67      - r_gripper_r_finger_joint
68      - l_gripper_l_finger_joint
69      - l_gripper_r_finger_joint
70    start_config:
71      torso_lift_joint: 0.3000262665739086
72      head_pan_joint: -0.016552842705291115
73      head_tilt_joint: 0.7287556667322448
74      r_upper_arm_roll_joint: -0.9545442485020886
75      r_shoulder_pan_joint: -0.9763766874612734
76      r_shoulder_lift_joint: 0.5734009433853502
77      r_forearm_roll_joint: 5.26860285279
78      r_elbow_flex_joint: -1.6422521567729969
79      r_wrist_flex_joint: -1.5074640847105494
80      r_wrist_roll_joint: 1.90604009753
81      l_elbow_flex_joint: -1.00213547438
82      l_forearm_roll_joint: 0.834058592757
83      l_shoulder_lift_joint: 0.103903217692
84      l_shoulder_pan_joint: 0.3688738798
85      l_upper_arm_roll_joint: 0.730572260662
86      l_wrist_flex_joint: -1.34841376457
87      l_wrist_roll_joint: 7.00870758722
88    projection_mode: false
89    sim_frequency: 100
90    watchdog_period: 0.1
```

188   CMakeLists.txt

```
1  cmake_minimum_required(VERSION 2.8.3)
2  project(skill_transfer)
3
4  ## Compile as C++11, supported in ROS Kinetic and newer
5  add_compile_options(-std=c++11)
6
7  ## Find catkin dependencies
8  find_package(catkin REQUIRED COMPONENTS
9    roscpp
10   actionlib
11   message_generation
12   giskard_core
13   giskard_ros_utils
14   kdl_conversions
15   std_msgs
16   gazebo_msgs
17   gazebo_ros
18   sensor_msgs
19  )
20
21  ## Find Boost
22  find_package(Boost REQUIRED COMPONENTS
23    system
24    filesystem
25  )
26
27  # Depend on system install of Gazebo
28  find_package(gazebo REQUIRED)
29
30  # YAML library
31  find_library(YAML_CPP_LIBRARIES yaml-cpp)
32  if(NOT YAML_CPP_LIBRARIES)
33    # If yaml-cpp not found in the system, try finding it as a user CMake-
          generated project
34    find_package(yaml-cpp REQUIRED)
35    include_directories(${YAML_CPP_INCLUDE_DIRS})
36  endif(NOT YAML_CPP_LIBRARIES)
37
38
39  ## Add actions
40  add_action_files(DIRECTORY action FILES
41    MoveArm.action
42  )
43
44  ## Add messages
45  add_message_files(
46   FILES
47   StopCondition.msg
48  )
49
50  add_service_files(
51    FILES
52    DetectTargetObjectInfo.srv
53    DetectToolInfo.srv
54    GetTaskSpec.srv
```

```
55    GetMotionSpec.srv
56  )
57
58  ## Generate messages
59  generate_messages(
60    DEPENDENCIES
61    std_msgs
62    actionlib_msgs
63    geometry_msgs
64    sensor_msgs
65  )
66
67  ## Define catkin exports
68  catkin_package(
69    CATKIN_DEPENDS message_runtime roscpp actionlib
70    DEPENDS Boost gazebo_ros
71  )
72
73  ## Setup link dirs
74  link_directories(
75    ${GAZEBO_LIBRARY_DIRS}
76  )
77
78  ## Setup include dirs
79  include_directories(
80    include
81    ${catkin_INCLUDE_DIRS}
82    ${Boost_INCLUDE_DIRS}
83    ${GAZEBO_INCLUDE_DIRS}
84    ${YAML_CPP_INCLUDE_DIRS}
85  )
86
87  ## Constraint controller for PR2 pr2
88  add_executable(constraint_controller_pr2
89    src/constraint_controller_pr2.cpp
90    src/giskard_adapter.cpp
91  )
92  target_link_libraries(constraint_controller_pr2 ${catkin_LIBRARIES})
93  add_dependencies(constraint_controller_pr2 ${${PROJECT_NAME}_EXPORTED_TARGETS} $
        {catkin_EXPORTED_TARGETS})
94
95  ## Constraint controller for gazebo free_ees
96  add_executable(constraint_controller_free_ees
97    src/constraint_controller_free_ees.cpp
98    src/giskard_adapter.cpp
99  )
100  target_link_libraries(constraint_controller_free_ees ${catkin_LIBRARIES})
101  add_dependencies(constraint_controller_free_ees ${${PROJECT_NAME}
        _EXPORTED_TARGETS} ${catkin_EXPORTED_TARGETS})
102
103  ## Task executive
104  add_executable(task_executive
105    src/task_executive.cpp
106    src/twist_log.cpp
107  )
108  target_link_libraries(task_executive ${catkin_LIBRARIES})
109  add_dependencies(task_executive ${${PROJECT_NAME}_EXPORTED_TARGETS} ${
```

```
         catkin_EXPORTED_TARGETS })
110
111  ## Knowledge manager
112  add_executable(knowledge_manager
113    src/knowledge_manager.cpp
114  )
115  target_link_libraries(knowledge_manager ${catkin_LIBRARIES} ${YAML_CPP_LIBRARIES
         })
116  add_dependencies(knowledge_manager ${${PROJECT_NAME}_EXPORTED_TARGETS} ${
         catkin_EXPORTED_TARGETS })
117
118  ## Feature detector
119  add_executable(feature_detector
120    src/feature_detector.cpp
121  )
122  target_link_libraries(feature_detector ${catkin_LIBRARIES})
123  add_dependencies(feature_detector ${${PROJECT_NAME}_EXPORTED_TARGETS} ${
         catkin_EXPORTED_TARGETS })
124
125  # Gazebo Plugins
126
127  ## Force controller plugin
128  add_library(velocity_controller_plugin plugins/velocity_controller_plugin.cpp)
129  target_link_libraries(velocity_controller_plugin ${catkin_LIBRARIES} ${
         GAZEBO_LIBRARIES })
130
131  ## Force controller plugin
132  add_library(position_controller_plugin plugins/position_controller_plugin.cpp)
133  target_link_libraries(position_controller_plugin ${catkin_LIBRARIES} ${
         GAZEBO_LIBRARIES })
134
135  ## TF broadcaster plugin
136  add_library(tf_broadcaster_plugin plugins/tf_broadcaster_plugin.cpp)
137  target_link_libraries(tf_broadcaster_plugin ${catkin_LIBRARIES} ${
         GAZEBO_LIBRARIES })
138
139  ## Feature visualization plugin
140  add_library(giskard_visualization_plugin plugins/giskard_visualization_plugin.
         cpp)
141  target_link_libraries(giskard_visualization_plugin ${catkin_LIBRARIES} ${
         GAZEBO_LIBRARIES })
142
143  ## Grip plugin
144  add_library(GripPlugin plugins/GripPlugin.cc)
145  target_link_libraries(GripPlugin ${catkin_LIBRARIES} ${GAZEBO_LIBRARIES})
146
147  ## Stick plugin
148  add_library(StickPlugin plugins/StickPlugin.cc)
149  target_link_libraries(StickPlugin ${catkin_LIBRARIES} ${GAZEBO_LIBRARIES})
150
151  ## book_grasp plugin
152  add_library(TiltGrabPlugin plugins/TiltGrabPlugin.cc)
153  target_link_libraries(TiltGrabPlugin ${catkin_LIBRARIES} ${GAZEBO_LIBRARIES})
154
155  ## other_book_grasp plugin
156  add_library(OtherGraspPlugin plugins/OtherGraspPlugin.cc)
157  target_link_libraries(OtherGraspPlugin ${catkin_LIBRARIES} ${GAZEBO_LIBRARIES})
```

```
158
159   ## Grip plugin
160   add_library(GrainsFactoryPlugin plugins/GrainsFactoryPlugin.cc)
161   target_link_libraries(GrainsFactoryPlugin ${catkin_LIBRARIES} ${GAZEBO_LIBRARIES
          })
162
163   ## Grip plugin
164   add_library(LasagnaFactoryPlugin plugins/LasagnaFactoryPlugin.cc)
165   target_link_libraries(LasagnaFactoryPlugin ${catkin_LIBRARIES} ${
          GAZEBO_LIBRARIES})
166
167   ## Controller visualization Gazebo plugin
168   #add_library(controller_visualization_plugin src/controller_visualization_plugin
          .cpp)
169   #target_link_libraries(controller_visualization_plugin ${catkin_LIBRARIES} ${
          GAZEBO_LIBRARIES})
170
171   ## Install scripts and executables
172   # install(PROGRAMS
173   #    scripts/gen_numbers.py
174   #    DESTINATION ${CATKIN_PACKAGE_BIN_DESTINATION})
175
176   # install(TARGETS averaging_server averaging_client
177   #    ARCHIVE DESTINATION ${CATKIN_PACKAGE_LIB_DESTINATION}
178   #    LIBRARY DESTINATION ${CATKIN_PACKAGE_LIB_DESTINATION}
179   #    RUNTIME DESTINATION ${CATKIN_PACKAGE_BIN_DESTINATION})
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_wildo_bowl_b_table_knife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_table_knife</uri>
15             <pose>0.060878 0.497562 1.005864 1.616805 0 0</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.135713 0.488941 1.003983 0.274231 1.507716 1.875637</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_table_knife::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_wildo_bowl</uri>
30             <pose>0.078818 -0.501749 0.988186 3.097035 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_table_knife::link</childLinkName>
59                <relativePose>0.060878 -0.002438 0.005864 1.6168 0 0</relativePose
                      >
60              </plugin>
61
62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65              </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                      libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_wildo_bowl::link</childLinkName>
94                <relativePose>0.0089419 0.0135799 0.0780419 1.55636 1.32285
                      -1.41637</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                  libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106                 <camera name='user_camera'>
107                     <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                     <view_controller>orbit</view_controller>
109                 </camera>
110             </gui>
111
112        </world>
113    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3
4      <world name="grabbing_book_v">
5
6          <!-- <physics type="ode">
7              <max_step_size>0.001</max_step_size>
8              <real_time_factor>1</real_time_factor>
9              <real_time_update_rate>1000</real_time_update_rate>
10             <bullet>
11                 <solver>
12                     <iters>70</iters>
13                 </solver>
14             </bullet>
15             <ode>
16                 <solver>
17                     <iters>70</iters>
18                 </solver>
19             </ode>
20         </physics> -->
21
22         <include>
23             <uri>model://sun</uri>
24         </include>
25
26         <include>
27             <uri>model://ground_plane</uri>
28         </include>
29  <!--
30         <include>
31             <uri>model://finger</uri>
32             <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33         </include> -->
34
35         <include>
36             <uri>model://freezer_box</uri>
37             <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38         </include>
39
40
41
42         <model name='book_target'>
43           <static>false</static>
44           <pose>0.220000 0.000000 0.300000 1.570796 0.000000 0.000000</pose>
45
46           <link name='book_link'>
47             <pose frame='link'>0.0 0.0 0.0 0.0 0 0</pose>
48             <inertial>
49               <mass>0.1</mass>
50               <pose frame='link'>0.0 0.0 0.0 0 0 0</pose>
51               <inertia>
52                 <ixx>0.000666667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
53                 <ixy>0</ixy>
54                 <ixz>0</ixz>
55                 <iyy>0.000666667</iyy>
```

```
56              <iyz>0</iyz>
57              <izz>0.000666667</izz>
58            </inertia>
59          </inertial>
60          <collision name='book_collision'>
61            <geometry>
62              <box>
63                <size>0.2 0.2 0.2</size>
64              </box>
65            </geometry>
66            <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
67            <surface>
68              <friction>
69                <ode>
70                  <mu>0.2</mu>
71                  <mu2>0.2</mu2>
72                </ode>
73              </friction>
74            </surface>
75          </collision>
76          <visual name='book_visual'>
77            <geometry>
78              <box>
79                <size>0.2 0.2 0.2</size>
80              </box>
81            </geometry>
82            <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
83          </visual>
84          <sensor name="main_bumper" type="contact">
85            <selfCollide>true</selfCollide>
86            <alwaysOn>true</alwaysOn>
87            <updateRate>15.0</updateRate>
88            <contact>
89              <collision>book_collision</collision>
90            </contact>
91          </sensor>
92        </link>
93        <plugin name="target_tf_broadcaster" filename="
            libtf_broadcaster_plugin.so">
94          <linkName>book_link</linkName>
95          <frameName>book_object_frame</frameName>
96        </plugin>
97        <plugin name="grasp" filename="libTiltGrabPlugin.so">
98          <parentLinkName>book_link</parentLinkName>
99          <childLinkName1>left_ee::link</childLinkName1>
100         <childLinkName2>right_ee::link</childLinkName2>
101         <childLinkName3>right_ee_2::link</childLinkName3>
102         <sensorName>book_contact</sensorName>
103       </plugin>
104     </model>
105
106
107
108     <!-- Left Gripper -->
109     <include>
110         <uri>model://finger</uri>
111         <name>left_ee</name>
```

```
112                  <pose>0.000000  0.000000  0.880000  0.000000  0.000000  1.57080</pose>
113
114
115              <plugin name="l_force_controller" filename="
                     libvelocity_controller_plugin.so">
116               <linkName>link</linkName>
117               <topicName>set_l_ee_twist</topicName>
118               <gains>
119                 <linear>
120                   <P>100.0</P>
121                   <I>0.0</I>
122                   <D>25.0</D>
123                 </linear>
124                 <angular>
125                   <P>100.0</P>
126                   <I>0.0</I>
127                   <D>25.0</D>
128                 </angular>
129               </gains>
130              </plugin>
131
132              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                     so">
133               <linkName>link</linkName>
134               <frameName>l_gripper_tool_frame</frameName>
135              </plugin>
136          </include>
137
138          <!-- Right Gripper -->
139          <include>
140              <uri>model://finger</uri>
141              <name>right_ee</name>
142              <pose>0.600000  0.500000  0.830000  0.000000  0.000000  1.57080</pose>
143
144              <plugin name="r_force_controller" filename="
                     libvelocity_controller_plugin.so">
145               <linkName>link</linkName>
146               <topicName>set_r_ee_twist</topicName>
147               <gains>
148                 <linear>
149                   <P>100.0</P>
150                   <I>0.0</I>
151                   <D>25.0</D>
152                 </linear>
153                 <angular>
154                   <P>100.0</P>
155                   <I>0.0</I>
156                   <D>25.0</D>
157                 </angular>
158               </gains>
159              </plugin>
160
161              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                     so">
162               <linkName>link</linkName>
163               <frameName>r_gripper_tool_frame</frameName>
164              </plugin>
```

```
165            </include>
166
167            <include>
168                    <uri>model://finger</uri>
169                    <name>right_ee_2</name>
170                    <pose>0.600000 -0.500000 0.830000 0.000000 0.000000 1.57080</pose>
171
172                    <plugin name="r_2_force_controller" filename="
                          libvelocity_controller_plugin.so">
173                      <linkName>link</linkName>
174                      <topicName>set_r_ee_2_twist</topicName>
175                      <gains>
176                        <linear>
177                          <P>100.0</P>
178                          <I>0.0</I>
179                          <D>25.0</D>
180                        </linear>
181                        <angular>
182                          <P>100.0</P>
183                          <I>0.0</I>
184                          <D>25.0</D>
185                        </angular>
186                      </gains>
187                    </plugin>
188
189                    <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                          .so">
190                      <linkName>link</linkName>
191                      <frameName>r_2_gripper_tool_frame</frameName>
192                    </plugin>
193            </include>
194
195        <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
196
197        <gui>
198            <camera name='user_camera'>
199                    <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
200                    <view_controller>orbit</view_controller>
201            </camera>
202        </gui>
203
204      </world>
205  </sdf>
```

```xml
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="b_frying_pan_b_table_knife_v">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_table_knife</uri>
15              <pose>0.060878 0.497562 1.005864 1.616805 0 0</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.135713 0.488941 1.003983 0.274231 1.507716 1.875637</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                <parentLinkName>link</parentLinkName>
23                <childLinkName>b_table_knife::link</childLinkName>
24                <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_frying_pan</uri>
30              <pose>0.228443 -0.496122 0.971397 0 0 0</pose>
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40                <linkName>link</linkName>
41                <topicName>set_l_ee_twist</topicName>
42                <gains>
43                  <linear>
44                    <P>100.0</P>
45                    <I>0.0</I>
46                    <D>25.0</D>
47                  </linear>
48                  <angular>
49                    <P>100.0</P>
50                    <I>0.0</I>
51                    <D>25.0</D>
52                  </angular>
53                </gains>
54              </plugin>
```

```
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_table_knife::link</childLinkName>
59                <relativePose>0.060878 -0.002438 0.005864 1.6168 0 0</relativePose
                      >
60              </plugin>
61
62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65              </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                      libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_frying_pan::link</childLinkName>
94                <relativePose>0.0186144 0.0468562 0.224672 -1.55141 -1.36676
                      1.3834</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                      libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_pot_b_knife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_knife</uri>
15              <pose>0.090993 0.503448 0.999041 -1.609842 0 0</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.226360 0.495670 0.996721 1.200479 1.549194 2.743074</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                <parentLinkName>link</parentLinkName>
23                <childLinkName>b_knife::link</childLinkName>
24                <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_pot</uri>
30              <pose>0.133471 -0.503990 0.971217 0 0 0</pose>
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40                <linkName>link</linkName>
41                <topicName>set_l_ee_twist</topicName>
42                <gains>
43                  <linear>
44                    <P>100.0</P>
45                    <I>0.0</I>
46                    <D>25.0</D>
47                  </linear>
48                  <angular>
49                    <P>100.0</P>
50                    <I>0.0</I>
51                    <D>25.0</D>
52                  </angular>
53                </gains>
54              </plugin>
```

```
55
56            <plugin name="l_grip" filename="libGripPlugin.so">
57              <parentLinkName>link</parentLinkName>
58              <childLinkName>b_knife::link</childLinkName>
59              <relativePose>0.090993 0.003448 -0.000959 -1.60984 0 0</
                    relativePose>
60            </plugin>
61
62            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
63              <linkName>link</linkName>
64              <frameName>l_gripper_tool_frame</frameName>
65            </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70            <uri>model://gripper</uri>
71            <name>right_ee</name>
72            <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74            <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
75              <linkName>link</linkName>
76              <topicName>set_r_ee_twist</topicName>
77              <gains>
78                <linear>
79                  <P>100.0</P>
80                  <I>0.0</I>
81                  <D>25.0</D>
82                </linear>
83                <angular>
84                  <P>100.0</P>
85                  <I>0.0</I>
86                  <D>25.0</D>
87                </angular>
88              </gains>
89            </plugin>
90
91            <plugin name="r_grip" filename="libGripPlugin.so">
92              <parentLinkName>link</parentLinkName>
93              <childLinkName>b_pot::link</childLinkName>
94              <relativePose>0.023942 0.0237816 0.132364 -1.55141 -1.36676
                    1.3834</relativePose>
95            </plugin>
96
97            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
98              <linkName>link</linkName>
99              <frameName>r_gripper_tool_frame</frameName>
100           </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                    libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

193   worlds/grabbing$_b$ook4.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3
4      <world name="grabbing_book_v">
5
6          <!-- <physics type="ode">
7              <max_step_size>0.001</max_step_size>
8              <real_time_factor>1</real_time_factor>
9              <real_time_update_rate>1000</real_time_update_rate>
10             <bullet>
11                 <solver>
12                     <iters>70</iters>
13                 </solver>
14             </bullet>
15             <ode>
16                 <solver>
17                     <iters>70</iters>
18                 </solver>
19             </ode>
20         </physics> -->
21
22         <include>
23             <uri>model://sun</uri>
24         </include>
25
26         <include>
27             <uri>model://ground_plane</uri>
28         </include>
29 <!--
30         <include>
31             <uri>model://finger</uri>
32             <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33         </include> -->
34
35         <include>
36             <uri>model://bookshelf_</uri>
37             <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38         </include>
39
40         <!-- Books -->
41
42
43         <!--<include>
44             <uri>model://book</uri>
45             <name>book3</name>
46             <pose>0.150000 0.624000 0.475000 0.000000 0.000000 1.57080</pose>
47         </include> -->
48
49
50         <model name='book_target'>
51           <static>false</static>
52           <pose>0.150000 0.861000 0.585000 0.000000 0.000000 1.57080</pose>
53
54           <link name='book_link'>
55             <pose frame='link'>0 0 0 0 0 0</pose>
```

```
56              <inertial>
57                <mass>0.1</mass>
58                <pose frame='link'>0 0 0 0 0 0</pose>
59                <inertia>
60                  <ixx>0.000666667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
61                  <ixy>0</ixy>
62                  <ixz>0</ixz>
63                  <iyy>0.000666667</iyy>
64                  <iyz>0</iyz>
65                  <izz>0.000666667</izz>
66                </inertia>
67              </inertial>
68              <collision name='book_collision'>
69                <geometry>
70                  <box>
71                    <size>0.2 0.2 0.2</size>
72                  </box>
73                </geometry>
74                <pose frame=''>0 0 0 0 0 0</pose>
75                <surface>
76                  <friction>
77                    <ode>
78                      <mu>0.2</mu>
79                      <mu2>0.2</mu2>
80                    </ode>
81                  </friction>
82                </surface>
83              </collision>
84              <visual name='book_visual'>
85                <geometry>
86                  <box>
87                    <size>0.2 0.2 0.2</size>
88                  </box>
89                </geometry>
90                <pose frame=''>0 0 0 0 0 0</pose>
91              </visual>
92              <sensor name="main_bumper" type="contact">
93                <selfCollide>true</selfCollide>
94                <alwaysOn>true</alwaysOn>
95                <updateRate>15.0</updateRate>
96                <contact>
97                  <collision>book_collision</collision>
98                </contact>
99                <!--<plugin name="gazebo_ros_bumper_controller" filename="
                        libgazebo_ros_bumper.so">
100                 <bumperTopicName>bumper_vals</bumperTopicName>
101                 <frameName>book_target</frameName>
102               </plugin> -->
103             </sensor>
104           </link>
105           <plugin name="target_tf_broadcaster" filename="
                    libtf_broadcaster_plugin.so">
106             <linkName>book_link</linkName>
107             <frameName>book_object_frame</frameName>
108           </plugin>
109           <plugin name="grasp" filename="libTiltGrabPlugin.so">
110             <parentLinkName>book_link</parentLinkName>
```

```
111              <childLinkName1>left_ee::link</childLinkName1>
112              <childLinkName2>right_ee::link</childLinkName2>
113              <childLinkName3>right_ee_2::link</childLinkName3>
114              <sensorName>book_contact</sensorName>
115            </plugin>
116          </model>
117
118
119
120          <!-- Left Gripper -->
121          <include>
122              <uri>model://finger</uri>
123              <name>left_ee</name>
124              <pose>1.150000 0.661000 0.575000 0.000000 0.000000 1.57080</pose>
125
126
127              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
128                <linkName>link</linkName>
129                <topicName>set_l_ee_twist</topicName>
130                <gains>
131                  <linear>
132                    <P>100.0</P>
133                    <I>0.0</I>
134                    <D>25.0</D>
135                  </linear>
136                  <angular>
137                    <P>100.0</P>
138                    <I>0.0</I>
139                    <D>25.0</D>
140                  </angular>
141                </gains>
142              </plugin>
143
144              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
145                <linkName>link</linkName>
146                <frameName>l_gripper_tool_frame</frameName>
147              </plugin>
148          </include>
149
150          <!-- Right Gripper -->
151          <include>
152              <uri>model://finger</uri>
153              <name>right_ee</name>
154              <pose>1.150000 0.600000 0.475000 0.000000 0.000000 1.57080</pose>
155
156              <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
157                <linkName>link</linkName>
158                <topicName>set_r_ee_twist</topicName>
159                <gains>
160                  <linear>
161                    <P>100.0</P>
162                    <I>0.0</I>
163                    <D>25.0</D>
164                  </linear>
```

```
165              <angular>
166                <P>100.0</P>
167                <I>0.0</I>
168                <D>25.0</D>
169              </angular>
170            </gains>
171          </plugin>
172
173          <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                 so">
174            <linkName>link</linkName>
175            <frameName>r_gripper_tool_frame</frameName>
176          </plugin>
177        </include>
178
179        <include>
180          <uri>model://finger</uri>
181          <name>right_ee_2</name>
182          <pose>1.150000 0.7000000 0.475000 0.000000 0.000000 1.57080</pose>
183
184          <plugin name="r_2_force_controller" filename="
                 libvelocity_controller_plugin.so">
185            <linkName>link</linkName>
186            <topicName>set_r_ee_2_twist</topicName>
187            <gains>
188              <linear>
189                <P>100.0</P>
190                <I>0.0</I>
191                <D>25.0</D>
192              </linear>
193              <angular>
194                <P>100.0</P>
195                <I>0.0</I>
196                <D>25.0</D>
197              </angular>
198            </gains>
199          </plugin>
200
201          <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                 .so">
202            <linkName>link</linkName>
203            <frameName>r_2_gripper_tool_frame</frameName>
204          </plugin>
205        </include>
206
207        <plugin name="feature_visualization_plugin" filename="
                 libgiskard_visualization_plugin.so"></plugin>
208
209        <gui>
210          <camera name='user_camera'>
211              <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
212              <view_controller>orbit</view_controller>
213          </camera>
214        </gui>
215
216      </world>
217  </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_wildo_bowl_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.461945 1.549196 2.743082</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_wildo_bowl</uri>
30             <pose>0.078818 -0.501749 0.988186 3.097035 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
40                 libvelocity_controller_plugin.so">
41               <linkName>link</linkName>
42               <topicName>set_l_ee_twist</topicName>
43               <gains>
44                 <linear>
45                   <P>100.0</P>
46                   <I>0.0</I>
47                   <D>25.0</D>
48                 </linear>
49                 <angular>
50                   <P>100.0</P>
51                   <I>0.0</I>
52                   <D>25.0</D>
53                 </angular>
54               </gains>
55             </plugin>
```

```
55
56            <plugin name="l_grip" filename="libGripPlugin.so">
57              <parentLinkName>link</parentLinkName>
58              <childLinkName>b_spatula::link</childLinkName>
59              <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                   -3.14159</relativePose>
60            </plugin>
61
62            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                   so">
63              <linkName>link</linkName>
64              <frameName>l_gripper_tool_frame</frameName>
65            </plugin>
66        </include>
67
68        <!-- Right Gripper -->
69        <include>
70            <uri>model://gripper</uri>
71            <name>right_ee</name>
72            <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74            <plugin name="r_force_controller" filename="
                   libvelocity_controller_plugin.so">
75              <linkName>link</linkName>
76              <topicName>set_r_ee_twist</topicName>
77              <gains>
78                <linear>
79                  <P>100.0</P>
80                  <I>0.0</I>
81                  <D>25.0</D>
82                </linear>
83                <angular>
84                  <P>100.0</P>
85                  <I>0.0</I>
86                  <D>25.0</D>
87                </angular>
88              </gains>
89            </plugin>
90
91            <plugin name="r_grip" filename="libGripPlugin.so">
92              <parentLinkName>link</parentLinkName>
93              <childLinkName>b_wildo_bowl::link</childLinkName>
94              <relativePose>0.0089419 0.0135799 0.0780419 1.55636 1.32285
                   -1.41637</relativePose>
95            </plugin>
96
97            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                   so">
98              <linkName>link</linkName>
99              <frameName>r_gripper_tool_frame</frameName>
100           </plugin>
101       </include>
102
103       <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
104
105       <gui>
```

```
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

195 worlds/freezer$_b$ox3.world

```
 1  <?xml version='1.0'?>
 2  <sdf version="1.6">
 3
 4      <world name="grabbing_book_v">
 5
 6          <!-- <physics type="ode">
 7              <max_step_size>0.001</max_step_size>
 8              <real_time_factor>1</real_time_factor>
 9              <real_time_update_rate>1000</real_time_update_rate>
10              <bullet>
11                  <solver>
12                      <iters>70</iters>
13                  </solver>
14              </bullet>
15              <ode>
16                  <solver>
17                      <iters>70</iters>
18                  </solver>
19              </ode>
20          </physics> -->
21
22          <include>
23              <uri>model://sun</uri>
24          </include>
25
26          <include>
27              <uri>model://ground_plane</uri>
28          </include>
29  <!--
30          <include>
31              <uri>model://finger</uri>
32              <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33          </include> -->
34
35          <include>
36              <uri>model://freezer_box</uri>
37              <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38          </include>
39
40
41
42          <model name='book_target'>
43            <static>false</static>
44            <pose>0.220000 0.000000 0.300000 1.570796 0.000000 0.000000</pose>
45
46            <link name='book_link'>
47              <pose frame='link'>0.0 0.0 0.0 0.0 0 0</pose>
48              <inertial>
49                <mass>0.1</mass>
50                <pose frame='link'>0.0 0.0 0.0 0 0 0</pose>
51                <inertia>
52                  <ixx>0.00416666</ixx><!--  1/12 * m * (h^2 + d^2)  -->
53                  <ixy>0</ixy>
54                  <ixz>0</ixz>
55                  <iyy>0.00416666</iyy>
```

298

```
56                    <iyz>0</iyz>
57                    <izz>0.00416666</izz>
58                  </inertia>
59                </inertial>
60                <collision name='book_collision'>
61                  <geometry>
62                    <box>
63                      <size>0.5 0.5 0.5</size>
64                    </box>
65                  </geometry>
66                  <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
67                  <surface>
68                    <friction>
69                      <ode>
70                        <mu>0.2</mu>
71                        <mu2>0.2</mu2>
72                      </ode>
73                    </friction>
74                  </surface>
75                </collision>
76                <visual name='book_visual'>
77                  <geometry>
78                    <box>
79                      <size>0.5 0.5 0.5</size>
80                    </box>
81                  </geometry>
82                  <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
83                </visual>
84                <sensor name="main_bumper" type="contact">
85                  <selfCollide>true</selfCollide>
86                  <alwaysOn>true</alwaysOn>
87                  <updateRate>15.0</updateRate>
88                  <contact>
89                    <collision>book_collision</collision>
90                  </contact>
91                </sensor>
92              </link>
93              <plugin name="target_tf_broadcaster" filename="
                  libtf_broadcaster_plugin.so">
94                <linkName>book_link</linkName>
95                <frameName>book_object_frame</frameName>
96              </plugin>
97              <plugin name="grasp" filename="libTiltGrabPlugin.so">
98                <parentLinkName>book_link</parentLinkName>
99                <childLinkName1>left_ee::link</childLinkName1>
100               <childLinkName2>right_ee::link</childLinkName2>
101               <childLinkName3>right_ee_2::link</childLinkName3>
102               <sensorName>book_contact</sensorName>
103             </plugin>
104          </model>
105
106
107
108          <!-- Left Gripper -->
109          <include>
110              <uri>model://finger</uri>
111              <name>left_ee</name>
```

```
112                   <pose>0.000000 0.000000 0.880000 0.000000 0.000000 1.57080</pose>
113
114
115                   <plugin name="l_force_controller" filename="
                          libvelocity_controller_plugin.so">
116                     <linkName>link</linkName>
117                     <topicName>set_l_ee_twist</topicName>
118                     <gains>
119                       <linear>
120                         <P>100.0</P>
121                         <I>0.0</I>
122                         <D>25.0</D>
123                       </linear>
124                       <angular>
125                         <P>100.0</P>
126                         <I>0.0</I>
127                         <D>25.0</D>
128                       </angular>
129                     </gains>
130                   </plugin>
131
132                   <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
133                     <linkName>link</linkName>
134                     <frameName>l_gripper_tool_frame</frameName>
135                   </plugin>
136               </include>
137
138           <!-- Right Gripper -->
139           <include>
140               <uri>model://finger</uri>
141               <name>right_ee</name>
142               <pose>0.600000 0.500000 0.830000 0.000000 0.000000 1.57080</pose>
143
144                   <plugin name="r_force_controller" filename="
                          libvelocity_controller_plugin.so">
145                     <linkName>link</linkName>
146                     <topicName>set_r_ee_twist</topicName>
147                     <gains>
148                       <linear>
149                         <P>100.0</P>
150                         <I>0.0</I>
151                         <D>25.0</D>
152                       </linear>
153                       <angular>
154                         <P>100.0</P>
155                         <I>0.0</I>
156                         <D>25.0</D>
157                       </angular>
158                     </gains>
159                   </plugin>
160
161                   <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
162                     <linkName>link</linkName>
163                     <frameName>r_gripper_tool_frame</frameName>
164                   </plugin>
```

```
165            </include>
166
167            <include>
168                <uri>model://finger</uri>
169                <name>right_ee_2</name>
170                <pose>0.600000 -0.500000 0.830000 0.000000 0.000000 1.57080</pose>
171
172                <plugin name="r_2_force_controller" filename="
                       libvelocity_controller_plugin.so">
173                  <linkName>link</linkName>
174                  <topicName>set_r_ee_2_twist</topicName>
175                  <gains>
176                    <linear>
177                      <P>100.0</P>
178                      <I>0.0</I>
179                      <D>25.0</D>
180                    </linear>
181                    <angular>
182                      <P>100.0</P>
183                      <I>0.0</I>
184                      <D>25.0</D>
185                    </angular>
186                  </gains>
187                </plugin>
188
189                <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                       .so">
190                  <linkName>link</linkName>
191                  <frameName>r_2_gripper_tool_frame</frameName>
192                </plugin>
193            </include>
194
195         <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
196
197         <gui>
198             <camera name='user_camera'>
199                 <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
200                 <view_controller>orbit</view_controller>
201             </camera>
202         </gui>
203
204      </world>
205  </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="big_bowl_serving_spoon_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_serving_spoon</uri>
15             <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16         </include>
17
18         <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19             <pose>0.024164 -0.383989 0.959287 0 0 0</pose>
20             <mass>0.001</mass>
21             <radius>0.015</radius>
22             <quantity>100</quantity>
23             <friction>0.4</friction>
24             <friction2>0.4</friction2>
25             <velocity_decay>0.3</velocity_decay>
26         </plugin>
27
28         <include>
29             <uri>model://b_big_bowl</uri>
30             <pose>0.024164 -0.383989 0.959287 -0.017186 -0.000884 -0.101566</
                   pose>
31         </include>
32
33         <include>
34             <uri>model://table</uri>
35             <pose>0.021929 0.062805 -0.116833 0 0 -1.571974</pose>
36         </include>
37
38         <!-- Left Gripper -->
39         <include>
40             <uri>model://gripper</uri>
41             <name>left_ee</name>
42             <pose>0 0.5 1 0 0 0</pose>
43
44             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
45               <linkName>link</linkName>
46               <topicName>set_l_ee_twist</topicName>
47               <gains>
48                 <linear>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </linear>
53                 <angular>
```

```
54                        <P>100.0</P>
55                        <I>0.0</I>
56                        <D>25.0</D>
57                      </angular>
58                    </gains>
59                  </plugin>
60
61                  <plugin name="l_grip" filename="libGripPlugin.so">
62                    <parentLinkName>link</parentLinkName>
63                    <childLinkName>b_serving_spoon::link</childLinkName>
64                    <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                          1.3828344221275815 0.015398730956486372 0.08077832485708741</
                          relativePose>
65                  </plugin>
66
67                  <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
68                    <linkName>link</linkName>
69                    <frameName>l_gripper_tool_frame</frameName>
70                  </plugin>
71              </include>
72
73              <!-- Right Gripper -->
74              <include>
75                  <uri>model://gripper</uri>
76                  <name>right_ee</name>
77                  <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
78
79                  <plugin name="r_force_controller" filename="
                          libvelocity_controller_plugin.so">
80                    <linkName>link</linkName>
81                    <topicName>set_r_ee_twist</topicName>
82                    <gains>
83                      <linear>
84                        <P>100.0</P>
85                        <I>0.0</I>
86                        <D>25.0</D>
87                      </linear>
88                      <angular>
89                        <P>100.0</P>
90                        <I>0.0</I>
91                        <D>25.0</D>
92                      </angular>
93                    </gains>
94                  </plugin>
95
96                  <plugin name="r_grip" filename="libGripPlugin.so">
97                    <parentLinkName>link</parentLinkName>
98                    <childLinkName>b_big_bowl::link</childLinkName>
99                    <relativePose>0.06 0.11 0 -1.57 -1.35 1.3</relativePose>
100                 </plugin>
101
102                 <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
103                   <linkName>link</linkName>
104                   <frameName>r_gripper_tool_frame</frameName>
105                 </plugin>
```

```
106            </include>
107
108            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
109
110            <gui>
111                <camera name='user_camera'>
112                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
113                    <view_controller>orbit</view_controller>
114                </camera>
115            </gui>
116
117        </world>
118    </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="b_red_mug_b_serving_spoon_v">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_serving_spoon</uri>
15              <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16          </include>
17
18          <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19              <pose>0.061612 -0.504614 1.006537 0 0 0</pose>
20              <mass>0.001</mass>
21              <radius>0.015</radius>
22              <quantity>100</quantity>
23              <friction>0.4</friction>
24              <friction2>0.4</friction2>
25              <velocity_decay>0.3</velocity_decay>
26          </plugin>
27
28          <include>
29              <uri>model://b_red_mug</uri>
30              <pose>0.061612 -0.504614 1.006537 0.423677 0 3.060068</pose>
31          </include>
32
33          <include>
34              <uri>model://table</uri>
35              <pose>0.021929 0.062805 -0.066428 0 0 -1.571974</pose>
36          </include>
37          <!-- Left Gripper -->
38          <include>
39              <uri>model://gripper</uri>
40              <name>left_ee</name>
41              <pose>0 0.5 1 0 0 0</pose>
42
43              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
44                <linkName>link</linkName>
45                <topicName>set_l_ee_twist</topicName>
46                <gains>
47                  <linear>
48                    <P>100.0</P>
49                    <I>0.0</I>
50                    <D>25.0</D>
51                  </linear>
52                  <angular>
53                    <P>100.0</P>
54                    <I>0.0</I>
```

```xml
                  <D>25.0</D>
                </angular>
              </gains>
            </plugin>

            <plugin name="l_grip" filename="libGripPlugin.so">
              <parentLinkName>link</parentLinkName>
              <childLinkName>b_serving_spoon::link</childLinkName>
              <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                  1.382834221275815 0.015398730956486372 0.08077832485708741</
                  relativePose>
            </plugin>

            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                so">
              <linkName>link</linkName>
              <frameName>l_gripper_tool_frame</frameName>
            </plugin>
        </include>

        <!-- Right Gripper -->
        <include>
            <uri>model://gripper</uri>
            <name>right_ee</name>
            <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>

            <plugin name="r_force_controller" filename="
                libvelocity_controller_plugin.so">
              <linkName>link</linkName>
              <topicName>set_r_ee_twist</topicName>
              <gains>
                <linear>
                  <P>100.0</P>
                  <I>0.0</I>
                  <D>25.0</D>
                </linear>
                <angular>
                  <P>100.0</P>
                  <I>0.0</I>
                  <D>25.0</D>
                </angular>
              </gains>
            </plugin>

            <plugin name="r_grip" filename="libGripPlugin.so">
              <parentLinkName>link</parentLinkName>
              <childLinkName>b_red_mug::link</childLinkName>
              <relativePose>-0.00780861 0.00428533 0.0614876 1.24173 -1.34456
                  1.65836</relativePose>
            </plugin>

            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                so">
              <linkName>link</linkName>
              <frameName>r_gripper_tool_frame</frameName>
            </plugin>
        </include>
```

```
106
107          <plugin name="feature_visualization_plugin" filename="
                  libgiskard_visualization_plugin.so"></plugin>
108
109          <gui>
110              <camera name='user_camera'>
111                  <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                  <view_controller>orbit</view_controller>
113              </camera>
114          </gui>
115
116      </world>
117  </sdf>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version="1.6">
 3      <world name="b_frying_pan_b_knife_v">
 4
 5          <include>
 6              <uri>model://sun</uri>
 7          </include>
 8
 9          <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_knife</uri>
15              <pose>0.090993 0.503448 0.999041 -1.609842 0 0</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.226360 0.495670 0.996721 1.200479 1.549194 2.743074</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                <parentLinkName>link</parentLinkName>
23                <childLinkName>b_knife::link</childLinkName>
24                <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_frying_pan</uri>
30              <pose>0.228443 -0.496122 0.971397 0 0 0</pose>
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40                <linkName>link</linkName>
41                <topicName>set_l_ee_twist</topicName>
42                <gains>
43                  <linear>
44                    <P>100.0</P>
45                    <I>0.0</I>
46                    <D>25.0</D>
47                  </linear>
48                  <angular>
49                    <P>100.0</P>
50                    <I>0.0</I>
51                    <D>25.0</D>
52                  </angular>
53                </gains>
54              </plugin>
```

```xml
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_knife::link</childLinkName>
59                <relativePose>0.090993 0.003448 -0.000959 -1.60984 0 0</
                      relativePose>
60              </plugin>
61
62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65              </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                      libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_frying_pan::link</childLinkName>
94                <relativePose>0.0186144 0.0468562 0.224672 -1.55141 -1.36676
                      1.3834</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                  libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106                 <camera name='user_camera'>
107                     <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                     <view_controller>orbit</view_controller>
109                 </camera>
110             </gui>
111
112         </world>
113     </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_red_mug_b_table_knife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_table_knife</uri>
15             <pose>0.060878 0.497562 1.005864 1.616805 0 0</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.135713 0.488941 1.003983 0.274231 1.507716 1.875637</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_table_knife::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_red_mug</uri>
30             <pose>0.061612 -0.504614 1.006537 0.423677 0 3.060068</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_table_knife::link</childLinkName>
59                <relativePose>0.060878 -0.002438 0.005864 1.6168 0 0</relativePose
                     >
60              </plugin>
61
62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                     so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65              </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                     libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_red_mug::link</childLinkName>
94                <relativePose>-0.00780861 0.00428533 0.0614876 1.24173 -1.34456
                     1.65836</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                     so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                 libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106              <camera name='user_camera'>
107                  <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                  <view_controller>orbit</view_controller>
109              </camera>
110          </gui>
111
112      </world>
113  </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="scraping_b_frying_pan_a_chineseknife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://a_chineseknife</uri>
15             <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.204097 0.507730 0.981312 2.803252 1.368166 </pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22                 <parentLinkName>link</parentLinkName>
23                 <childLinkName>a_chineseknife::link</childLinkName>
24                 <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_frying_pan</uri>
30             <pose>0.024164 -0.383989 0.959287 -0.008482 0.014974 1.005299</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40                 <linkName>link</linkName>
41                 <topicName>set_l_ee_twist</topicName>
42                 <gains>
43                     <linear>
44                         <P>100.0</P>
45                         <I>0.0</I>
46                         <D>25.0</D>
47                     </linear>
48                     <angular>
49                         <P>100.0</P>
50                         <I>0.0</I>
51                         <D>25.0</D>
52                     </angular>
53                 </gains>
54             </plugin>
```

```
55
56            <plugin name="l_grip" filename="libGripPlugin.so">
57              <parentLinkName>link</parentLinkName>
58              <childLinkName>a_chineseknife::link</childLinkName>
59              <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                    1.3828344221275815 0.015398730956486372 0.08077832485708741</
                    relativePose>
60            </plugin>
61
62            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
63              <linkName>link</linkName>
64              <frameName>l_gripper_tool_frame</frameName>
65            </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>-0.090855 -0.578006 0.994380 1.547371 1.402340 1.343701</pose>
73
74              <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_frying_pan::link</childLinkName>
94                <relativePose>0.06 0.11 0 -1.57 -1.35 1.3</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                    libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="b_coffee_cup_b_serving_spoon_v">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_serving_spoon</uri>
15              <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.198795 0.509112 3.036336 1.368174 -1.866245</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                <parentLinkName>link</parentLinkName>
23                <childLinkName>b_serving_spoon::link</childLinkName>
24                <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_coffee_cup</uri>
30              <pose>-0.016492 -0.468631 0.965206 2.603069 -1.513021 -2.66073</pose
                  >
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_force_controller" filename="
                  libvelocity_controller_plugin.so">
40                <linkName>link</linkName>
41                <topicName>set_l_ee_twist</topicName>
42                <gains>
43                  <linear>
44                    <P>100.0</P>
45                    <I>0.0</I>
46                    <D>25.0</D>
47                  </linear>
48                  <angular>
49                    <P>100.0</P>
50                    <I>0.0</I>
51                    <D>25.0</D>
52                  </angular>
53                </gains>
```

```xml
54                    </plugin>
55
56                    <plugin name="l_grip" filename="libGripPlugin.so">
57                      <parentLinkName>link</parentLinkName>
58                      <childLinkName>b_serving_spoon::link</childLinkName>
59                      <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                              1.3828344221275815 0.015398730956486372 0.08077832485708741</
                              relativePose>
60                    </plugin>
61
62                    <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                              so">
63                      <linkName>link</linkName>
64                      <frameName>l_gripper_tool_frame</frameName>
65                    </plugin>
66                </include>
67
68            <!-- Right Gripper -->
69            <include>
70                    <uri>model://gripper</uri>
71                    <name>right_ee</name>
72                    <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74                    <plugin name="r_force_controller" filename="
                              libvelocity_controller_plugin.so">
75                      <linkName>link</linkName>
76                      <topicName>set_r_ee_twist</topicName>
77                      <gains>
78                        <linear>
79                          <P>100.0</P>
80                          <I>0.0</I>
81                          <D>25.0</D>
82                        </linear>
83                        <angular>
84                          <P>100.0</P>
85                          <I>0.0</I>
86                          <D>25.0</D>
87                        </angular>
88                      </gains>
89                    </plugin>
90
91                    <plugin name="r_grip" filename="libGripPlugin.so">
92                      <parentLinkName>link</parentLinkName>
93                      <childLinkName>b_coffee_cup::link</childLinkName>
94                      <relativePose>0.0284501 0.0346428 -0.0213798 2.93848 0.00496188
                              2.88401</relativePose>
95                    </plugin>
96
97                    <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                              so">
98                      <linkName>link</linkName>
99                      <frameName>r_gripper_tool_frame</frameName>
100                   </plugin>
101               </include>
102
103           <plugin name="feature_visualization_plugin" filename="
                        libgiskard_visualization_plugin.so"></plugin>
```

```
104
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="big_bowl_spatula_v">
4
5          <!-- <physics type="ode">
6              <max_step_size>0.001</max_step_size>
7              <real_time_factor>1</real_time_factor>
8              <real_time_update_rate>1000</real_time_update_rate>
9              <bullet>
10                 <solver>
11                     <iters>70</iters>
12                 </solver>
13             </bullet>
14             <ode>
15                 <solver>
16                     <iters>70</iters>
17                 </solver>
18             </ode>
19         </physics> -->
20
21         <include>
22             <uri>model://sun</uri>
23         </include>
24
25         <include>
26             <uri>model://ground_plane</uri>
27         </include>
28
29
30         <include>
31             <uri>model://bookshelf_</uri>
32             <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
33         </include>
34
35
36         <include>
37             <uri>model://book</uri>
38             <name>book_target</name>
39             <pose>0.150000 0.661000 0.475000 0.000000 0.000000 1.57080</pose>
40
41             <plugin name="target_tf_broadcaster" filename="
                   libtf_broadcaster_plugin.so">
42               <linkName>link</linkName>
43               <frameName>book_object_frame</frameName>
44             </plugin>
45         </include>
46
47
48
49         <!-- Left Gripper -->
50         <include>
51             <uri>model://finger</uri>
52             <name>left_ee</name>
53             <pose>1.150000 0.661000 0.575000 0.000000 0.000000 1.57080</pose>
54
```

```
 55
 56            <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
 57              <linkName>link</linkName>
 58              <topicName>set_l_ee_twist</topicName>
 59              <gains>
 60                <linear>
 61                  <P>100.0</P>
 62                  <I>0.0</I>
 63                  <D>25.0</D>
 64                </linear>
 65                <angular>
 66                  <P>100.0</P>
 67                  <I>0.0</I>
 68                  <D>25.0</D>
 69                </angular>
 70              </gains>
 71            </plugin>
 72
 73            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                   so">
 74              <linkName>link</linkName>
 75              <frameName>l_gripper_tool_frame</frameName>
 76            </plugin>
 77        </include>
 78
 79        <!-- Right Gripper -->
 80        <include>
 81            <uri>model://finger</uri>
 82            <name>right_ee</name>
 83            <pose>1.150000 0.600000 0.475000 0.000000 0.000000 1.57080</pose>
 84
 85            <plugin name="r_force_controller" filename="
                   libvelocity_controller_plugin.so">
 86              <linkName>link</linkName>
 87              <topicName>set_r_ee_twist</topicName>
 88              <gains>
 89                <linear>
 90                  <P>100.0</P>
 91                  <I>0.0</I>
 92                  <D>25.0</D>
 93                </linear>
 94                <angular>
 95                  <P>100.0</P>
 96                  <I>0.0</I>
 97                  <D>25.0</D>
 98                </angular>
 99              </gains>
100            </plugin>
101
102            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                   so">
103              <linkName>link</linkName>
104              <frameName>r_gripper_tool_frame</frameName>
105            </plugin>
106        </include>
107
```

```xml
108            <include>
109                <uri>model://finger</uri>
110                <name>right_ee_2</name>
111                <pose>1.150000 0.7000000 0.475000 0.000000 0.000000 1.57080</pose>
112
113                <plugin name="r_2_force_controller" filename="
                       libvelocity_controller_plugin.so">
114                  <linkName>link</linkName>
115                  <topicName>set_r_ee_2_twist</topicName>
116                  <gains>
117                    <linear>
118                      <P>100.0</P>
119                      <I>0.0</I>
120                      <D>25.0</D>
121                    </linear>
122                    <angular>
123                      <P>100.0</P>
124                      <I>0.0</I>
125                      <D>25.0</D>
126                    </angular>
127                  </gains>
128                </plugin>
129
130                <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                       .so">
131                  <linkName>link</linkName>
132                  <frameName>r_2_gripper_tool_frame</frameName>
133                </plugin>
134            </include>
135
136        <plugin name="feature_visualization_plugin" filename="
               libgiskard_visualization_plugin.so"></plugin>
137
138        <gui>
139            <camera name='user_camera'>
140                <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
141                <view_controller>orbit</view_controller>
142            </camera>
143        </gui>
144
145    </world>
146  </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="big_bowl_spatula_v">
4
5          <!-- <physics type="ode">
6              <max_step_size>0.001</max_step_size>
7              <real_time_factor>1</real_time_factor>
8              <real_time_update_rate>1000</real_time_update_rate>
9              <bullet>
10                  <solver>
11                      <iters>70</iters>
12                  </solver>
13              </bullet>
14              <ode>
15                  <solver>
16                      <iters>70</iters>
17                  </solver>
18              </ode>
19          </physics> -->
20
21          <include>
22              <uri>model://sun</uri>
23          </include>
24
25          <include>
26              <uri>model://ground_plane</uri>
27          </include>
28
29          <include>
30              <uri>model://b_spatula</uri>
31              <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
32          </include>
33
34          <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
35              <pose>0.024164 -0.383989 0.959287 0 0 0</pose>
36              <mass>0.001</mass>
37              <radius>0.015</radius>
38              <quantity>100</quantity>
39              <friction>0.4</friction>
40              <friction2>0.4</friction2>
41              <velocity_decay>0.3</velocity_decay>
42          </plugin>
43
44          <include>
45              <uri>model://b_big_bowl</uri>
46              <pose>0.024164 -0.383989 0.959287 -0.017186 -0.000884 -0.101566</
                  pose>
47          </include>
48
49          <include>
50              <uri>model://table</uri>
51              <pose>0.021929 0.062805 -0.116833 0 0 -1.571974</pose>
52          </include>
53
54          <!-- Left Gripper -->
```

```
55          <include>
56              <uri>model://gripper</uri>
57              <name>left_ee</name>
58              <pose>0  0.5  1  0  0  0</pose>
59
60              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
61                <linkName>link</linkName>
62                <topicName>set_l_ee_twist</topicName>
63                <gains>
64                  <linear>
65                    <P>0.1</P>
66                    <I>0.0</I>
67                    <D>0.02</D>
68                  </linear>
69                  <angular>
70                    <P>0.0001</P>
71                    <I>0.0</I>
72                    <D>0.000002</D>
73                  </angular>
74                </gains>
75              </plugin>
76
77              <plugin name="l_grip" filename="libGripPlugin.so">
78                <parentLinkName>link</parentLinkName>
79                <childLinkName>b_spatula::link</childLinkName>
80                <relativePose>0.14  0.028  -0.002  -1.57  3.20  0.20</relativePose>
81              </plugin>
82
83              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
84                <linkName>link</linkName>
85                <frameName>l_gripper_tool_frame</frameName>
86              </plugin>
87          </include>
88
89          <!-- Right Gripper -->
90          <include>
91              <uri>model://gripper</uri>
92              <name>right_ee</name>
93              <pose>0  -0.5  1  1.547368  1.402341  1.343703</pose>
94
95              <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
96                <linkName>link</linkName>
97                <topicName>set_r_ee_twist</topicName>
98                <gains>
99                  <linear>
100                   <P>0.1</P>
101                   <I>0.0</I>
102                   <D>0.02</D>
103                 </linear>
104                 <angular>
105                   <P>0.1</P>
106                   <I>0.0</I>
107                   <D>0.002</D>
108                 </angular>
```

```
109                     </gains>
110                 </plugin>
111
112                 <plugin name="r_grip" filename="libGripPlugin.so">
113                   <parentLinkName>link</parentLinkName>
114                   <childLinkName>b_big_bowl::link</childLinkName>
115                   <relativePose>0.06 0.11 0 -1.57 -1.35 1.3</relativePose>
116                 </plugin>
117
118                 <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                        so">
119                   <linkName>link</linkName>
120                   <frameName>r_gripper_tool_frame</frameName>
121                 </plugin>
122             </include>
123
124         <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
125
126         <gui>
127             <camera name='user_camera'>
128                 <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
129                 <view_controller>orbit</view_controller>
130             </camera>
131         </gui>
132
133     </world>
134 </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="b_coffee_cup_b_serving_spoon_v">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_serving_spoon</uri>
15              <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16          </include>
17
18          <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19              <pose>-0.016492 -0.468631 0.965206 0 0 0</pose>
20              <mass>0.001</mass>
21              <radius>0.015</radius>
22              <quantity>100</quantity>
23              <friction>0.4</friction>
24              <friction2>0.4</friction2>
25              <velocity_decay>0.3</velocity_decay>
26          </plugin>
27
28          <include>
29              <uri>model://b_coffee_cup</uri>
30              <pose>-0.016492 -0.468631 0.965206 2.603069 -1.513021 -2.66073</pose
                    >
31          </include>
32
33          <include>
34              <uri>model://table</uri>
35              <pose>0.021929 0.062805 -0.085745 0 0 -1.571974</pose>
36          </include>
37          <!-- Left Gripper -->
38          <include>
39              <uri>model://gripper</uri>
40              <name>left_ee</name>
41              <pose>0 0.5 1 0 0 0</pose>
42
43              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
44                <linkName>link</linkName>
45                <topicName>set_l_ee_twist</topicName>
46                <gains>
47                  <linear>
48                    <P>100.0</P>
49                    <I>0.0</I>
50                    <D>25.0</D>
51                  </linear>
52                  <angular>
53                    <P>100.0</P>
```

```
54              <I>0.0</I>
55              <D>25.0</D>
56            </angular>
57          </gains>
58        </plugin>
59
60        <plugin name="l_grip" filename="libGripPlugin.so">
61          <parentLinkName>link</parentLinkName>
62          <childLinkName>b_serving_spoon::link</childLinkName>
63          <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                1.3828344221275815 0.015398730956486372 0.08077832485708741</
                relativePose>
64        </plugin>
65
66        <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
              so">
67          <linkName>link</linkName>
68          <frameName>l_gripper_tool_frame</frameName>
69        </plugin>
70      </include>
71
72      <!-- Right Gripper -->
73      <include>
74        <uri>model://gripper</uri>
75        <name>right_ee</name>
76        <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
77
78        <plugin name="r_force_controller" filename="
              libvelocity_controller_plugin.so">
79          <linkName>link</linkName>
80          <topicName>set_r_ee_twist</topicName>
81          <gains>
82            <linear>
83              <P>100.0</P>
84              <I>0.0</I>
85              <D>25.0</D>
86            </linear>
87            <angular>
88              <P>100.0</P>
89              <I>0.0</I>
90              <D>25.0</D>
91            </angular>
92          </gains>
93        </plugin>
94
95        <plugin name="r_grip" filename="libGripPlugin.so">
96          <parentLinkName>link</parentLinkName>
97          <childLinkName>b_coffee_cup::link</childLinkName>
98          <relativePose>0.0284501 0.0346428 -0.0213798 2.93848 0.00496188
                2.88401</relativePose>
99        </plugin>
100
101        <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
              so">
102          <linkName>link</linkName>
103          <frameName>r_gripper_tool_frame</frameName>
104        </plugin>
```

```
105            </include>
106
107            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
108
109            <gui>
110                <camera name='user_camera'>
111                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                    <view_controller>orbit</view_controller>
113                </camera>
114            </gui>
115
116        </world>
117    </sdf>
```

205 worlds/scraping$_{bp}ot_{bt}hin_spatula_v$.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_pot_b_thin_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_thin_spatula</uri>
15             <pose>0.094321 0.507657 1.009274 -1.637236 0.074980 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.218391 0.495434 1.018867 1.118105 1.524620 2.552731</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22                 <parentLinkName>link</parentLinkName>
23                 <childLinkName>b_thin_spatula::link</childLinkName>
24                 <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_pot</uri>
30             <pose>0.133471 -0.503990 0.971217 0 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40                 <linkName>link</linkName>
41                 <topicName>set_l_ee_twist</topicName>
42                 <gains>
43                     <linear>
44                         <P>100.0</P>
45                         <I>0.0</I>
46                         <D>25.0</D>
47                     </linear>
48                     <angular>
49                         <P>100.0</P>
50                         <I>0.0</I>
51                         <D>25.0</D>
52                     </angular>
53                 </gains>
54             </plugin>
```

```
55
56             <plugin name="l_grip" filename="libGripPlugin.so">
57               <parentLinkName>link</parentLinkName>
58               <childLinkName>b_thin_spatula::link</childLinkName>
59               <relativePose>0.094321 0.007657 0.009274 -1.63724 0.07498
                     -3.14159</relativePose>
60             </plugin>
61
62             <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                   so">
63               <linkName>link</linkName>
64               <frameName>l_gripper_tool_frame</frameName>
65             </plugin>
66         </include>
67
68         <!-- Right Gripper -->
69         <include>
70             <uri>model://gripper</uri>
71             <name>right_ee</name>
72             <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74             <plugin name="r_force_controller" filename="
                   libvelocity_controller_plugin.so">
75               <linkName>link</linkName>
76               <topicName>set_r_ee_twist</topicName>
77               <gains>
78                 <linear>
79                   <P>100.0</P>
80                   <I>0.0</I>
81                   <D>25.0</D>
82                 </linear>
83                 <angular>
84                   <P>100.0</P>
85                   <I>0.0</I>
86                   <D>25.0</D>
87                 </angular>
88               </gains>
89             </plugin>
90
91             <plugin name="r_grip" filename="libGripPlugin.so">
92               <parentLinkName>link</parentLinkName>
93               <childLinkName>b_pot::link</childLinkName>
94               <relativePose>0.023942 0.0237816 0.132364 -1.55141 -1.36676
                     1.3834</relativePose>
95             </plugin>
96
97             <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                   so">
98               <linkName>link</linkName>
99               <frameName>r_gripper_tool_frame</frameName>
100            </plugin>
101        </include>
102
103        <plugin name="feature_visualization_plugin" filename="
                 libgiskard_visualization_plugin.so"></plugin>
104
105        <gui>
```

```
106                    <camera name='user_camera'>
107                        <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                        <view_controller>orbit</view_controller>
109                    </camera>
110                </gui>
111
112        </world>
113    </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_wildo_bowl_b_knife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_knife</uri>
15             <pose>0.090993 0.503448 0.999041 -1.609842 0 0</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.200479 1.549194 2.743074</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_knife::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_wildo_bowl</uri>
30             <pose>0.078818 -0.501749 0.988186 3.097035 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```xml
         <plugin name="l_grip" filename="libGripPlugin.so">
           <parentLinkName>link</parentLinkName>
           <childLinkName>b_knife::link</childLinkName>
           <relativePose>0.090993 0.003448 -0.000959 -1.60984 0 0</
               relativePose>
         </plugin>

         <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
             so">
           <linkName>link</linkName>
           <frameName>l_gripper_tool_frame</frameName>
         </plugin>
       </include>

       <!-- Right Gripper -->
       <include>
         <uri>model://gripper</uri>
         <name>right_ee</name>
         <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>

         <plugin name="r_force_controller" filename="
             libvelocity_controller_plugin.so">
           <linkName>link</linkName>
           <topicName>set_r_ee_twist</topicName>
           <gains>
             <linear>
               <P>100.0</P>
               <I>0.0</I>
               <D>25.0</D>
             </linear>
             <angular>
               <P>100.0</P>
               <I>0.0</I>
               <D>25.0</D>
             </angular>
           </gains>
         </plugin>

         <plugin name="r_grip" filename="libGripPlugin.so">
           <parentLinkName>link</parentLinkName>
           <childLinkName>b_wildo_bowl::link</childLinkName>
           <relativePose>0.0089419 0.0135799 0.0780419 1.55636 1.32285
               -1.41637</relativePose>
         </plugin>

         <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
             so">
           <linkName>link</linkName>
           <frameName>r_gripper_tool_frame</frameName>
         </plugin>
       </include>

       <plugin name="feature_visualization_plugin" filename="
           libgiskard_visualization_plugin.so"></plugin>

       <gui>
```

```
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version="1.6">
 3      <world name="b_pot_b_serving_spoon_v">
 4
 5          <include>
 6              <uri>model://sun</uri>
 7          </include>
 8
 9          <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_serving_spoon</uri>
15              <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16          </include>
17
18          <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19              <pose>0.133471 -0.503990 0.971217 0 0 0</pose>
20              <mass>0.001</mass>
21              <radius>0.015</radius>
22              <quantity>100</quantity>
23              <friction>0.4</friction>
24              <friction2>0.4</friction2>
25              <velocity_decay>0.3</velocity_decay>
26          </plugin>
27
28          <include>
29              <uri>model://b_pot</uri>
30              <pose>0.133471 -0.503990 0.971217 0 0 0</pose>
31          </include>
32
33          <include>
34              <uri>model://table</uri>
35              <pose>0.021929 0.062805 -0.079240 0 0 -1.571974</pose>
36          </include>
37          <!-- Left Gripper -->
38          <include>
39              <uri>model://gripper</uri>
40              <name>left_ee</name>
41              <pose>0 0.5 1 0 0 0</pose>
42
43              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
44                <linkName>link</linkName>
45                <topicName>set_l_ee_twist</topicName>
46                <gains>
47                  <linear>
48                    <P>100.0</P>
49                    <I>0.0</I>
50                    <D>25.0</D>
51                  </linear>
52                  <angular>
53                    <P>100.0</P>
54                    <I>0.0</I>
```

```xml
55                    <D>25.0</D>
56                  </angular>
57                </gains>
58              </plugin>
59
60              <plugin name="l_grip" filename="libGripPlugin.so">
61                <parentLinkName>link</parentLinkName>
62                <childLinkName>b_serving_spoon::link</childLinkName>
63                <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                      1.3828344221275815 0.015398730956486372 0.08077832485708741</
                      relativePose>
64              </plugin>
65
66              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
67                <linkName>link</linkName>
68                <frameName>l_gripper_tool_frame</frameName>
69              </plugin>
70          </include>
71
72          <!-- Right Gripper -->
73          <include>
74              <uri>model://gripper</uri>
75              <name>right_ee</name>
76              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
77
78              <plugin name="r_force_controller" filename="
                      libvelocity_controller_plugin.so">
79                <linkName>link</linkName>
80                <topicName>set_r_ee_twist</topicName>
81                <gains>
82                  <linear>
83                    <P>100.0</P>
84                    <I>0.0</I>
85                    <D>25.0</D>
86                  </linear>
87                  <angular>
88                    <P>100.0</P>
89                    <I>0.0</I>
90                    <D>25.0</D>
91                  </angular>
92                </gains>
93              </plugin>
94
95              <plugin name="r_grip" filename="libGripPlugin.so">
96                <parentLinkName>link</parentLinkName>
97                <childLinkName>b_pot::link</childLinkName>
98                <relativePose>0.023942 0.0237816 0.132364 -1.55141 -1.36676
                      1.3834</relativePose>
99              </plugin>
100
101             <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
102               <linkName>link</linkName>
103               <frameName>r_gripper_tool_frame</frameName>
104             </plugin>
105         </include>
```

```
106
107          <plugin name="feature_visualization_plugin" filename="
                 libgiskard_visualization_plugin.so"></plugin>
108
109          <gui>
110              <camera name='user_camera'>
111                  <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                  <view_controller>orbit</view_controller>
113              </camera>
114          </gui>
115
116      </world>
117  </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_wildo_bowl_b_thin_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_thin_spatula</uri>
15             <pose>0.094321 0.507657 1.009274 -1.637236 0.074980 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.218391 0.495434 1.018867 1.118105 1.524620 2.552731</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_thin_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_wildo_bowl</uri>
30             <pose>0.078818 -0.501749 0.988186 3.097035 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```
55
56            <plugin name="l_grip" filename="libGripPlugin.so">
57              <parentLinkName>link</parentLinkName>
58              <childLinkName>b_thin_spatula::link</childLinkName>
59              <relativePose>0.094321 0.007657 0.009274 -1.63724 0.07498
                    -3.14159</relativePose>
60            </plugin>
61
62            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
63              <linkName>link</linkName>
64              <frameName>l_gripper_tool_frame</frameName>
65            </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_wildo_bowl::link</childLinkName>
94                <relativePose>0.0089419 0.0135799 0.0780419 1.55636 1.32285
                      -1.41637</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                    libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

209 worlds/scraping$_{bf}rying_pan_{bs}patula_v$.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_frying_pan_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.461945 1.549196 2.743082</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_frying_pan</uri>
30             <pose>0.228443 -0.496122 0.971397 0 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
40                 libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```
55
56            <plugin name="l_grip" filename="libGripPlugin.so">
57              <parentLinkName>link</parentLinkName>
58              <childLinkName>b_spatula::link</childLinkName>
59              <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                    -3.14159</relativePose>
60            </plugin>
61
62            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
63              <linkName>link</linkName>
64              <frameName>l_gripper_tool_frame</frameName>
65            </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70            <uri>model://gripper</uri>
71            <name>right_ee</name>
72            <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74            <plugin name="r_force_controller" filename="
                  libvelocity_controller_plugin.so">
75              <linkName>link</linkName>
76              <topicName>set_r_ee_twist</topicName>
77              <gains>
78                <linear>
79                  <P>100.0</P>
80                  <I>0.0</I>
81                  <D>25.0</D>
82                </linear>
83                <angular>
84                  <P>100.0</P>
85                  <I>0.0</I>
86                  <D>25.0</D>
87                </angular>
88              </gains>
89            </plugin>
90
91            <plugin name="r_grip" filename="libGripPlugin.so">
92              <parentLinkName>link</parentLinkName>
93              <childLinkName>b_frying_pan::link</childLinkName>
94              <relativePose>0.0186144 0.0468562 0.224672 -1.55141 -1.36676
                    1.3834</relativePose>
95            </plugin>
96
97            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
98              <linkName>link</linkName>
99              <frameName>r_gripper_tool_frame</frameName>
100           </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106                 <camera name='user_camera'>
107                     <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                     <view_controller>orbit</view_controller>
109                 </camera>
110             </gui>
111
112         </world>
113     </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3
4       <world name="grabbing_book_v">
5
6           <!-- <physics type="ode">
7               <max_step_size>0.001</max_step_size>
8               <real_time_factor>1</real_time_factor>
9               <real_time_update_rate>1000</real_time_update_rate>
10              <bullet>
11                  <solver>
12                      <iters>70</iters>
13                  </solver>
14              </bullet>
15              <ode>
16                  <solver>
17                      <iters>70</iters>
18                  </solver>
19              </ode>
20          </physics> -->
21
22          <include>
23              <uri>model://sun</uri>
24          </include>
25
26          <include>
27              <uri>model://ground_plane</uri>
28          </include>
29  <!--
30          <include>
31              <uri>model://finger</uri>
32              <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33          </include> -->
34
35          <include>
36              <uri>model://bookshelf_</uri>
37              <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38          </include>
39
40          <!-- Books -->
41
42
43          <!--<include>
44              <uri>model://book</uri>
45              <name>book3</name>
46              <pose>0.150000 0.624000 0.475000 0.000000 0.000000 1.57080</pose>
47          </include> -->
48
49
50          <model name='book_target'>
51            <static>false</static>
52            <pose>0.150000 0.861000 0.585000 0.000000 0.000000 1.57080</pose>
53
54            <link name='book_link'>
55              <pose frame='link'>0 0 0 0 0 0</pose>
```

```
56              <inertial>
57                <mass>0.1</mass>
58                <pose frame='link'>0 0 0 0 0 0</pose>
59                <inertia>
60                  <ixx>0.00010416667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
61                  <ixy>0</ixy>
62                  <ixz>0</ixz>
63                  <iyy>0.00010416667</iyy>
64                  <iyz>0</iyz>
65                  <izz>0.00004166667</izz>
66                </inertia>
67              </inertial>
68              <collision name='book_collision'>
69                <geometry>
70                  <box>
71                    <size>0.05 0.05 0.1</size>
72                  </box>
73                </geometry>
74                <pose frame=''>0 0 0 0 0 0</pose>
75                <surface>
76                  <friction>
77                    <ode>
78                      <mu>0.2</mu>
79                      <mu2>0.2</mu2>
80                    </ode>
81                  </friction>
82                </surface>
83              </collision>
84              <visual name='book_visual'>
85                <geometry>
86                  <box>
87                    <size>0.05 0.05 0.1</size>
88                  </box>
89                </geometry>
90                <pose frame=''>0 0 0 0 0 0</pose>
91              </visual>
92              <sensor name="main_bumper" type="contact">
93                <selfCollide>true</selfCollide>
94                <alwaysOn>true</alwaysOn>
95                <updateRate>15.0</updateRate>
96                <contact>
97                  <collision>book_collision</collision>
98                </contact>
99                <!--<plugin name="gazebo_ros_bumper_controller" filename="
                        libgazebo_ros_bumper.so">
100                 <bumperTopicName>bumper_vals</bumperTopicName>
101                 <frameName>book_target</frameName>
102               </plugin> -->
103             </sensor>
104         </link>
105         <plugin name="target_tf_broadcaster" filename="
                    libtf_broadcaster_plugin.so">
106           <linkName>book_link</linkName>
107           <frameName>book_object_frame</frameName>
108         </plugin>
109         <plugin name="grasp" filename="libTiltGrabPlugin.so">
110           <parentLinkName>book_link</parentLinkName>
```

```
111                 <childLinkName1>left_ee::link</childLinkName1>
112                 <childLinkName2>right_ee::link</childLinkName2>
113                 <childLinkName3>right_ee_2::link</childLinkName3>
114                 <sensorName>book_contact</sensorName>
115             </plugin>
116         </model>
117
118
119
120         <!-- Left Gripper -->
121         <include>
122             <uri>model://finger</uri>
123             <name>left_ee</name>
124             <pose>1.150000 0.661000 0.575000 0.000000 0.000000 1.57080</pose>
125
126
127             <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
128               <linkName>link</linkName>
129               <topicName>set_l_ee_twist</topicName>
130               <gains>
131                 <linear>
132                   <P>100.0</P>
133                   <I>0.0</I>
134                   <D>25.0</D>
135                 </linear>
136                 <angular>
137                   <P>100.0</P>
138                   <I>0.0</I>
139                   <D>25.0</D>
140                 </angular>
141               </gains>
142             </plugin>
143
144             <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
145               <linkName>link</linkName>
146               <frameName>l_gripper_tool_frame</frameName>
147             </plugin>
148         </include>
149
150         <!-- Right Gripper -->
151         <include>
152             <uri>model://finger</uri>
153             <name>right_ee</name>
154             <pose>1.150000 0.600000 0.475000 0.000000 0.000000 1.57080</pose>
155
156             <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
157               <linkName>link</linkName>
158               <topicName>set_r_ee_twist</topicName>
159               <gains>
160                 <linear>
161                   <P>100.0</P>
162                   <I>0.0</I>
163                   <D>25.0</D>
164                 </linear>
```

```
165                <angular>
166                    <P>100.0</P>
167                    <I>0.0</I>
168                    <D>25.0</D>
169                </angular>
170              </gains>
171            </plugin>
172
173            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
174              <linkName>link</linkName>
175              <frameName>r_gripper_tool_frame</frameName>
176            </plugin>
177        </include>
178
179        <include>
180            <uri>model://finger</uri>
181            <name>right_ee_2</name>
182            <pose>1.150000 0.7000000 0.475000 0.000000 0.000000 1.57080</pose>
183
184            <plugin name="r_2_force_controller" filename="
                    libvelocity_controller_plugin.so">
185              <linkName>link</linkName>
186              <topicName>set_r_ee_2_twist</topicName>
187              <gains>
188                <linear>
189                    <P>100.0</P>
190                    <I>0.0</I>
191                    <D>25.0</D>
192                </linear>
193                <angular>
194                    <P>100.0</P>
195                    <I>0.0</I>
196                    <D>25.0</D>
197                </angular>
198              </gains>
199            </plugin>
200
201            <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                    .so">
202              <linkName>link</linkName>
203              <frameName>r_2_gripper_tool_frame</frameName>
204            </plugin>
205        </include>
206
207        <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
208
209        <gui>
210            <camera name='user_camera'>
211                <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
212                <view_controller>orbit</view_controller>
213            </camera>
214        </gui>
215
216    </world>
217 </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_bucket_b_serving_spoon_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_serving_spoon</uri>
15             <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16         </include>
17
18         <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19             <pose>0.100858 -0.510180 0.939254 0 0 0</pose>
20             <mass>0.001</mass>
21             <radius>0.015</radius>
22             <quantity>100</quantity>
23             <friction>0.4</friction>
24             <friction2>0.4</friction2>
25             <velocity_decay>0.3</velocity_decay>
26         </plugin>
27
28         <include>
29             <uri>model://b_bucket</uri>
30             <pose>0.100858 -0.510180 0.939254 -3.128475 -0.140461 3.129033</pose
                >
31         </include>
32
33         <include>
34             <uri>model://table</uri>
35             <pose>0.021929 0.062805 -0.137579 0 0 -1.571974</pose>
36         </include>
37
38         <!-- Left Gripper -->
39         <include>
40             <uri>model://gripper</uri>
41             <name>left_ee</name>
42             <pose>0 0.5 1 0 0 0</pose>
43
44             <plugin name="l_force_controller" filename="
                  libvelocity_controller_plugin.so">
45               <linkName>link</linkName>
46               <topicName>set_l_ee_twist</topicName>
47               <gains>
48                 <linear>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </linear>
53                 <angular>
```

```
54              <P>100.0</P>
55              <I>0.0</I>
56              <D>25.0</D>
57            </angular>
58          </gains>
59        </plugin>
60
61        <plugin name="l_grip" filename="libGripPlugin.so">
62          <parentLinkName>link</parentLinkName>
63          <childLinkName>b_serving_spoon::link</childLinkName>
64          <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                  1.3828344221275815 0.015398730956486372 0.08077832485708741</
                  relativePose>
65        </plugin>
66
67        <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
              so">
68          <linkName>link</linkName>
69          <frameName>l_gripper_tool_frame</frameName>
70        </plugin>
71      </include>
72
73      <!-- Right Gripper -->
74      <include>
75        <uri>model://gripper</uri>
76        <name>right_ee</name>
77        <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
78
79        <plugin name="r_force_controller" filename="
              libvelocity_controller_plugin.so">
80          <linkName>link</linkName>
81          <topicName>set_r_ee_twist</topicName>
82          <gains>
83            <linear>
84              <P>100.0</P>
85              <I>0.0</I>
86              <D>25.0</D>
87            </linear>
88            <angular>
89              <P>100.0</P>
90              <I>0.0</I>
91              <D>25.0</D>
92            </angular>
93          </gains>
94        </plugin>
95
96        <plugin name="r_grip" filename="libGripPlugin.so">
97          <parentLinkName>link</parentLinkName>
98          <childLinkName>b_bucket::link</childLinkName>
99          <relativePose>0.0577053 0.0189525 0.101375 2.17015 1.31252
              2.31211</relativePose>
100       </plugin>
101
102       <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
              so">
103         <linkName>link</linkName>
104         <frameName>r_gripper_tool_frame</frameName>
```

```
105                    </plugin>
106                </include>
107
108            <plugin name="feature_visualization_plugin" filename="
                    libgiskard_visualization_plugin.so"></plugin>
109
110            <gui>
111                <camera name='user_camera'>
112                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
113                    <view_controller>orbit</view_controller>
114                </camera>
115            </gui>
116
117        </world>
118    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_red_mug_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.461945 1.549196 2.743082</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_red_mug</uri>
30             <pose>0.061612 -0.504614 1.006537 0.423677 0 3.060068</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                  libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_spatula::link</childLinkName>
59                <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                      -3.14159</relativePose>
60              </plugin>
61
62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65              </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                      libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_red_mug::link</childLinkName>
94                <relativePose>-0.00780861 0.00428533 0.0614876 1.24173 -1.34456
                      1.65836</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                  libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

213 worlds/scraping$_{br}ed_mug_{bs}erving_spoon_v$.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_red_mug_b_serving_spoon_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_serving_spoon</uri>
15             <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.198795 0.509112 0.981783 3.036336 1.368174 -1.866245</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_serving_spoon::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_red_mug</uri>
30             <pose>0.061612 -0.504614 1.006537 0.423677 0 3.060068</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```xml
55
56            <plugin name="l_grip" filename="libGripPlugin.so">
57              <parentLinkName>link</parentLinkName>
58              <childLinkName>b_serving_spoon::link</childLinkName>
59              <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                      1.3828344221275815 0.015398730956486372 0.08077832485708741</
                      relativePose>
60            </plugin>
61
62            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
63              <linkName>link</linkName>
64              <frameName>l_gripper_tool_frame</frameName>
65            </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                      libvelocity_controller_plugin.so">
75              <linkName>link</linkName>
76              <topicName>set_r_ee_twist</topicName>
77              <gains>
78                <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                </linear>
83                <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                </angular>
88              </gains>
89            </plugin>
90
91            <plugin name="r_grip" filename="libGripPlugin.so">
92              <parentLinkName>link</parentLinkName>
93              <childLinkName>b_red_mug::link</childLinkName>
94              <relativePose>-0.00780861 0.00428533 0.0614876 1.24173 -1.34456
                      1.65836</relativePose>
95            </plugin>
96
97            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
98              <linkName>link</linkName>
99              <frameName>r_gripper_tool_frame</frameName>
100           </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                  libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_red_mug_b_thin_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_thin_spatula</uri>
15             <pose>0.094321 0.507657 1.009274 -1.637236 0.074980 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.218391 0.495434 1.018867 1.118105 1.524620 2.552731</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_thin_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_red_mug</uri>
30             <pose>0.061612 -0.504614 1.006537 0.423677 0 3.060068</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_thin_spatula::link</childLinkName>
59                <relativePose>0.094321 0.007657 0.009274 -1.63724 0.07498
                      -3.14159</relativePose>
60            </plugin>
61
62            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65            </plugin>
66        </include>
67
68        <!-- Right Gripper -->
69        <include>
70            <uri>model://gripper</uri>
71            <name>right_ee</name>
72            <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74            <plugin name="r_force_controller" filename="
                  libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89            </plugin>
90
91            <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_red_mug::link</childLinkName>
94                <relativePose>-0.00780861 0.00428533 0.0614876 1.24173 -1.34456
                      1.65836</relativePose>
95            </plugin>
96
97            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100           </plugin>
101       </include>
102
103       <plugin name="feature_visualization_plugin" filename="
                  libgiskard_visualization_plugin.so"></plugin>
104
105       <gui>
```

358

```
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

215 worlds/grabbing$_b$ook6.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3
4      <world name="grabbing_book_v">
5
6          <!-- <physics type="ode">
7              <max_step_size>0.001</max_step_size>
8              <real_time_factor>1</real_time_factor>
9              <real_time_update_rate>1000</real_time_update_rate>
10             <bullet>
11                 <solver>
12                     <iters>70</iters>
13                 </solver>
14             </bullet>
15             <ode>
16                 <solver>
17                     <iters>70</iters>
18                 </solver>
19             </ode>
20         </physics> -->
21
22         <include>
23             <uri>model://sun</uri>
24         </include>
25
26         <include>
27             <uri>model://ground_plane</uri>
28         </include>
29  <!--
30         <include>
31             <uri>model://finger</uri>
32             <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33         </include> -->
34
35         <include>
36             <uri>model://bookshelf_</uri>
37             <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38         </include>
39
40         <!-- Books -->
41
42
43         <!--<include>
44             <uri>model://book</uri>
45             <name>book3</name>
46             <pose>0.150000 0.624000 0.475000 0.000000 0.000000 1.57080</pose>
47         </include> -->
48
49
50         <model name='book_target'>
51           <static>false</static>
52           <pose>0.150000 0.861000 0.585000 0.000000 0.000000 1.57080</pose>
53
54           <link name='book_link'>
55             <pose frame='link'>0 0 0 0 0 0</pose>
```

```
56              <inertial>
57                <mass>0.1</mass>
58                <pose frame='link'>0 0 0 0 0 0</pose>
59                <inertia>
60                  <ixx>0.00041666667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
61                  <ixy>0</ixy>
62                  <ixz>0</ixz>
63                  <iyy>0.00010416667</iyy>
64                  <iyz>0</iyz>
65                  <izz>0.00035416667</izz>
66                </inertia>
67              </inertial>
68              <collision name='book_collision'>
69                <geometry>
70                  <box>
71                    <size>0.05 0.2 0.1</size>
72                  </box>
73                </geometry>
74                <pose frame=''>0 0 0 0 0 0</pose>
75                <surface>
76                  <friction>
77                    <ode>
78                      <mu>0.2</mu>
79                      <mu2>0.2</mu2>
80                    </ode>
81                  </friction>
82                </surface>
83              </collision>
84              <visual name='book_visual'>
85                <geometry>
86                  <box>
87                    <size>0.05 0.2 0.1</size>
88                  </box>
89                </geometry>
90                <pose frame=''>0 0 0 0 0 0</pose>
91              </visual>
92              <sensor name="main_bumper" type="contact">
93                <selfCollide>true</selfCollide>
94                <alwaysOn>true</alwaysOn>
95                <updateRate>15.0</updateRate>
96                <contact>
97                  <collision>book_collision</collision>
98                </contact>
99                <!--<plugin name="gazebo_ros_bumper_controller" filename="
                       libgazebo_ros_bumper.so">
100                  <bumperTopicName>bumper_vals</bumperTopicName>
101                  <frameName>book_target</frameName>
102                </plugin> -->
103              </sensor>
104            </link>
105            <plugin name="target_tf_broadcaster" filename="
                   libtf_broadcaster_plugin.so">
106              <linkName>book_link</linkName>
107              <frameName>book_object_frame</frameName>
108            </plugin>
109            <plugin name="grasp" filename="libTiltGrabPlugin.so">
110              <parentLinkName>book_link</parentLinkName>
```

```xml
                <childLinkName1>left_ee::link</childLinkName1>
                <childLinkName2>right_ee::link</childLinkName2>
                <childLinkName3>right_ee_2::link</childLinkName3>
                <sensorName>book_contact</sensorName>
            </plugin>
        </model>



        <!-- Left Gripper -->
        <include>
            <uri>model://finger</uri>
            <name>left_ee</name>
            <pose>1.150000 0.661000 0.575000 0.000000 0.000000 1.57080</pose>


            <plugin name="l_force_controller" filename="
                libvelocity_controller_plugin.so">
              <linkName>link</linkName>
              <topicName>set_l_ee_twist</topicName>
              <gains>
                <linear>
                  <P>100.0</P>
                  <I>0.0</I>
                  <D>25.0</D>
                </linear>
                <angular>
                  <P>100.0</P>
                  <I>0.0</I>
                  <D>25.0</D>
                </angular>
              </gains>
            </plugin>

            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                so">
              <linkName>link</linkName>
              <frameName>l_gripper_tool_frame</frameName>
            </plugin>
        </include>

        <!-- Right Gripper -->
        <include>
            <uri>model://finger</uri>
            <name>right_ee</name>
            <pose>1.150000 0.600000 0.475000 0.000000 0.000000 1.57080</pose>

            <plugin name="r_force_controller" filename="
                libvelocity_controller_plugin.so">
              <linkName>link</linkName>
              <topicName>set_r_ee_twist</topicName>
              <gains>
                <linear>
                  <P>100.0</P>
                  <I>0.0</I>
                  <D>25.0</D>
                </linear>
```

```
165                    <angular>
166                      <P>100.0</P>
167                      <I>0.0</I>
168                      <D>25.0</D>
169                    </angular>
170                  </gains>
171                </plugin>
172
173                <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                       so">
174                  <linkName>link</linkName>
175                  <frameName>r_gripper_tool_frame</frameName>
176                </plugin>
177            </include>
178
179            <include>
180                <uri>model://finger</uri>
181                <name>right_ee_2</name>
182                <pose>1.150000 0.7000000 0.475000 0.000000 0.000000 1.57080</pose>
183
184                <plugin name="r_2_force_controller" filename="
                       libvelocity_controller_plugin.so">
185                  <linkName>link</linkName>
186                  <topicName>set_r_ee_2_twist</topicName>
187                  <gains>
188                    <linear>
189                      <P>100.0</P>
190                      <I>0.0</I>
191                      <D>25.0</D>
192                    </linear>
193                    <angular>
194                      <P>100.0</P>
195                      <I>0.0</I>
196                      <D>25.0</D>
197                    </angular>
198                  </gains>
199                </plugin>
200
201                <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                       .so">
202                  <linkName>link</linkName>
203                  <frameName>r_2_gripper_tool_frame</frameName>
204                </plugin>
205            </include>
206
207            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
208
209            <gui>
210                <camera name='user_camera'>
211                    <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
212                    <view_controller>orbit</view_controller>
213                </camera>
214            </gui>
215
216        </world>
217  </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_bucket_b_thin_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_thin_spatula</uri>
15             <pose>0.094321 0.507657 1.009274 -1.637236 0.074980 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.218391 0.495434 1.018867 1.118105 1.524620 2.552731</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_thin_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_bucket</uri>
30             <pose>0.100858 -0.510180 0.939254 -3.128475 -0.140461 3.129033</pose
                   >
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
```

```xml
54              </plugin>

56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_thin_spatula::link</childLinkName>
59                <relativePose>0.094321 0.007657 0.009274 -1.63724 0.07498
                    -3.14159</relativePose>
60              </plugin>

62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65              </plugin>
66          </include>

68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>

74              <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>

91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_bucket::link</childLinkName>
94                <relativePose>0.0577053 0.0189525 0.101375 2.17015 1.31252
                    2.31211</relativePose>
95              </plugin>

97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>

103         <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3
4      <world name="grabbing_book_v">
5
6          <!-- <physics type="ode">
7              <max_step_size>0.001</max_step_size>
8              <real_time_factor>1</real_time_factor>
9              <real_time_update_rate>1000</real_time_update_rate>
10             <bullet>
11                 <solver>
12                     <iters>70</iters>
13                 </solver>
14             </bullet>
15             <ode>
16                 <solver>
17                     <iters>70</iters>
18                 </solver>
19             </ode>
20         </physics> -->
21
22         <include>
23             <uri>model://sun</uri>
24         </include>
25
26         <include>
27             <uri>model://ground_plane</uri>
28         </include>
29  <!--
30         <include>
31             <uri>model://finger</uri>
32             <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33         </include> -->
34
35         <include>
36             <uri>model://bookshelf_ </uri>
37             <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38         </include>
39
40         <!-- Books -->
41
42
43         <!--<include>
44             <uri>model://book</uri>
45             <name>book3</name>
46             <pose>0.150000 0.624000 0.475000 0.000000 0.000000 1.57080</pose>
47         </include> -->
48
49
50         <model name='book_target'>
51           <static>false</static>
52           <pose>0.150000 0.861000 0.585000 0.000000 0.000000 1.57080</pose>
53
54           <link name='book_link'>
55             <pose frame='link'>0 0 0 0 0 0</pose>
```

```
56               <inertial>
57                 <mass>0.1</mass>
58                 <pose frame='link'>0 0 0 0 0 0</pose>
59                 <inertia>
60                   <ixx>0.00016666667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
61                   <ixy>0</ixy>
62                   <ixz>0</ixz>
63                   <iyy>0.00010416667</iyy>
64                   <iyz>0</iyz>
65                   <izz>0.00010416667</izz>
66                 </inertia>
67               </inertial>
68               <collision name='book_collision'>
69                 <geometry>
70                   <box>
71                     <size>0.05 0.1 0.1</size>
72                   </box>
73                 </geometry>
74                 <pose frame=''>0 0 0 0 0 0</pose>
75                 <surface>
76                   <friction>
77                     <ode>
78                       <mu>0.2</mu>
79                       <mu2>0.2</mu2>
80                     </ode>
81                   </friction>
82                 </surface>
83               </collision>
84               <visual name='book_visual'>
85                 <geometry>
86                   <box>
87                     <size>0.05 0.1 0.1</size>
88                   </box>
89                 </geometry>
90                 <pose frame=''>0 0 0 0 0 0</pose>
91               </visual>
92               <sensor name="main_bumper" type="contact">
93                 <selfCollide>true</selfCollide>
94                 <alwaysOn>true</alwaysOn>
95                 <updateRate>15.0</updateRate>
96                 <contact>
97                   <collision>book_collision</collision>
98                 </contact>
99                 <!--<plugin name="gazebo_ros_bumper_controller" filename="
                       libgazebo_ros_bumper.so">
100                   <bumperTopicName>bumper_vals</bumperTopicName>
101                   <frameName>book_target</frameName>
102                 </plugin> -->
103               </sensor>
104           </link>
105           <plugin name="target_tf_broadcaster" filename="
                   libtf_broadcaster_plugin.so">
106             <linkName>book_link</linkName>
107             <frameName>book_object_frame</frameName>
108           </plugin>
109           <plugin name="grasp" filename="libTiltGrabPlugin.so">
110             <parentLinkName>book_link</parentLinkName>
```

```xml
            <childLinkName1>left_ee::link</childLinkName1>
            <childLinkName2>right_ee::link</childLinkName2>
            <childLinkName3>right_ee_2::link</childLinkName3>
            <sensorName>book_contact</sensorName>
          </plugin>
        </model>



        <!-- Left Gripper -->
        <include>
            <uri>model://finger</uri>
            <name>left_ee</name>
            <pose>1.150000 0.661000 0.575000 0.000000 0.000000 1.57080</pose>


            <plugin name="l_force_controller" filename="
                libvelocity_controller_plugin.so">
              <linkName>link</linkName>
              <topicName>set_l_ee_twist</topicName>
              <gains>
                <linear>
                  <P>100.0</P>
                  <I>0.0</I>
                  <D>25.0</D>
                </linear>
                <angular>
                  <P>100.0</P>
                  <I>0.0</I>
                  <D>25.0</D>
                </angular>
              </gains>
            </plugin>

            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                so">
              <linkName>link</linkName>
              <frameName>l_gripper_tool_frame</frameName>
            </plugin>
        </include>

        <!-- Right Gripper -->
        <include>
            <uri>model://finger</uri>
            <name>right_ee</name>
            <pose>1.150000 0.600000 0.475000 0.000000 0.000000 1.57080</pose>

            <plugin name="r_force_controller" filename="
                libvelocity_controller_plugin.so">
              <linkName>link</linkName>
              <topicName>set_r_ee_twist</topicName>
              <gains>
                <linear>
                  <P>100.0</P>
                  <I>0.0</I>
                  <D>25.0</D>
                </linear>
```

```
165              <angular>
166                <P>100.0</P>
167                <I>0.0</I>
168                <D>25.0</D>
169              </angular>
170            </gains>
171          </plugin>
172
173          <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
174            <linkName>link</linkName>
175            <frameName>r_gripper_tool_frame</frameName>
176          </plugin>
177        </include>
178
179        <include>
180          <uri>model://finger</uri>
181          <name>right_ee_2</name>
182          <pose>1.150000  0.7000000  0.475000  0.000000  0.000000  1.57080</pose>
183
184          <plugin name="r_2_force_controller" filename="
                  libvelocity_controller_plugin.so">
185            <linkName>link</linkName>
186            <topicName>set_r_ee_2_twist</topicName>
187            <gains>
188              <linear>
189                <P>100.0</P>
190                <I>0.0</I>
191                <D>25.0</D>
192              </linear>
193              <angular>
194                <P>100.0</P>
195                <I>0.0</I>
196                <D>25.0</D>
197              </angular>
198            </gains>
199          </plugin>
200
201          <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                  .so">
202            <linkName>link</linkName>
203            <frameName>r_2_gripper_tool_frame</frameName>
204          </plugin>
205        </include>
206
207        <plugin name="feature_visualization_plugin" filename="
                  libgiskard_visualization_plugin.so"></plugin>
208
209        <gui>
210          <camera name='user_camera'>
211              <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
212              <view_controller>orbit</view_controller>
213          </camera>
214        </gui>
215
216      </world>
217  </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_big_bowl_b_knife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_knife</uri>
15             <pose>0.090993 0.503448 0.999041 -1.609842 0 0</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.200479 1.549194 2.743074</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_knife::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_big_bowl</uri>
30             <pose>0.024164 -0.383989 0.959287 -0.017186 -0.000884 -0.101566</
                  pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                  libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
```

```xml
54                </plugin>
55
56                <plugin name="l_grip" filename="libGripPlugin.so">
57                  <parentLinkName>link</parentLinkName>
58                  <childLinkName>b_knife::link</childLinkName>
59                  <relativePose>0.090993 0.003448 -0.000959 -1.60984 0 0</
                        relativePose>
60                </plugin>
61
62                <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                        so">
63                  <linkName>link</linkName>
64                  <frameName>l_gripper_tool_frame</frameName>
65                </plugin>
66            </include>
67
68            <!-- Right Gripper -->
69            <include>
70                <uri>model://gripper</uri>
71                <name>right_ee</name>
72                <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74                <plugin name="r_force_controller" filename="
                        libvelocity_controller_plugin.so">
75                  <linkName>link</linkName>
76                  <topicName>set_r_ee_twist</topicName>
77                  <gains>
78                    <linear>
79                      <P>100.0</P>
80                      <I>0.0</I>
81                      <D>25.0</D>
82                    </linear>
83                    <angular>
84                      <P>100.0</P>
85                      <I>0.0</I>
86                      <D>25.0</D>
87                    </angular>
88                  </gains>
89                </plugin>
90
91                <plugin name="r_grip" filename="libGripPlugin.so">
92                  <parentLinkName>link</parentLinkName>
93                  <childLinkName>b_big_bowl::link</childLinkName>
94                  <relativePose>0.06 0.11 0 -1.57 -1.35 1.3</relativePose>
95                </plugin>
96
97                <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                        so">
98                  <linkName>link</linkName>
99                  <frameName>r_gripper_tool_frame</frameName>
100               </plugin>
101           </include>
102
103           <plugin name="feature_visualization_plugin" filename="
                    libgiskard_visualization_plugin.so"></plugin>
104
105           <gui>
```

```
106                  <camera name='user_camera'>
107                      <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                      <view_controller>orbit</view_controller>
109                  </camera>
110              </gui>
111
112          </world>
113      </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_frying_pan_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16         </include>
17
18         <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19             <pose>0.228443 -0.496122 0.971397 0 0 0</pose>
20             <mass>0.001</mass>
21             <radius>0.015</radius>
22             <quantity>100</quantity>
23             <friction>0.4</friction>
24             <friction2>0.4</friction2>
25             <velocity_decay>0.3</velocity_decay>
26         </plugin>
27
28         <include>
29             <uri>model://b_frying_pan</uri>
30             <pose>0.228443 -0.496122 0.971397 0 0 0</pose>
31         </include>
32
33         <include>
34             <uri>model://table</uri>
35             <pose>0.021929 0.062805 -0.065959 0 0 -1.571974</pose>
36         </include>
37         <!-- Left Gripper -->
38         <include>
39             <uri>model://gripper</uri>
40             <name>left_ee</name>
41             <pose>0 0.5 1 0 0 0</pose>
42
43             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
44               <linkName>link</linkName>
45               <topicName>set_l_ee_twist</topicName>
46               <gains>
47                 <linear>
48                   <P>100.0</P>
49                   <I>0.0</I>
50                   <D>25.0</D>
51                 </linear>
52                 <angular>
53                   <P>100.0</P>
54                   <I>0.0</I>
```

```
55              <D>25.0</D>
56            </angular>
57          </gains>
58        </plugin>
59
60        <plugin name="l_grip" filename="libGripPlugin.so">
61          <parentLinkName>link</parentLinkName>
62          <childLinkName>b_spatula::link</childLinkName>
63          <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                  -3.14159</relativePose>
64        </plugin>
65
66        <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
67          <linkName>link</linkName>
68          <frameName>l_gripper_tool_frame</frameName>
69        </plugin>
70      </include>
71
72      <!-- Right Gripper -->
73      <include>
74          <uri>model://gripper</uri>
75          <name>right_ee</name>
76          <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
77
78          <plugin name="r_force_controller" filename="
                  libvelocity_controller_plugin.so">
79          <linkName>link</linkName>
80          <topicName>set_r_ee_twist</topicName>
81          <gains>
82            <linear>
83              <P>100.0</P>
84              <I>0.0</I>
85              <D>25.0</D>
86            </linear>
87            <angular>
88              <P>100.0</P>
89              <I>0.0</I>
90              <D>25.0</D>
91            </angular>
92          </gains>
93        </plugin>
94
95        <plugin name="r_grip" filename="libGripPlugin.so">
96          <parentLinkName>link</parentLinkName>
97          <childLinkName>b_frying_pan::link</childLinkName>
98          <relativePose>0.0186144 0.0468562 0.224672 -1.55141 -1.36676
                  1.3834</relativePose>
99        </plugin>
100
101        <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
102          <linkName>link</linkName>
103          <frameName>r_gripper_tool_frame</frameName>
104        </plugin>
105      </include>
106
```

```
107            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
108
109            <gui>
110                <camera name='user_camera'>
111                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                    <view_controller>orbit</view_controller>
113                </camera>
114            </gui>
115
116        </world>
117    </sdf>
```

220   worlds/scraping$_{bb}ig_bowl_{bt}hin_spatula_v$.world

```xml
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="b_big_bowl_b_thin_spatula_v">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_thin_spatula</uri>
15              <pose>0.094321 0.507657 1.009274 -1.637236 0.074980 -3.141592</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.218391 0.495434 1.018867 1.118105 1.524620 2.552731</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                  <parentLinkName>link</parentLinkName>
23                  <childLinkName>b_thin_spatula::link</childLinkName>
24                  <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_big_bowl</uri>
30              <pose>0.024164 -0.383989 0.959287 -0.017186 -0.000884 -0.101566</
                    pose>
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40                  <linkName>link</linkName>
41                  <topicName>set_l_ee_twist</topicName>
42                  <gains>
43                      <linear>
44                          <P>100.0</P>
45                          <I>0.0</I>
46                          <D>25.0</D>
47                      </linear>
48                      <angular>
49                          <P>100.0</P>
50                          <I>0.0</I>
51                          <D>25.0</D>
52                      </angular>
53                  </gains>
```

```
54                </plugin>
55
56                <plugin name="l_grip" filename="libGripPlugin.so">
57                  <parentLinkName>link</parentLinkName>
58                  <childLinkName>b_thin_spatula::link</childLinkName>
59                  <relativePose>0.094321 0.007657 0.009274 -1.63724 0.07498
                        -3.14159</relativePose>
60                </plugin>
61
62                <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                        so">
63                  <linkName>link</linkName>
64                  <frameName>l_gripper_tool_frame</frameName>
65                </plugin>
66            </include>
67
68            <!-- Right Gripper -->
69            <include>
70                <uri>model://gripper</uri>
71                <name>right_ee</name>
72                <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74                <plugin name="r_force_controller" filename="
                        libvelocity_controller_plugin.so">
75                  <linkName>link</linkName>
76                  <topicName>set_r_ee_twist</topicName>
77                  <gains>
78                    <linear>
79                      <P>100.0</P>
80                      <I>0.0</I>
81                      <D>25.0</D>
82                    </linear>
83                    <angular>
84                      <P>100.0</P>
85                      <I>0.0</I>
86                      <D>25.0</D>
87                    </angular>
88                  </gains>
89                </plugin>
90
91                <plugin name="r_grip" filename="libGripPlugin.so">
92                  <parentLinkName>link</parentLinkName>
93                  <childLinkName>b_big_bowl::link</childLinkName>
94                  <relativePose>0.06 0.11 0 -1.57 -1.35 1.3</relativePose>
95                </plugin>
96
97                <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                        so">
98                  <linkName>link</linkName>
99                  <frameName>r_gripper_tool_frame</frameName>
100               </plugin>
101           </include>
102
103           <plugin name="feature_visualization_plugin" filename="
                    libgiskard_visualization_plugin.so"></plugin>
104
105           <gui>
```

```
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

221 worlds/scraping$_{bc}offee_cup_{bt}able_knife_v$.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_coffee_cup_b_table_knife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_table_knife</uri>
15             <pose>0.060878 0.497562 1.005864 1.616805 0 0</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.135713 0.488941 1.003983 0.274231 1.507716 1.875637</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_table_knife::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_coffee_cup</uri>
30             <pose>-0.016492 -0.468631 0.965206 2.603069 -1.513021 -2.66073</pose
                   >
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
```

```xml
54                    </plugin>
55
56                    <plugin name="l_grip" filename="libGripPlugin.so">
57                      <parentLinkName>link</parentLinkName>
58                      <childLinkName>b_table_knife::link</childLinkName>
59                      <relativePose>0.060878 -0.002438 0.005864 1.6168 0 0</relativePose
                          >
60                    </plugin>
61
62                    <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
63                      <linkName>link</linkName>
64                      <frameName>l_gripper_tool_frame</frameName>
65                    </plugin>
66              </include>
67
68              <!-- Right Gripper -->
69              <include>
70                    <uri>model://gripper</uri>
71                    <name>right_ee</name>
72                    <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74                    <plugin name="r_force_controller" filename="
                          libvelocity_controller_plugin.so">
75                      <linkName>link</linkName>
76                      <topicName>set_r_ee_twist</topicName>
77                      <gains>
78                        <linear>
79                          <P>100.0</P>
80                          <I>0.0</I>
81                          <D>25.0</D>
82                        </linear>
83                        <angular>
84                          <P>100.0</P>
85                          <I>0.0</I>
86                          <D>25.0</D>
87                        </angular>
88                      </gains>
89                    </plugin>
90
91                    <plugin name="r_grip" filename="libGripPlugin.so">
92                      <parentLinkName>link</parentLinkName>
93                      <childLinkName>b_coffee_cup::link</childLinkName>
94                      <relativePose>0.0284501 0.0346428 -0.0213798 2.93848 0.00496188
                          2.88401</relativePose>
95                    </plugin>
96
97                    <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
98                      <linkName>link</linkName>
99                      <frameName>r_gripper_tool_frame</frameName>
100                   </plugin>
101             </include>
102
103             <plugin name="feature_visualization_plugin" filename="
                      libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3
4       <world name="grabbing_book_v">
5
6           <!-- <physics type="ode">
7                   <max_step_size>0.001</max_step_size>
8                   <real_time_factor>1</real_time_factor>
9                   <real_time_update_rate>1000</real_time_update_rate>
10                  <bullet>
11                      <solver>
12                          <iters>70</iters>
13                      </solver>
14                  </bullet>
15                  <ode>
16                      <solver>
17                          <iters>70</iters>
18                      </solver>
19                  </ode>
20          </physics> -->
21
22          <include>
23              <uri>model://sun</uri>
24          </include>
25
26          <include>
27              <uri>model://ground_plane</uri>
28          </include>
29  <!--
30          <include>
31              <uri>model://finger</uri>
32              <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33          </include> -->
34
35          <include>
36              <uri>model://bookshelf_</uri>
37              <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38          </include>
39
40          <!-- Books -->
41
42
43          <!--<include>
44              <uri>model://book</uri>
45              <name>book3</name>
46              <pose>0.150000 0.624000 0.475000 0.000000 0.000000 1.57080</pose>
47          </include> -->
48
49
50          <model name='book_target'>
51            <static>false</static>
52            <pose>0.150000 0.861000 0.585000 0.000000 0.000000 1.57080</pose>
53
54            <link name='book_link'>
55              <pose frame='link'>0 0 0 0 0 0</pose>
```

```
56                    <inertial>
57                      <mass>0.1</mass>
58                      <pose frame='link'>0 0 0 0 0 0</pose>
59                      <inertia>
60                        <ixx>0.000666667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
61                        <ixy>0</ixy>
62                        <ixz>0</ixz>
63                        <iyy>0.00035416667</iyy>
64                        <iyz>0</iyz>
65                        <izz>0.00035416667</izz>
66                      </inertia>
67                    </inertial>
68                    <collision name='book_collision'>
69                      <geometry>
70                        <box>
71                          <size>0.05 0.2 0.2</size>
72                        </box>
73                      </geometry>
74                      <pose frame=''>0 0 0 0 0 0</pose>
75                      <surface>
76                        <friction>
77                          <ode>
78                            <mu>0.2</mu>
79                            <mu2>0.2</mu2>
80                          </ode>
81                        </friction>
82                      </surface>
83                    </collision>
84                    <visual name='book_visual'>
85                      <geometry>
86                        <box>
87                          <size>0.05 0.2 0.2</size>
88                        </box>
89                      </geometry>
90                      <pose frame=''>0 0 0 0 0 0</pose>
91                    </visual>
92                    <sensor name="main_bumper" type="contact">
93                      <selfCollide>true</selfCollide>
94                      <alwaysOn>true</alwaysOn>
95                      <updateRate>15.0</updateRate>
96                      <contact>
97                        <collision>book_collision</collision>
98                      </contact>
99                      <!--<plugin name="gazebo_ros_bumper_controller" filename="
                            libgazebo_ros_bumper.so">
100                       <bumperTopicName>bumper_vals</bumperTopicName>
101                       <frameName>book_target</frameName>
102                      </plugin> -->
103                    </sensor>
104                  </link>
105                  <plugin name="target_tf_broadcaster" filename="
                          libtf_broadcaster_plugin.so">
106                    <linkName>book_link</linkName>
107                    <frameName>book_object_frame</frameName>
108                  </plugin>
109                  <plugin name="grasp" filename="libTiltGrabPlugin.so">
110                    <parentLinkName>book_link</parentLinkName>
```

```
111            <childLinkName1>left_ee::link</childLinkName1>
112            <childLinkName2>right_ee::link</childLinkName2>
113            <childLinkName3>right_ee_2::link</childLinkName3>
114            <sensorName>book_contact</sensorName>
115          </plugin>
116        </model>
117
118
119
120        <!-- Left Gripper -->
121        <include>
122            <uri>model://finger</uri>
123            <name>left_ee</name>
124            <pose>1.150000 0.661000 0.575000 0.000000 0.000000 1.57080</pose>
125
126
127            <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
128              <linkName>link</linkName>
129              <topicName>set_l_ee_twist</topicName>
130              <gains>
131                <linear>
132                  <P>100.0</P>
133                  <I>0.0</I>
134                  <D>25.0</D>
135                </linear>
136                <angular>
137                  <P>100.0</P>
138                  <I>0.0</I>
139                  <D>25.0</D>
140                </angular>
141              </gains>
142            </plugin>
143
144            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                   so">
145              <linkName>link</linkName>
146              <frameName>l_gripper_tool_frame</frameName>
147            </plugin>
148        </include>
149
150        <!-- Right Gripper -->
151        <include>
152            <uri>model://finger</uri>
153            <name>right_ee</name>
154            <pose>1.150000 0.600000 0.475000 0.000000 0.000000 1.57080</pose>
155
156            <plugin name="r_force_controller" filename="
                   libvelocity_controller_plugin.so">
157              <linkName>link</linkName>
158              <topicName>set_r_ee_twist</topicName>
159              <gains>
160                <linear>
161                  <P>100.0</P>
162                  <I>0.0</I>
163                  <D>25.0</D>
164                </linear>
```

```
165                    <angular>
166                      <P>100.0</P>
167                      <I>0.0</I>
168                      <D>25.0</D>
169                    </angular>
170                  </gains>
171                </plugin>
172
173                <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                       so">
174                  <linkName>link</linkName>
175                  <frameName>r_gripper_tool_frame</frameName>
176                </plugin>
177            </include>
178
179            <include>
180                <uri>model://finger</uri>
181                <name>right_ee_2</name>
182                <pose>1.150000 0.7000000 0.475000 0.000000 0.000000 1.57080</pose>
183
184                <plugin name="r_2_force_controller" filename="
                       libvelocity_controller_plugin.so">
185                  <linkName>link</linkName>
186                  <topicName>set_r_ee_2_twist</topicName>
187                  <gains>
188                    <linear>
189                      <P>100.0</P>
190                      <I>0.0</I>
191                      <D>25.0</D>
192                    </linear>
193                    <angular>
194                      <P>100.0</P>
195                      <I>0.0</I>
196                      <D>25.0</D>
197                    </angular>
198                  </gains>
199                </plugin>
200
201                <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                       .so">
202                  <linkName>link</linkName>
203                  <frameName>r_2_gripper_tool_frame</frameName>
204                </plugin>
205            </include>
206
207            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
208
209            <gui>
210                <camera name='user_camera'>
211                    <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
212                    <view_controller>orbit</view_controller>
213                </camera>
214            </gui>
215
216        </world>
217    </sdf>
```

```xml
 1  <?xml version='1.0'?>
 2  <sdf version="1.6">
 3      <world name="big_bowl_spatula_v">
 4
 5          <!-- <physics type="ode">
 6              <max_step_size>0.001</max_step_size>
 7              <real_time_factor>1</real_time_factor>
 8              <real_time_update_rate>1000</real_time_update_rate>
 9              <bullet>
10                  <solver>
11                      <iters>70</iters>
12                  </solver>
13              </bullet>
14              <ode>
15                  <solver>
16                      <iters>70</iters>
17                  </solver>
18              </ode>
19          </physics> -->
20
21          <include>
22              <uri>model://sun</uri>
23          </include>
24
25          <include>
26              <uri>model://ground_plane</uri>
27          </include>
28
29          <!-- level 0 -->
30          <include>
31              <uri>model://jenga_block</uri> <!-- 2.5x7.5x1.5 -->
32              <name>book_target</name>
33              <pose>0.115000 0.660000 0.007500 -1.570796 1.570796 0.00</pose>
34
35              <plugin name="target_tf_broadcaster" filename="
                    libtf_broadcaster_plugin.so">
36                <linkName>link</linkName>
37                <frameName>book_object_frame</frameName>
38              </plugin>
39          </include>
40          <include>
41              <uri>model://jenga_block</uri>
42              <name>block2</name>
43              <pose>0.090000 0.660000 0.007500 -1.570796 1.570796 0.00</pose>
44          </include>
45          <include>
46              <uri>model://jenga_block</uri>
47              <name>block3</name>
48              <pose>0.065000 0.660000 0.007500 -1.570796 1.570796 0.00</pose>
49          </include>
50          <!-- level 1 -->
51          <include>
52              <uri>model://jenga_block</uri>
53              <name>block4</name>
54              <pose>0.090000 0.685000 0.022550 3.141593 1.570796 0.00</pose>
```

```
55                  </include>
56                  <include>
57                      <uri>model://jenga_block</uri>
58                      <name>block5</name>
59                      <pose>0.090000 0.660000 0.022550 3.141593 1.570796 0.00</pose>
60                  </include>
61                  <include>
62                      <uri>model://jenga_block</uri>
63                      <name>block6</name>
64                      <pose>0.090000 0.635000 0.022550 3.141593 1.570796 0.00</pose>
65                  </include>
66                  <!-- level 2 -->
67                  <include>
68                      <uri>model://jenga_block</uri> <!-- 2.5x7.5x1.5 -->
69                      <name>block7</name>
70                      <pose>0.115000 0.660000 0.037600 -1.570796 1.570796 0.00</pose>
71                  </include>
72                  <include>
73                      <uri>model://jenga_block</uri>
74                      <name>block8</name>
75                      <pose>0.090000 0.660000 0.037600 -1.570796 1.570796 0.00</pose>
76                  </include>
77                  <include>
78                      <uri>model://jenga_block</uri>
79                      <name>block9</name>
80                      <pose>0.065000 0.660000 0.037600 -1.570796 1.570796 0.00</pose>
81                  </include>
82                  <!-- level 3 -->
83                  <include>
84                      <uri>model://jenga_block</uri>
85                      <name>block10</name>
86                      <pose>0.090000 0.685000 0.052650 3.141593 1.570796 0.00</pose>
87                  </include>
88                  <include>
89                      <uri>model://jenga_block</uri>
90                      <name>block11</name>
91                      <pose>0.090000 0.660000 0.052650 3.141593 1.570796 0.00</pose>
92                  </include>
93                  <include>
94                      <uri>model://jenga_block</uri>
95                      <name>block12</name>
96                      <pose>0.090000 0.635000 0.052650 3.141593 1.570796 0.00</pose>
97                  </include>
98                  <!-- level 4 -->
99                  <include>
100                     <uri>model://jenga_block</uri> <!-- 2.5x7.5x1.5 -->
101                     <name>block13</name>
102                     <pose>0.115000 0.660000 0.067700 -1.570796 1.570796 0.00</pose>
103                 </include>
104                 <include>
105                     <uri>model://jenga_block</uri>
106                     <name>block14</name>
107                     <pose>0.090000 0.660000 0.067700 -1.570796 1.570796 0.00</pose>
108                 </include>
109                 <include>
110                     <uri>model://jenga_block</uri>
111                     <name>block15</name>
```

```
112                <pose>0.065000 0.660000 0.067700 -1.570796 1.570796 0.00</pose>
113            </include>
114            <!-- level 5 -->
115            <include>
116                <uri>model://jenga_block</uri>
117                <name>block16</name>
118                <pose>0.090000 0.685000 0.082750 3.141593 1.570796 0.00</pose>
119            </include>
120            <include>
121                <uri>model://jenga_block</uri>
122                <name>block17</name>
123                <pose>0.090000 0.660000 0.082750 3.141593 1.570796 0.00</pose>
124            </include>
125            <include>
126                <uri>model://jenga_block</uri>
127                <name>block18</name>
128                <pose>0.090000 0.635000 0.082750 3.141593 1.570796 0.00</pose>
129            </include>
130            <!-- level 6 -->
131            <include>
132                <uri>model://jenga_block</uri> <!-- 2.5x7.5x1.5 -->
133                <name>block19</name>
134                <pose>0.115000 0.660000 0.097800 -1.570796 1.570796 0.00</pose>
135            </include>
136            <include>
137                <uri>model://jenga_block</uri>
138                <name>block20</name>
139                <pose>0.090000 0.660000 0.097800 -1.570796 1.570796 0.00</pose>
140            </include>
141            <include>
142                <uri>model://jenga_block</uri>
143                <name>block21</name>
144                <pose>0.065000 0.660000 0.097800 -1.570796 1.570796 0.00</pose>
145            </include>
146
147
148
149
150            <!-- Left Gripper -->
151            <include>
152                <uri>model://finger</uri>
153                <name>left_ee</name>
154                <pose>1.150000 0.661000 0.575000 0.000000 0.000000 1.57080</pose>
155
156
157            <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
158              <linkName>link</linkName>
159              <topicName>set_l_ee_twist</topicName>
160              <gains>
161                <linear>
162                  <P>100.0</P>
163                  <I>0.0</I>
164                  <D>25.0</D>
165                </linear>
166                <angular>
167                  <P>100.0</P>
```

```
168            <I>0.0</I>
169            <D>25.0</D>
170          </angular>
171        </gains>
172      </plugin>
173
174      <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
              so">
175        <linkName>link</linkName>
176        <frameName>l_gripper_tool_frame</frameName>
177      </plugin>
178    </include>
179
180    <!-- Right Gripper -->
181    <include>
182      <uri>model://finger</uri>
183      <name>right_ee</name>
184      <pose>1.150000 0.600000 0.475000 0.000000 0.000000 1.57080</pose>
185
186      <plugin name="r_force_controller" filename="
              libvelocity_controller_plugin.so">
187        <linkName>link</linkName>
188        <topicName>set_r_ee_twist</topicName>
189        <gains>
190          <linear>
191            <P>100.0</P>
192            <I>0.0</I>
193            <D>25.0</D>
194          </linear>
195          <angular>
196            <P>100.0</P>
197            <I>0.0</I>
198            <D>25.0</D>
199          </angular>
200        </gains>
201      </plugin>
202
203      <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
              so">
204        <linkName>link</linkName>
205        <frameName>r_gripper_tool_frame</frameName>
206      </plugin>
207    </include>
208
209    <include>
210      <uri>model://finger</uri>
211      <name>right_ee_2</name>
212      <pose>1.150000 0.7000000 0.475000 0.000000 0.000000 1.57080</pose>
213
214      <plugin name="r_2_force_controller" filename="
              libvelocity_controller_plugin.so">
215        <linkName>link</linkName>
216        <topicName>set_r_ee_2_twist</topicName>
217        <gains>
218          <linear>
219            <P>100.0</P>
220            <I>0.0</I>
```

```
221                     <D>25.0</D>
222                   </linear>
223                   <angular>
224                     <P>100.0</P>
225                     <I>0.0</I>
226                     <D>25.0</D>
227                   </angular>
228                 </gains>
229               </plugin>
230
231               <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                      .so">
232                 <linkName>link</linkName>
233                 <frameName>r_2_gripper_tool_frame</frameName>
234               </plugin>
235           </include>
236
237           <plugin name="feature_visualization_plugin" filename="
                  libgiskard_visualization_plugin.so"></plugin>
238
239           <gui>
240               <camera name='user_camera'>
241                   <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
242                   <view_controller>orbit</view_controller>
243               </camera>
244           </gui>
245
246       </world>
247   </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3
4      <world name="grabbing_book_v">
5
6          <!-- <physics type="ode">
7              <max_step_size>0.001</max_step_size>
8              <real_time_factor>1</real_time_factor>
9              <real_time_update_rate>1000</real_time_update_rate>
10             <bullet>
11                 <solver>
12                     <iters>70</iters>
13                 </solver>
14             </bullet>
15             <ode>
16                 <solver>
17                     <iters>70</iters>
18                 </solver>
19             </ode>
20         </physics> -->
21
22         <include>
23             <uri>model://sun</uri>
24         </include>
25
26         <include>
27             <uri>model://ground_plane</uri>
28         </include>
29 <!--
30         <include>
31             <uri>model://finger</uri>
32             <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33         </include> -->
34
35         <include>
36             <uri>model://bookshelf_</uri>
37             <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38         </include>
39
40         <!-- Books -->
41
42
43         <!--<include>
44             <uri>model://book</uri>
45             <name>book3</name>
46             <pose>0.150000 0.624000 0.475000 0.000000 0.000000 1.57080</pose>
47         </include> -->
48
49
50         <model name='book_target'>
51           <static>false</static>
52           <pose>0.150000 0.861000 0.585000 0.000000 0.000000 1.57080</pose>
53
54           <link name='book_link'>
55             <pose frame='link'>0 0 0 0 0 0</pose>
```

```xml
             <inertial>
               <mass>0.1</mass>
               <pose frame='link'>0 0 0 0 0 0</pose>
               <inertia>
                 <ixx>0.000666667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
                 <ixy>0</ixy>
                 <ixz>0</ixz>
                 <iyy>0.00241667</iyy>
                 <iyz>0</iyz>
                 <izz>0.00241667</izz>
               </inertia>
             </inertial>
             <collision name='book_collision'>
               <geometry>
                 <box>
                   <size>0.5 0.2 0.2</size>
                 </box>
               </geometry>
               <pose frame=''>0 0 0 0 0 0</pose>
               <surface>
                 <friction>
                   <ode>
                     <mu>0.2</mu>
                     <mu2>0.2</mu2>
                   </ode>
                 </friction>
               </surface>
             </collision>
             <visual name='book_visual'>
               <geometry>
                 <box>
                   <size>0.5 0.2 0.2</size>
                 </box>
               </geometry>
               <pose frame=''>0 0 0 0 0 0</pose>
             </visual>
             <sensor name="main_bumper" type="contact">
               <selfCollide>true</selfCollide>
               <alwaysOn>true</alwaysOn>
               <updateRate>15.0</updateRate>
               <contact>
                 <collision>book_collision</collision>
               </contact>
               <!--<plugin name="gazebo_ros_bumper_controller" filename="
                   libgazebo_ros_bumper.so">
                 <bumperTopicName>bumper_vals</bumperTopicName>
                 <frameName>book_target</frameName>
               </plugin> -->
             </sensor>
           </link>
           <plugin name="target_tf_broadcaster" filename="
               libtf_broadcaster_plugin.so">
             <linkName>book_link</linkName>
             <frameName>book_object_frame</frameName>
           </plugin>
           <plugin name="grasp" filename="libTiltGrabPlugin.so">
             <parentLinkName>book_link</parentLinkName>
```

```
111            <childLinkName1>left_ee::link</childLinkName1>
112            <childLinkName2>right_ee::link</childLinkName2>
113            <childLinkName3>right_ee_2::link</childLinkName3>
114            <sensorName>book_contact</sensorName>
115          </plugin>
116        </model>
117
118
119
120        <!-- Left Gripper -->
121        <include>
122            <uri>model://finger</uri>
123            <name>left_ee</name>
124            <pose>1.150000 0.661000 0.575000 0.000000 0.000000 1.57080</pose>
125
126
127            <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
128              <linkName>link</linkName>
129              <topicName>set_l_ee_twist</topicName>
130              <gains>
131                <linear>
132                  <P>100.0</P>
133                  <I>0.0</I>
134                  <D>25.0</D>
135                </linear>
136                <angular>
137                  <P>100.0</P>
138                  <I>0.0</I>
139                  <D>25.0</D>
140                </angular>
141              </gains>
142            </plugin>
143
144            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
145              <linkName>link</linkName>
146              <frameName>l_gripper_tool_frame</frameName>
147            </plugin>
148        </include>
149
150        <!-- Right Gripper -->
151        <include>
152            <uri>model://finger</uri>
153            <name>right_ee</name>
154            <pose>1.150000 0.600000 0.475000 0.000000 0.000000 1.57080</pose>
155
156            <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
157              <linkName>link</linkName>
158              <topicName>set_r_ee_twist</topicName>
159              <gains>
160                <linear>
161                  <P>100.0</P>
162                  <I>0.0</I>
163                  <D>25.0</D>
164                </linear>
```

```
165                 <angular>
166                   <P>100.0</P>
167                   <I>0.0</I>
168                   <D>25.0</D>
169                 </angular>
170               </gains>
171             </plugin>
172
173             <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
174               <linkName>link</linkName>
175               <frameName>r_gripper_tool_frame</frameName>
176             </plugin>
177         </include>
178
179         <include>
180             <uri>model://finger</uri>
181             <name>right_ee_2</name>
182             <pose>1.150000 0.7000000 0.475000 0.000000 0.000000 1.57080</pose>
183
184             <plugin name="r_2_force_controller" filename="
                    libvelocity_controller_plugin.so">
185               <linkName>link</linkName>
186               <topicName>set_r_ee_2_twist</topicName>
187               <gains>
188                 <linear>
189                   <P>100.0</P>
190                   <I>0.0</I>
191                   <D>25.0</D>
192                 </linear>
193                 <angular>
194                   <P>100.0</P>
195                   <I>0.0</I>
196                   <D>25.0</D>
197                 </angular>
198               </gains>
199             </plugin>
200
201             <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                    .so">
202               <linkName>link</linkName>
203               <frameName>r_2_gripper_tool_frame</frameName>
204             </plugin>
205         </include>
206
207         <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
208
209         <gui>
210             <camera name='user_camera'>
211                 <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
212                 <view_controller>orbit</view_controller>
213             </camera>
214         </gui>
215
216     </world>
217 </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="b_wildo_bowl_b_serving_spoon_v">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_serving_spoon</uri>
15              <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16          </include>
17
18          <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19              <pose>0.078818 -0.501749 0.988186 0 0 0</pose>
20              <mass>0.001</mass>
21              <radius>0.015</radius>
22              <quantity>100</quantity>
23              <friction>0.4</friction>
24              <friction2>0.4</friction2>
25              <velocity_decay>0.3</velocity_decay>
26          </plugin>
27
28          <include>
29              <uri>model://b_wildo_bowl</uri>
30              <pose>0.078818 -0.501749 0.988186 3.097035 0 0</pose>
31          </include>
32
33          <include>
34              <uri>model://table</uri>
35              <pose>0.021929 0.062805 -0.066428 0 0 -1.571974</pose>
36          </include>
37          <!-- Left Gripper -->
38          <include>
39              <uri>model://gripper</uri>
40              <name>left_ee</name>
41              <pose>0 0.5 1 0 0 0</pose>
42
43              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
44                <linkName>link</linkName>
45                <topicName>set_l_ee_twist</topicName>
46                <gains>
47                  <linear>
48                    <P>100.0</P>
49                    <I>0.0</I>
50                    <D>25.0</D>
51                  </linear>
52                  <angular>
53                    <P>100.0</P>
54                    <I>0.0</I>
```

```
55                        <D>25.0</D>
56                      </angular>
57                    </gains>
58                </plugin>
59
60                <plugin name="l_grip" filename="libGripPlugin.so">
61                  <parentLinkName>link</parentLinkName>
62                  <childLinkName>b_serving_spoon::link</childLinkName>
63                  <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                        1.382834421275815 0.015398730956486372 0.08077832485708741</
                        relativePose>
64                </plugin>
65
66                <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                        so">
67                  <linkName>link</linkName>
68                  <frameName>l_gripper_tool_frame</frameName>
69                </plugin>
70            </include>
71
72            <!-- Right Gripper -->
73            <include>
74                <uri>model://gripper</uri>
75                <name>right_ee</name>
76                <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
77
78                <plugin name="r_force_controller" filename="
                        libvelocity_controller_plugin.so">
79                  <linkName>link</linkName>
80                  <topicName>set_r_ee_twist</topicName>
81                  <gains>
82                    <linear>
83                      <P>100.0</P>
84                      <I>0.0</I>
85                      <D>25.0</D>
86                    </linear>
87                    <angular>
88                      <P>100.0</P>
89                      <I>0.0</I>
90                      <D>25.0</D>
91                    </angular>
92                  </gains>
93                </plugin>
94
95                <plugin name="r_grip" filename="libGripPlugin.so">
96                  <parentLinkName>link</parentLinkName>
97                  <childLinkName>b_wildo_bowl::link</childLinkName>
98                  <relativePose>0.0089419 0.0135799 0.0780419 1.55636 1.32285
                        -1.41637</relativePose>
99                </plugin>
100
101               <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                        so">
102                 <linkName>link</linkName>
103                 <frameName>r_gripper_tool_frame</frameName>
104               </plugin>
105           </include>
```

```
106
107         <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
108
109         <gui>
110             <camera name='user_camera'>
111                 <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                 <view_controller>orbit</view_controller>
113             </camera>
114         </gui>
115
116     </world>
117 </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_frying_pan_b_thin_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_thin_spatula</uri>
15             <pose>0.094321 0.507657 1.009274 -1.637236 0.074980 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.218391 0.495434 1.018867 1.118105 1.524620 2.552731</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_thin_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_frying_pan</uri>
30             <pose>0.228443 -0.496122 0.971397 0 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```
 55
 56            <plugin name="l_grip" filename="libGripPlugin.so">
 57              <parentLinkName>link</parentLinkName>
 58              <childLinkName>b_thin_spatula::link</childLinkName>
 59              <relativePose>0.094321 0.007657 0.009274 -1.63724 0.07498
                    -3.14159</relativePose>
 60            </plugin>
 61
 62            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
 63              <linkName>link</linkName>
 64              <frameName>l_gripper_tool_frame</frameName>
 65            </plugin>
 66          </include>
 67
 68          <!-- Right Gripper -->
 69          <include>
 70            <uri>model://gripper</uri>
 71            <name>right_ee</name>
 72            <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
 73
 74            <plugin name="r_force_controller" filename="
                  libvelocity_controller_plugin.so">
 75              <linkName>link</linkName>
 76              <topicName>set_r_ee_twist</topicName>
 77              <gains>
 78                <linear>
 79                  <P>100.0</P>
 80                  <I>0.0</I>
 81                  <D>25.0</D>
 82                </linear>
 83                <angular>
 84                  <P>100.0</P>
 85                  <I>0.0</I>
 86                  <D>25.0</D>
 87                </angular>
 88              </gains>
 89            </plugin>
 90
 91            <plugin name="r_grip" filename="libGripPlugin.so">
 92              <parentLinkName>link</parentLinkName>
 93              <childLinkName>b_frying_pan::link</childLinkName>
 94              <relativePose>0.0186144 0.0468562 0.224672 -1.55141 -1.36676
                    1.3834</relativePose>
 95            </plugin>
 96
 97            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
 98              <linkName>link</linkName>
 99              <frameName>r_gripper_tool_frame</frameName>
100            </plugin>
101          </include>
102
103          <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
104
105          <gui>
```

```
106                    <camera name='user_camera'>
107                        <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                        <view_controller>orbit</view_controller>
109                    </camera>
110                </gui>
111
112        </world>
113    </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_pot_b_serving_spoon_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_serving_spoon</uri>
15             <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.198795 0.509112 3.036336 1.368174 -1.866245</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_serving_spoon::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_pot</uri>
30             <pose>0.133471 -0.503990 0.971217 0 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```
 55
 56              <plugin name="l_grip" filename="libGripPlugin.so">
 57                <parentLinkName>link</parentLinkName>
 58                <childLinkName>b_serving_spoon::link</childLinkName>
 59                <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                       1.3828344221275815 0.015398730956486372 0.08077832485708741</
                       relativePose>
 60              </plugin>
 61
 62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                       so">
 63                <linkName>link</linkName>
 64                <frameName>l_gripper_tool_frame</frameName>
 65              </plugin>
 66          </include>
 67
 68          <!-- Right Gripper -->
 69          <include>
 70              <uri>model://gripper</uri>
 71              <name>right_ee</name>
 72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
 73
 74              <plugin name="r_force_controller" filename="
                       libvelocity_controller_plugin.so">
 75                <linkName>link</linkName>
 76                <topicName>set_r_ee_twist</topicName>
 77                <gains>
 78                  <linear>
 79                    <P>100.0</P>
 80                    <I>0.0</I>
 81                    <D>25.0</D>
 82                  </linear>
 83                  <angular>
 84                    <P>100.0</P>
 85                    <I>0.0</I>
 86                    <D>25.0</D>
 87                  </angular>
 88                </gains>
 89              </plugin>
 90
 91              <plugin name="r_grip" filename="libGripPlugin.so">
 92                <parentLinkName>link</parentLinkName>
 93                <childLinkName>b_pot::link</childLinkName>
 94                <relativePose>0.023942 0.0237816 0.132364 -1.55141 -1.36676
                       1.3834</relativePose>
 95              </plugin>
 96
 97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                       so">
 98                <linkName>link</linkName>
 99                <frameName>r_gripper_tool_frame</frameName>
100              </plugin>
101          </include>
102
103          <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3
4      <world name="grabbing_book_v">
5
6          <!-- <physics type="ode">
7              <max_step_size>0.001</max_step_size>
8              <real_time_factor>1</real_time_factor>
9              <real_time_update_rate>1000</real_time_update_rate>
10             <bullet>
11                 <solver>
12                     <iters>70</iters>
13                 </solver>
14             </bullet>
15             <ode>
16                 <solver>
17                     <iters>70</iters>
18                 </solver>
19             </ode>
20         </physics> -->
21
22         <include>
23             <uri>model://sun</uri>
24         </include>
25
26         <include>
27             <uri>model://ground_plane</uri>
28         </include>
29 <!--
30         <include>
31             <uri>model://finger</uri>
32             <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33         </include> -->
34
35         <include>
36             <uri>model://freezer_box</uri>
37             <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38         </include>
39
40
41
42         <model name='book_target'>
43           <static>false</static>
44           <pose>0.220000 0.000000 0.300000 1.570796 0.000000 0.000000</pose>
45
46           <link name='book_link'>
47             <pose frame='link'>0.0 0.0 0.0 0.0 0 0</pose>
48             <inertial>
49               <mass>1</mass>
50               <pose frame='link'>0.0 0.0 0.0 0 0 0</pose>
51               <inertia>
52                 <ixx>0.0416666</ixx><!--  1/12 * m * (h^2 + d^2)  -->
53                 <ixy>0</ixy>
54                 <ixz>0</ixz>
55                 <iyy>0.0416666</iyy>
```

```
56                    <iyz>0</iyz>
57                    <izz>0.0416666</izz>
58                  </inertia>
59                </inertial>
60                <collision name='book_collision'>
61                  <geometry>
62                    <box>
63                      <size>0.5 0.5 0.5</size>
64                    </box>
65                  </geometry>
66                  <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
67                  <surface>
68                    <friction>
69                      <ode>
70                        <mu>0.2</mu>
71                        <mu2>0.2</mu2>
72                      </ode>
73                    </friction>
74                  </surface>
75                </collision>
76                <visual name='book_visual'>
77                  <geometry>
78                    <box>
79                      <size>0.5 0.5 0.5</size>
80                    </box>
81                  </geometry>
82                  <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
83                </visual>
84                <sensor name="main_bumper" type="contact">
85                  <selfCollide>true</selfCollide>
86                  <alwaysOn>true</alwaysOn>
87                  <updateRate>15.0</updateRate>
88                  <contact>
89                    <collision>book_collision</collision>
90                  </contact>
91                </sensor>
92              </link>
93              <plugin name="target_tf_broadcaster" filename="
                    libtf_broadcaster_plugin.so">
94                <linkName>book_link</linkName>
95                <frameName>book_object_frame</frameName>
96              </plugin>
97              <plugin name="grasp" filename="libTiltGrabPlugin.so">
98                <parentLinkName>book_link</parentLinkName>
99                <childLinkName1>left_ee::link</childLinkName1>
100               <childLinkName2>right_ee::link</childLinkName2>
101               <childLinkName3>right_ee_2::link</childLinkName3>
102               <sensorName>book_contact</sensorName>
103             </plugin>
104           </model>
105
106
107
108           <!-- Left Gripper -->
109           <include>
110               <uri>model://finger</uri>
111               <name>left_ee</name>
```

```
112             <pose>0.000000 0.000000 0.880000 0.000000 0.000000 1.57080</pose>
113
114
115             <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
116               <linkName>link</linkName>
117               <topicName>set_l_ee_twist</topicName>
118               <gains>
119                 <linear>
120                   <P>100.0</P>
121                   <I>0.0</I>
122                   <D>25.0</D>
123                 </linear>
124                 <angular>
125                   <P>100.0</P>
126                   <I>0.0</I>
127                   <D>25.0</D>
128                 </angular>
129               </gains>
130             </plugin>
131
132             <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
133               <linkName>link</linkName>
134               <frameName>l_gripper_tool_frame</frameName>
135             </plugin>
136         </include>
137
138         <!-- Right Gripper -->
139         <include>
140             <uri>model://finger</uri>
141             <name>right_ee</name>
142             <pose>0.600000 0.500000 0.830000 0.000000 0.000000 1.57080</pose>
143
144             <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
145               <linkName>link</linkName>
146               <topicName>set_r_ee_twist</topicName>
147               <gains>
148                 <linear>
149                   <P>100.0</P>
150                   <I>0.0</I>
151                   <D>25.0</D>
152                 </linear>
153                 <angular>
154                   <P>100.0</P>
155                   <I>0.0</I>
156                   <D>25.0</D>
157                 </angular>
158               </gains>
159             </plugin>
160
161             <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
162               <linkName>link</linkName>
163               <frameName>r_gripper_tool_frame</frameName>
164             </plugin>
```

```
165              </include>
166
167          <include>
168                <uri>model://finger</uri>
169                <name>right_ee_2</name>
170                <pose>0.600000 -0.500000 0.830000 0.000000 0.000000 1.57080</pose>
171
172                <plugin name="r_2_force_controller" filename="
                        libvelocity_controller_plugin.so">
173                  <linkName>link</linkName>
174                  <topicName>set_r_ee_2_twist</topicName>
175                  <gains>
176                    <linear>
177                      <P>100.0</P>
178                      <I>0.0</I>
179                      <D>25.0</D>
180                    </linear>
181                    <angular>
182                      <P>100.0</P>
183                      <I>0.0</I>
184                      <D>25.0</D>
185                    </angular>
186                  </gains>
187                </plugin>
188
189                <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                        .so">
190                  <linkName>link</linkName>
191                  <frameName>r_2_gripper_tool_frame</frameName>
192                </plugin>
193          </include>
194
195        <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
196
197        <gui>
198            <camera name='user_camera'>
199                <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
200                <view_controller>orbit</view_controller>
201            </camera>
202        </gui>
203
204      </world>
205  </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="b_coffee_cup_b_serving_spoon_v">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_serving_spoon</uri>
15              <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.198795 0.509112 3.036336 1.368174 -1.866245</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                <parentLinkName>link</parentLinkName>
23                <childLinkName>b_serving_spoon::link</childLinkName>
24                <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_coffee_cup</uri>
30              <pose>-0.016492 -0.468631 0.965206 2.603069 -1.513021 -2.66073</pose
                    >
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40                <linkName>link</linkName>
41                <topicName>set_l_ee_twist</topicName>
42                <gains>
43                  <linear>
44                    <P>100.0</P>
45                    <I>0.0</I>
46                    <D>25.0</D>
47                  </linear>
48                  <angular>
49                    <P>100.0</P>
50                    <I>0.0</I>
51                    <D>25.0</D>
52                  </angular>
53                </gains>
```

```
54                 </plugin>
55
56                 <plugin name="l_grip" filename="libGripPlugin.so">
57                   <parentLinkName>link</parentLinkName>
58                   <childLinkName>b_serving_spoon::link</childLinkName>
59                   <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                         1.3828344221275815 0.015398730956486372 0.08077832485708741</
                         relativePose>
60                 </plugin>
61
62                 <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                       so">
63                   <linkName>link</linkName>
64                   <frameName>l_gripper_tool_frame</frameName>
65                 </plugin>
66             </include>
67
68             <!-- Right Gripper -->
69             <include>
70                 <uri>model://gripper</uri>
71                 <name>right_ee</name>
72                 <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74                 <plugin name="r_force_controller" filename="
                       libvelocity_controller_plugin.so">
75                   <linkName>link</linkName>
76                   <topicName>set_r_ee_twist</topicName>
77                   <gains>
78                     <linear>
79                       <P>100.0</P>
80                       <I>0.0</I>
81                       <D>25.0</D>
82                     </linear>
83                     <angular>
84                       <P>100.0</P>
85                       <I>0.0</I>
86                       <D>25.0</D>
87                     </angular>
88                   </gains>
89                 </plugin>
90
91                 <plugin name="r_grip" filename="libGripPlugin.so">
92                   <parentLinkName>link</parentLinkName>
93                   <childLinkName>b_coffee_cup::link</childLinkName>
94                   <relativePose>0.0284501 0.0346428 -0.0213798 2.93848 0.00496188
                         2.88401</relativePose>
95                 </plugin>
96
97                 <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                       so">
98                   <linkName>link</linkName>
99                   <frameName>r_gripper_tool_frame</frameName>
100                </plugin>
101            </include>
102
103            <plugin name="feature_visualization_plugin" filename="
                     libgiskard_visualization_plugin.so"></plugin>
```

```
104
105          <gui>
106              <camera name='user_camera'>
107                  <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                  <view_controller>orbit</view_controller>
109              </camera>
110          </gui>
111
112      </world>
113  </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3
4       <world name="grabbing_book_v">
5
6           <!-- <physics type="ode">
7               <max_step_size>0.001</max_step_size>
8               <real_time_factor>1</real_time_factor>
9               <real_time_update_rate>1000</real_time_update_rate>
10              <bullet>
11                  <solver>
12                      <iters>70</iters>
13                  </solver>
14              </bullet>
15              <ode>
16                  <solver>
17                      <iters>70</iters>
18                  </solver>
19              </ode>
20          </physics> -->
21
22          <include>
23              <uri>model://sun</uri>
24          </include>
25
26          <include>
27              <uri>model://ground_plane</uri>
28          </include>
29  <!--
30          <include>
31              <uri>model://finger</uri>
32              <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33          </include> -->
34
35          <include>
36              <uri>model://bookshelf_</uri>
37              <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38          </include>
39
40          <!-- Books -->
41          <include>
42              <uri>model://book</uri>
43              <name>book1</name>
44              <pose>0.150000 0.550000 0.475000 0.000000 0.000000 1.57080</pose>
45          </include>
46
47          <include>
48              <uri>model://book</uri>
49              <name>book2</name>
50              <pose>0.150000 0.587000 0.475000 0.000000 0.000000 1.57080</pose>
51          </include>
52
53          <!--<include>
54              <uri>model://book</uri>
55              <name>book3</name>
```

```
56                     <pose>0.150000 0.624000 0.475000 0.000000 0.000000 1.57080</pose>
57          </include> -->
58
59
60          <model name='book_target'>
61            <static>false</static>
62            <pose>0.150000 0.661000 0.475000 0.000000 0.000000 1.57080</pose>
63
64            <link name='book_link'>
65              <pose frame='link'>-0.031125 0 0.010809 1e-06 -0 0</pose>
66              <inertial>
67                <mass>1</mass>
68                <pose frame='link'>0.03 0 0.18 0 -0 0</pose>
69                <inertia>
70                  <ixx>.01495105</ixx><!--  1/12 * m * (h^2 + d^2)  -->
71                  <ixy>0</ixy>
72                  <ixz>0</ixz>
73                  <iyy>0.01270166</iyy>
74                  <iyz>0</iyz>
75                  <izz>0.00247143</izz>
76                </inertia>
77              </inertial>
78              <collision name='book_collision'>
79                <geometry>
80                  <mesh>
81                    <uri>model://book/book.stl</uri>
82                  </mesh>
83                </geometry>
84                <pose frame=''>0.26 0 -0.32 0 -0 0</pose>
85                <surface>
86                  <friction>
87                    <ode>
88                      <mu>0.2</mu>
89                      <mu2>0.2</mu2>
90                    </ode>
91                  </friction>
92                </surface>
93              </collision>
94              <visual name='book_visual'>
95                <geometry>
96                  <mesh>
97                    <uri>model://book/book.stl</uri>
98                  </mesh>
99                </geometry>
100                <pose frame=''>0.26 0 -0.32 0 -0 0</pose>
101              </visual>
102              <sensor name="main_bumper" type="contact">
103                <selfCollide>true</selfCollide>
104                <alwaysOn>true</alwaysOn>
105                <updateRate>15.0</updateRate>
106                <contact>
107                  <collision>book_collision</collision>
108                </contact>
109                <!--<plugin name="gazebo_ros_bumper_controller" filename="
                      libgazebo_ros_bumper.so">
110                  <bumperTopicName>bumper_vals</bumperTopicName>
111                  <frameName>book_target</frameName>
```

```
112                            </plugin> -->
113                        </sensor>
114                    </link>
115                    <plugin name="target_tf_broadcaster" filename="
                            libtf_broadcaster_plugin.so">
116                        <linkName>book_link</linkName>
117                        <frameName>book_object_frame</frameName>
118                    </plugin>
119                    <plugin name="grasp" filename="libTiltGrabPlugin.so">
120                        <parentLinkName>book_link</parentLinkName>
121                        <childLinkName1>left_ee::link</childLinkName1>
122                        <childLinkName2>right_ee::link</childLinkName2>
123                        <childLinkName3>right_ee_2::link</childLinkName3>
124                        <sensorName>book_contact</sensorName>
125                    </plugin>
126                </model>
127
128                <!--<include>
129                    <uri>model://book</uri>
130                    <name>book5</name>
131                    <pose>0.150000 0.698000 0.475000 0.000000 0.000000 1.57080</pose>
132                </include> -->
133
134                <include>
135                    <uri>model://book</uri>
136                    <name>book6</name>
137                    <pose>0.150000 0.735000 0.475000 0.000000 0.000000 1.57080</pose>
138                </include>
139
140                <include>
141                    <uri>model://book</uri>
142                    <name>book7</name>
143                    <pose>0.150000 0.772000 0.475000 0.000000 0.000000 1.57080</pose>
144                </include>
145
146                <include>
147                    <uri>model://book</uri>
148                    <name>book8</name>
149                    <pose>0.150000 0.809000 0.475000 0.000000 0.000000 1.57080</pose>
150                </include>
151
152                <include>
153                    <uri>model://book</uri>
154                    <name>book9</name>
155                    <pose>0.150000 0.846000 0.475000 0.000000 0.000000 1.57080</pose>
156                </include>
157
158                <!-- Leaning Books
159                <include>
160                    <uri>model://book</uri>
161                    <name>book6</name>
162                    <pose>0.150000 0.768000 0.475000 0.000000 -0.084533 1.57080</pose>
163                </include>
164
165                <include>
166                    <uri>model://book</uri>
167                    <name>book7</name>
```

```
168                     <pose>0.150000 0.840000 0.475000 0.000000 -0.174533 1.57080</pose>
169                 </include>
170
171                 <include>
172                     <uri>model://book</uri>
173                     <name>book8</name>
174                     <pose>0.150000 0.947000 0.475000 0.000000 -0.349066 1.57080</pose>
175                 </include>
176
177                 <include>
178                     <uri>model://book</uri>
179                     <name>book9</name>
180                     <pose>0.150000 1.10000 0.475000 0.000000 -0.523599 1.57080</pose>
181                 </include>
182                 -->
183
184                 <!-- Left Gripper -->
185                 <include>
186                     <uri>model://finger</uri>
187                     <name>left_ee</name>
188                     <pose>1.150000 0.661000 0.575000 0.000000 0.000000 1.57080</pose>
189
190
191                     <plugin name="l_force_controller" filename="
                              libvelocity_controller_plugin.so">
192                       <linkName>link</linkName>
193                       <topicName>set_l_ee_twist</topicName>
194                       <gains>
195                         <linear>
196                           <P>100.0</P>
197                           <I>0.0</I>
198                           <D>25.0</D>
199                         </linear>
200                         <angular>
201                           <P>100.0</P>
202                           <I>0.0</I>
203                           <D>25.0</D>
204                         </angular>
205                       </gains>
206                     </plugin>
207
208                     <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                              so">
209                       <linkName>link</linkName>
210                       <frameName>l_gripper_tool_frame</frameName>
211                     </plugin>
212                 </include>
213
214                 <!-- Right Gripper -->
215                 <include>
216                     <uri>model://finger</uri>
217                     <name>right_ee</name>
218                     <pose>1.150000 0.600000 0.475000 0.000000 0.000000 1.57080</pose>
219
220                     <plugin name="r_force_controller" filename="
                              libvelocity_controller_plugin.so">
221                       <linkName>link</linkName>
```

```
222                    <topicName>set_r_ee_twist</topicName>
223                    <gains>
224                      <linear>
225                        <P>100.0</P>
226                        <I>0.0</I>
227                        <D>25.0</D>
228                      </linear>
229                      <angular>
230                        <P>100.0</P>
231                        <I>0.0</I>
232                        <D>25.0</D>
233                      </angular>
234                    </gains>
235                  </plugin>
236
237              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                       so">
238                    <linkName>link</linkName>
239                    <frameName>r_gripper_tool_frame</frameName>
240                  </plugin>
241            </include>
242
243            <include>
244                <uri>model://finger</uri>
245                <name>right_ee_2</name>
246                <pose>1.150000 0.7000000 0.475000 0.000000 0.000000 1.57080</pose>
247
248              <plugin name="r_2_force_controller" filename="
                       libvelocity_controller_plugin.so">
249                    <linkName>link</linkName>
250                    <topicName>set_r_ee_2_twist</topicName>
251                    <gains>
252                      <linear>
253                        <P>100.0</P>
254                        <I>0.0</I>
255                        <D>25.0</D>
256                      </linear>
257                      <angular>
258                        <P>100.0</P>
259                        <I>0.0</I>
260                        <D>25.0</D>
261                      </angular>
262                    </gains>
263                  </plugin>
264
265              <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                       .so">
266                    <linkName>link</linkName>
267                    <frameName>r_2_gripper_tool_frame</frameName>
268                  </plugin>
269            </include>
270
271            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
272
273            <gui>
274                <camera name='user_camera'>
```

```
275                    <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
276                    <view_controller>orbit</view_controller>
277                </camera>
278            </gui>
279
280        </world>
281    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="big_bowl_serving_spoon_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_serving_spoon</uri>
15             <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.198795 0.509112 3.036336 1.368174 -1.866245</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_serving_spoon::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_big_bowl</uri>
30             <pose>0.024164 -0.383989 0.959287 -0.017186 -0.000884 -0.101566</
                    pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
```

```
54              </plugin >
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName >link </parentLinkName >
58                <childLinkName >b_serving_spoon ::link </childLinkName >
59                <relativePose >0.112571612 0.00813051871955 -0.0153673645109
                      1.3828344221275815 0.015398730956486372 0.08077832485708741</
                      relativePose >
60              </plugin >
61
62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
63                <linkName >link </linkName >
64                <frameName >l_gripper_tool_frame </frameName >
65              </plugin >
66          </include >
67
68          <!-- Right Gripper -->
69          <include >
70              <uri >model ://gripper </uri >
71              <name >right_ee </name >
72              <pose >0 -0.5 1 1.547368 1.402341 1.343703 </pose >
73
74              <plugin name="r_force_controller" filename="
                      libvelocity_controller_plugin.so">
75                <linkName >link </linkName >
76                <topicName >set_r_ee_twist </topicName >
77                <gains >
78                  <linear >
79                    <P>100.0 </P>
80                    <I>0.0 </I>
81                    <D>25.0 </D>
82                  </linear >
83                  <angular >
84                    <P>100.0 </P>
85                    <I>0.0 </I>
86                    <D>25.0 </D>
87                  </angular >
88                </gains >
89              </plugin >
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName >link </parentLinkName >
93                <childLinkName >b_big_bowl ::link </childLinkName >
94                <relativePose >0.06 0.11 0 -1.57 -1.35 1.3</relativePose >
95              </plugin >
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
98                <linkName >link </linkName >
99                <frameName >r_gripper_tool_frame </frameName >
100             </plugin >
101         </include >
102
103         <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin >
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="big_bowl_spatula_v">
4
5           <!-- <physics type="ode">
6               <max_step_size>0.001</max_step_size>
7               <real_time_factor>1</real_time_factor>
8               <real_time_update_rate>1000</real_time_update_rate>
9               <bullet>
10                  <solver>
11                      <iters>70</iters>
12                  </solver>
13              </bullet>
14              <ode>
15                  <solver>
16                      <iters>70</iters>
17                  </solver>
18              </ode>
19          </physics> -->
20
21          <include>
22              <uri>model://sun</uri>
23          </include>
24
25          <include>
26              <uri>model://ground_plane</uri>
27          </include>
28
29          <include>
30              <uri>model://b_spatula</uri>
31              <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
32          </include>
33
34          <include>
35              <uri>model://butter_box</uri>
36              <pose>0.208221 0.534198 0.991390 1.634659 1.569999 -0.001148</pose>
37              <plugin name="stick" filename="libStickPlugin.so">
38                <parentLinkName>link</parentLinkName>
39                <childLinkName>b_spatula::link</childLinkName>
40                <force>5</force>
41              </plugin>
42          </include>
43
44          <include>
45              <uri>model://b_big_bowl</uri>
46              <pose>0.024164 -0.383989 0.959287 -0.017186 -0.000884 -0.101566</
                    pose>
47          </include>
48
49          <!-- Left Gripper -->
50          <include>
51              <uri>model://gripper</uri>
52              <name>left_ee</name>
53              <pose>0 0.5 1 0 0 0</pose>
54
```

```
55                <plugin name="l_force_controller" filename="
                      libvelocity_controller_plugin.so">
56                  <linkName>link</linkName>
57                  <topicName>set_l_ee_twist</topicName>
58                  <gains>
59                    <linear>
60                      <P>0.1</P>
61                      <I>0.0</I>
62                      <D>0.02</D>
63                    </linear>
64                    <angular>
65                      <P>0.0001</P>
66                      <I>0.0</I>
67                      <D>0.000002</D>
68                    </angular>
69                  </gains>
70                </plugin>
71
72                <plugin name="l_grip" filename="libGripPlugin.so">
73                  <parentLinkName>link</parentLinkName>
74                  <childLinkName>b_spatula::link</childLinkName>
75                  <relativePose>0.14 0.028 -0.002 -1.57 3.20 0.20</relativePose>
76                </plugin>
77
78                <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
79                  <linkName>link</linkName>
80                  <frameName>l_gripper_tool_frame</frameName>
81                </plugin>
82            </include>
83
84            <!-- Right Gripper -->
85            <include>
86                <uri>model://gripper</uri>
87                <name>right_ee</name>
88                <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
89
90                <plugin name="r_force_controller" filename="
                      libvelocity_controller_plugin.so">
91                  <linkName>link</linkName>
92                  <topicName>set_r_ee_twist</topicName>
93                  <gains>
94                    <linear>
95                      <P>0.1</P>
96                      <I>0.0</I>
97                      <D>0.02</D>
98                    </linear>
99                    <angular>
100                     <P>0.1</P>
101                     <I>0.0</I>
102                     <D>0.002</D>
103                   </angular>
104                 </gains>
105               </plugin>
106
107               <plugin name="r_grip" filename="libGripPlugin.so">
108                 <parentLinkName>link</parentLinkName>
```

```
109                    <childLinkName>b_big_bowl::link</childLinkName>
110                    <relativePose>0.06 0.11 0 -1.57 -1.35 1.3</relativePose>
111                </plugin>
112
113                <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                       so">
114                    <linkName>link</linkName>
115                    <frameName>r_gripper_tool_frame</frameName>
116                </plugin>
117            </include>
118
119            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
120
121            <gui>
122                <camera name='user_camera'>
123                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
124                    <view_controller>orbit</view_controller>
125                </camera>
126            </gui>
127
128        </world>
129    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_coffee_cup_b_knife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_knife</uri>
15             <pose>0.090993 0.503448 0.999041 -1.609842 0 0</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.200479 1.549194 2.743074</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_knife::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_coffee_cup</uri>
30             <pose>-0.016492 -0.468631 0.965206 2.603069 -1.513021 -2.66073</pose
                 >
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                 libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
```

```
54                      </plugin>
55
56                      <plugin name="l_grip" filename="libGripPlugin.so">
57                        <parentLinkName>link</parentLinkName>
58                        <childLinkName>b_knife::link</childLinkName>
59                        <relativePose>0.090993 0.003448 -0.000959 -1.60984 0 0</
                             relativePose>
60                      </plugin>
61
62                      <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                             so">
63                        <linkName>link</linkName>
64                        <frameName>l_gripper_tool_frame</frameName>
65                      </plugin>
66                  </include>
67
68                  <!-- Right Gripper -->
69                  <include>
70                      <uri>model://gripper</uri>
71                      <name>right_ee</name>
72                      <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74                      <plugin name="r_force_controller" filename="
                             libvelocity_controller_plugin.so">
75                        <linkName>link</linkName>
76                        <topicName>set_r_ee_twist</topicName>
77                        <gains>
78                          <linear>
79                            <P>100.0</P>
80                            <I>0.0</I>
81                            <D>25.0</D>
82                          </linear>
83                          <angular>
84                            <P>100.0</P>
85                            <I>0.0</I>
86                            <D>25.0</D>
87                          </angular>
88                        </gains>
89                      </plugin>
90
91                      <plugin name="r_grip" filename="libGripPlugin.so">
92                        <parentLinkName>link</parentLinkName>
93                        <childLinkName>b_coffee_cup::link</childLinkName>
94                        <relativePose>0.0284501 0.0346428 -0.0213798 2.93848 0.00496188
                             2.88401</relativePose>
95                      </plugin>
96
97                      <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                             so">
98                        <linkName>link</linkName>
99                        <frameName>r_gripper_tool_frame</frameName>
100                     </plugin>
101                 </include>
102
103                 <plugin name="feature_visualization_plugin" filename="
                         libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```xml
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="b_pot_b_table_knife_v">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_table_knife</uri>
15              <pose>0.060878 0.497562 1.005864 1.616805 0 0</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.135713 0.488941 1.003983 0.274231 1.507716 1.875637</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                <parentLinkName>link</parentLinkName>
23                <childLinkName>b_table_knife::link</childLinkName>
24                <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_pot</uri>
30              <pose>0.133471 -0.503990 0.971217 0 0 0</pose>
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40                <linkName>link</linkName>
41                <topicName>set_l_ee_twist</topicName>
42                <gains>
43                  <linear>
44                    <P>100.0</P>
45                    <I>0.0</I>
46                    <D>25.0</D>
47                  </linear>
48                  <angular>
49                    <P>100.0</P>
50                    <I>0.0</I>
51                    <D>25.0</D>
52                  </angular>
53                </gains>
54              </plugin>
```

```xml
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_table_knife::link</childLinkName>
59                <relativePose>0.060878 -0.002438 0.005864 1.6168 0 0</relativePose
                      >
60              </plugin>
61
62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65              </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                      libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_pot::link</childLinkName>
94                <relativePose>0.023942 0.0237816 0.132364 -1.55141 -1.36676
                      1.3834</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                  libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106                    <camera name='user_camera'>
107                        <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                        <view_controller>orbit</view_controller>
109                    </camera>
110                </gui>
111
112        </world>
113    </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_bucket_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16         </include>
17
18         <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19             <pose>0.100858 -0.510180 0.939254 0 0 0</pose>
20             <mass>0.001</mass>
21             <radius>0.015</radius>
22             <quantity>100</quantity>
23             <friction>0.4</friction>
24             <friction2>0.4</friction2>
25             <velocity_decay>0.3</velocity_decay>
26         </plugin>
27
28         <include>
29             <uri>model://b_bucket</uri>
30             <pose>0.100858 -0.510180 0.939254 -3.128475 -0.140461 3.129033</pose>
31         </include>
32
33         <include>
34             <uri>model://table</uri>
35             <pose>0.021929 0.062805 -0.137579 0 0 -1.571974</pose>
36         </include>
37         <!-- Left Gripper -->
38         <include>
39             <uri>model://gripper</uri>
40             <name>left_ee</name>
41             <pose>0 0.5 1 0 0 0</pose>
42
43             <plugin name="l_force_controller" filename="libvelocity_controller_plugin.so">
44               <linkName>link</linkName>
45               <topicName>set_l_ee_twist</topicName>
46               <gains>
47                 <linear>
48                   <P>100.0</P>
49                   <I>0.0</I>
50                   <D>25.0</D>
51                 </linear>
52                 <angular>
53                   <P>100.0</P>
```

```
54                    <I>0.0</I>
55                    <D>25.0</D>
56                  </angular>
57                </gains>
58              </plugin>
59
60              <plugin name="l_grip" filename="libGripPlugin.so">
61                <parentLinkName>link</parentLinkName>
62                <childLinkName>b_spatula::link</childLinkName>
63                <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                      -3.14159</relativePose>
64              </plugin>
65
66              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
67                <linkName>link</linkName>
68                <frameName>l_gripper_tool_frame</frameName>
69              </plugin>
70          </include>
71
72          <!-- Right Gripper -->
73          <include>
74              <uri>model://gripper</uri>
75              <name>right_ee</name>
76              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
77
78              <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
79                <linkName>link</linkName>
80                <topicName>set_r_ee_twist</topicName>
81                <gains>
82                  <linear>
83                    <P>100.0</P>
84                    <I>0.0</I>
85                    <D>25.0</D>
86                  </linear>
87                  <angular>
88                    <P>100.0</P>
89                    <I>0.0</I>
90                    <D>25.0</D>
91                  </angular>
92                </gains>
93              </plugin>
94
95              <plugin name="r_grip" filename="libGripPlugin.so">
96                <parentLinkName>link</parentLinkName>
97                <childLinkName>b_bucket::link</childLinkName>
98                <relativePose>0.0577053 0.0189525 0.101375 2.17015 1.31252
                      2.31211</relativePose>
99              </plugin>
100
101              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
102                <linkName>link</linkName>
103                <frameName>r_gripper_tool_frame</frameName>
104              </plugin>
105          </include>
```

```
106
107            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
108
109            <gui>
110                <camera name='user_camera'>
111                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                    <view_controller>orbit</view_controller>
113                </camera>
114            </gui>
115
116        </world>
117    </sdf>
```

236 worlds/scraping$_{bc}offee_cup_{bs}patula_v$.world

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_coffee_cup_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_thin_spatula</uri>
15             <pose>0.094321 0.507657 1.009274 -1.637236 0.074980 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.218391 0.495434 1.018867 1.118105 1.524620 2.552731</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22                 <parentLinkName>link</parentLinkName>
23                 <childLinkName>b_thin_spatula::link</childLinkName>
24                 <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_coffee_cup</uri>
30             <pose>-0.016492 -0.468631 0.965206 2.603069 -1.513021 -2.66073</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="libvelocity_controller_plugin.so">
40                 <linkName>link</linkName>
41                 <topicName>set_l_ee_twist</topicName>
42                 <gains>
43                     <linear>
44                         <P>100.0</P>
45                         <I>0.0</I>
46                         <D>25.0</D>
47                     </linear>
48                     <angular>
49                         <P>100.0</P>
50                         <I>0.0</I>
51                         <D>25.0</D>
52                     </angular>
53                 </gains>
```

```
54                    </plugin>
55
56                    <plugin name="l_grip" filename="libGripPlugin.so">
57                      <parentLinkName>link</parentLinkName>
58                      <childLinkName>b_thin_spatula::link</childLinkName>
59                      <relativePose>0.094321 0.007657 0.009274 -1.63724 0.07498
                           -3.14159</relativePose>
60                    </plugin>
61
62                    <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                         so">
63                      <linkName>link</linkName>
64                      <frameName>l_gripper_tool_frame</frameName>
65                    </plugin>
66              </include>
67
68              <!-- Right Gripper -->
69              <include>
70                  <uri>model://gripper</uri>
71                  <name>right_ee</name>
72                  <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74                  <plugin name="r_force_controller" filename="
                         libvelocity_controller_plugin.so">
75                      <linkName>link</linkName>
76                      <topicName>set_r_ee_twist</topicName>
77                      <gains>
78                        <linear>
79                          <P>100.0</P>
80                          <I>0.0</I>
81                          <D>25.0</D>
82                        </linear>
83                        <angular>
84                          <P>100.0</P>
85                          <I>0.0</I>
86                          <D>25.0</D>
87                        </angular>
88                      </gains>
89                  </plugin>
90
91                  <plugin name="r_grip" filename="libGripPlugin.so">
92                      <parentLinkName>link</parentLinkName>
93                      <childLinkName>b_coffee_cup::link</childLinkName>
94                      <relativePose>0.0284501 0.0346428 -0.0213798 2.93848 0.00496188
                           2.88401</relativePose>
95                  </plugin>
96
97                  <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                         so">
98                      <linkName>link</linkName>
99                      <frameName>r_gripper_tool_frame</frameName>
100                 </plugin>
101             </include>
102
103             <plugin name="feature_visualization_plugin" filename="
                     libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="b_bucket_b_serving_spoon_v">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_serving_spoon</uri>
15              <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.198795 0.509112 3.036336 1.368174 -1.866245</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                <parentLinkName>link</parentLinkName>
23                <childLinkName>b_serving_spoon::link</childLinkName>
24                <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_bucket</uri>
30              <pose>0.100858 -0.510180 0.939254 -3.128475 -0.140461 3.129033</pose
                    >
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40                <linkName>link</linkName>
41                <topicName>set_l_ee_twist</topicName>
42                <gains>
43                  <linear>
44                    <P>100.0</P>
45                    <I>0.0</I>
46                    <D>25.0</D>
47                  </linear>
48                  <angular>
49                    <P>100.0</P>
50                    <I>0.0</I>
51                    <D>25.0</D>
52                  </angular>
53                </gains>
```

```
 54                    </plugin>
 55
 56                    <plugin name="l_grip" filename="libGripPlugin.so">
 57                      <parentLinkName>link</parentLinkName>
 58                      <childLinkName>b_serving_spoon::link</childLinkName>
 59                      <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                            1.3828344221275815 0.015398730956486372 0.08077832485708741</
                            relativePose>
 60                    </plugin>
 61
 62                    <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
 63                      <linkName>link</linkName>
 64                      <frameName>l_gripper_tool_frame</frameName>
 65                    </plugin>
 66                </include>
 67
 68                <!-- Right Gripper -->
 69                <include>
 70                    <uri>model://gripper</uri>
 71                    <name>right_ee</name>
 72                    <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
 73
 74                    <plugin name="r_force_controller" filename="
                          libvelocity_controller_plugin.so">
 75                      <linkName>link</linkName>
 76                      <topicName>set_r_ee_twist</topicName>
 77                      <gains>
 78                        <linear>
 79                          <P>100.0</P>
 80                          <I>0.0</I>
 81                          <D>25.0</D>
 82                        </linear>
 83                        <angular>
 84                          <P>100.0</P>
 85                          <I>0.0</I>
 86                          <D>25.0</D>
 87                        </angular>
 88                      </gains>
 89                    </plugin>
 90
 91                    <plugin name="r_grip" filename="libGripPlugin.so">
 92                      <parentLinkName>link</parentLinkName>
 93                      <childLinkName>b_bucket::link</childLinkName>
 94                      <relativePose>0.0577053 0.0189525 0.101375 2.17015 1.31252
                            2.31211</relativePose>
 95                    </plugin>
 96
 97                    <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
 98                      <linkName>link</linkName>
 99                      <frameName>r_gripper_tool_frame</frameName>
100                    </plugin>
101                </include>
102
103                <plugin name="feature_visualization_plugin" filename="
                        libgiskard_visualization_plugin.so"></plugin>
```

```
104
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113  </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_bucket_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.461945 1.549196 2.743082</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_bucket</uri>
30             <pose>0.100858 -0.510180 0.939254 -3.128475 -0.140461 3.129033</pose
                  >
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                  libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
```

```xml
54                </plugin>
55
56                <plugin name="l_grip" filename="libGripPlugin.so">
57                  <parentLinkName>link</parentLinkName>
58                  <childLinkName>b_spatula::link</childLinkName>
59                  <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                        -3.14159</relativePose>
60                </plugin>
61
62                <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                        so">
63                  <linkName>link</linkName>
64                  <frameName>l_gripper_tool_frame</frameName>
65                </plugin>
66            </include>
67
68            <!-- Right Gripper -->
69            <include>
70                <uri>model://gripper</uri>
71                <name>right_ee</name>
72                <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74                <plugin name="r_force_controller" filename="
                        libvelocity_controller_plugin.so">
75                  <linkName>link</linkName>
76                  <topicName>set_r_ee_twist</topicName>
77                  <gains>
78                    <linear>
79                      <P>100.0</P>
80                      <I>0.0</I>
81                      <D>25.0</D>
82                    </linear>
83                    <angular>
84                      <P>100.0</P>
85                      <I>0.0</I>
86                      <D>25.0</D>
87                    </angular>
88                  </gains>
89                </plugin>
90
91                <plugin name="r_grip" filename="libGripPlugin.so">
92                  <parentLinkName>link</parentLinkName>
93                  <childLinkName>b_bucket::link</childLinkName>
94                  <relativePose>0.0577053 0.0189525 0.101375 2.17015 1.31252
                        2.31211</relativePose>
95                </plugin>
96
97                <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                        so">
98                  <linkName>link</linkName>
99                  <frameName>r_gripper_tool_frame</frameName>
100               </plugin>
101           </include>
102
103           <plugin name="feature_visualization_plugin" filename="
                    libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_frying_pan_b_serving_spoon_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_serving_spoon</uri>
15             <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16         </include>
17
18         <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19             <pose>0.228443 -0.496122 0.971397 0 0 0</pose>
20             <mass>0.001</mass>
21             <radius>0.015</radius>
22             <quantity>100</quantity>
23             <friction>0.4</friction>
24             <friction2>0.4</friction2>
25             <velocity_decay>0.3</velocity_decay>
26         </plugin>
27
28         <include>
29             <uri>model://b_frying_pan</uri>
30             <pose>0.228443 -0.496122 0.971397 0 0 0</pose>
31         </include>
32
33         <include>
34             <uri>model://table</uri>
35             <pose>0.021929 0.062805 -0.065959 0 0 -1.571974</pose>
36         </include>
37         <!-- Left Gripper -->
38         <include>
39             <uri>model://gripper</uri>
40             <name>left_ee</name>
41             <pose>0 0.5 1 0 0 0</pose>
42
43             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
44               <linkName>link</linkName>
45               <topicName>set_l_ee_twist</topicName>
46               <gains>
47                 <linear>
48                   <P>100.0</P>
49                   <I>0.0</I>
50                   <D>25.0</D>
51                 </linear>
52                 <angular>
53                   <P>100.0</P>
54                   <I>0.0</I>
```

```
55              <D>25.0</D>
56            </angular>
57          </gains>
58        </plugin>
59
60        <plugin name="l_grip" filename="libGripPlugin.so">
61          <parentLinkName>link</parentLinkName>
62          <childLinkName>b_serving_spoon::link</childLinkName>
63          <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                1.382834221275815 0.015398730956486372 0.08077832485708741</
                relativePose>
64        </plugin>
65
66        <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                so">
67          <linkName>link</linkName>
68          <frameName>l_gripper_tool_frame</frameName>
69        </plugin>
70      </include>
71
72      <!-- Right Gripper -->
73      <include>
74          <uri>model://gripper</uri>
75          <name>right_ee</name>
76          <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
77
78          <plugin name="r_force_controller" filename="
                libvelocity_controller_plugin.so">
79          <linkName>link</linkName>
80          <topicName>set_r_ee_twist</topicName>
81          <gains>
82            <linear>
83              <P>100.0</P>
84              <I>0.0</I>
85              <D>25.0</D>
86            </linear>
87            <angular>
88              <P>100.0</P>
89              <I>0.0</I>
90              <D>25.0</D>
91            </angular>
92          </gains>
93        </plugin>
94
95        <plugin name="r_grip" filename="libGripPlugin.so">
96          <parentLinkName>link</parentLinkName>
97          <childLinkName>b_frying_pan::link</childLinkName>
98          <relativePose>0.0186144 0.0468562 0.224672 -1.55141 -1.36676
                1.3834</relativePose>
99        </plugin>
100
101        <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                so">
102          <linkName>link</linkName>
103          <frameName>r_gripper_tool_frame</frameName>
104        </plugin>
105      </include>
```

```
106
107          <plugin name="feature_visualization_plugin" filename="
                 libgiskard_visualization_plugin.so"></plugin>
108
109          <gui>
110              <camera name='user_camera'>
111                  <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                  <view_controller>orbit</view_controller>
113              </camera>
114          </gui>
115
116      </world>
117  </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_red_mug_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16         </include>
17
18         <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19             <pose>0.061612 -0.504614 1.006537 0 0 0</pose>
20             <mass>0.001</mass>
21             <radius>0.015</radius>
22             <quantity>100</quantity>
23             <friction>0.4</friction>
24             <friction2>0.4</friction2>
25             <velocity_decay>0.3</velocity_decay>
26         </plugin>
27
28         <include>
29             <uri>model://b_red_mug</uri>
30             <pose>0.061612 -0.504614 1.006537 0.423677 0 3.060068</pose>
31         </include>
32
33         <include>
34             <uri>model://table</uri>
35             <pose>0.021929 0.062805 -0.066428 0 0 -1.571974</pose>
36         </include>
37         <!-- Left Gripper -->
38         <include>
39             <uri>model://gripper</uri>
40             <name>left_ee</name>
41             <pose>0 0.5 1 0 0 0</pose>
42
43             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
44               <linkName>link</linkName>
45               <topicName>set_l_ee_twist</topicName>
46               <gains>
47                 <linear>
48                   <P>100.0</P>
49                   <I>0.0</I>
50                   <D>25.0</D>
51                 </linear>
52                 <angular>
53                   <P>100.0</P>
54                   <I>0.0</I>
```

```xml
              <D>25.0</D>
            </angular>
          </gains>
        </plugin>

        <plugin name="l_grip" filename="libGripPlugin.so">
          <parentLinkName>link</parentLinkName>
          <childLinkName>b_spatula::link</childLinkName>
          <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                -3.14159</relativePose>
        </plugin>

        <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
            so">
          <linkName>link</linkName>
          <frameName>l_gripper_tool_frame</frameName>
        </plugin>
      </include>

      <!-- Right Gripper -->
      <include>
          <uri>model://gripper</uri>
          <name>right_ee</name>
          <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>

          <plugin name="r_force_controller" filename="
              libvelocity_controller_plugin.so">
          <linkName>link</linkName>
          <topicName>set_r_ee_twist</topicName>
          <gains>
            <linear>
              <P>100.0</P>
              <I>0.0</I>
              <D>25.0</D>
            </linear>
            <angular>
              <P>100.0</P>
              <I>0.0</I>
              <D>25.0</D>
            </angular>
          </gains>
        </plugin>

        <plugin name="r_grip" filename="libGripPlugin.so">
          <parentLinkName>link</parentLinkName>
          <childLinkName>b_red_mug::link</childLinkName>
          <relativePose>-0.00780861 0.00428533 0.0614876 1.24173 -1.34456
                1.65836</relativePose>
        </plugin>

        <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
            so">
          <linkName>link</linkName>
          <frameName>r_gripper_tool_frame</frameName>
        </plugin>
      </include>
```

```
107            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
108
109            <gui>
110                <camera name='user_camera'>
111                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                    <view_controller>orbit</view_controller>
113                </camera>
114            </gui>
115
116        </world>
117    </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="scraping">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://table</uri>
15              <pose>0 0 0 0 0 -1.57694</pose>
16              <static>true</static>
17          </include>
18
19          <include>
20              <uri>model://b_spatula</uri>
21              <pose>0.140489 0.527566 1.397957 1.571605 -0.058101 -2.939758</pose>
22          </include>
23
24          <plugin name="lasagna_factory" filename="libLasagnaFactoryPlugin.so">
25            <pose>0 0 1.035 0 0 0</pose>
26            <size>8 8 2</size>
27            <radius>0.01</radius>
28            <friction>0.1</friction>
29            <friction2>0.1</friction2>
30            <jointDamping>10</jointDamping>
31            <jointFriction>5</jointFriction>
32          </plugin>
33
34          <!-- Left Gripper -->
35          <include>
36              <uri>model://gripper</uri>
37              <name>left_ee</name>
38              <pose>0 0.5 1.4 0 0 0</pose>
39
40              <plugin name="l_force_controller" filename="
                      libvelocity_controller_plugin.so">
41                <linkName>link</linkName>
42                <topicName>set_l_ee_twist</topicName>
43                <gains>
44                  <linear>
45                    <P>100.0</P>
46                    <I>0.0</I>
47                    <D>25.0</D>
48                  </linear>
49                  <angular>
50                    <P>100.0</P>
51                    <I>0.0</I>
52                    <D>25.0</D>
53                  </angular>
54                </gains>
```

```
55                </plugin>
56
57                <plugin name="l_grip" filename="libGripPlugin.so">
58                  <parentLinkName>link</parentLinkName>
59                  <childLinkName>b_spatula::link</childLinkName>
60                  <relativePose>0.14 0.028 -0.002 -1.57 3.20 0.20</relativePose>
61                </plugin>
62
63                <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                     so">
64                  <linkName>link</linkName>
65                  <frameName>l_gripper_tool_frame</frameName>
66                </plugin>
67            </include>
68
69            <!-- Right Gripper -->
70            <include>
71                <uri>model://gripper</uri>
72                <name>right_ee</name>
73                <pose>0 -0.5 1.039100 1.547368 1.402341 1.343703</pose>
74
75                <plugin name="r_force_controller" filename="
                     libvelocity_controller_plugin.so">
76                  <linkName>link</linkName>
77                  <topicName>set_r_ee_twist</topicName>
78                  <gains>
79                    <linear>
80                      <P>100.0</P>
81                      <I>0.0</I>
82                      <D>25.0</D>
83                    </linear>
84                    <angular>
85                      <P>100.0</P>
86                      <I>0.0</I>
87                      <D>25.0</D>
88                    </angular>
89                  </gains>
90                </plugin>
91
92
93                <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                     so">
94                  <linkName>link</linkName>
95                  <frameName>r_gripper_tool_frame</frameName>
96                </plugin>
97            </include>
98
99            <plugin name="feature_visualization_plugin" filename="
                 libgiskard_visualization_plugin.so"></plugin>
100
101           <gui>
102               <camera name='user_camera'>
103                   <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
104                   <view_controller>orbit</view_controller>
105               </camera>
106           </gui>
107
```

```
108          </world>
109     </sdf>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version="1.6">
 3
 4      <world name="grabbing_book_v">
 5
 6          <!-- <physics type="ode">
 7              <max_step_size>0.001</max_step_size>
 8              <real_time_factor>1</real_time_factor>
 9              <real_time_update_rate>1000</real_time_update_rate>
10              <bullet>
11                  <solver>
12                      <iters>70</iters>
13                  </solver>
14              </bullet>
15              <ode>
16                  <solver>
17                      <iters>70</iters>
18                  </solver>
19              </ode>
20          </physics> -->
21
22          <include>
23              <uri>model://sun</uri>
24          </include>
25
26          <include>
27              <uri>model://ground_plane</uri>
28          </include>
29  <!--
30          <include>
31              <uri>model://finger</uri>
32              <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33          </include> -->
34
35          <include>
36              <uri>model://freezer_box</uri>
37              <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38          </include>
39
40
41
42          <model name='book_target'>
43            <static>false</static>
44            <pose>0.220000 0.000000 0.300000 1.570796 0.000000 0.000000</pose>
45
46            <link name='book_link'>
47              <pose frame='link'>0.0 0.0 0.0 0.0 0 0</pose>
48              <inertial>
49                <mass>0.1</mass>
50                <pose frame='link'>0.0 0.0 0.0 0 0 0</pose>
51                <inertia>
52                  <ixx>0.002416667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
53                  <ixy>0</ixy>
54                  <ixz>0</ixz>
55                  <iyy>0.000666667</iyy>
```

```
56                    <iyz>0</iyz>
57                    <izz>0.002416667</izz>
58                  </inertia>
59                </inertial>
60                <collision name='book_collision'>
61                  <geometry>
62                    <box>
63                      <size>0.2 0.5 0.2</size>
64                    </box>
65                  </geometry>
66                  <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
67                  <surface>
68                    <friction>
69                      <ode>
70                        <mu>0.2</mu>
71                        <mu2>0.2</mu2>
72                      </ode>
73                    </friction>
74                  </surface>
75                </collision>
76                <visual name='book_visual'>
77                  <geometry>
78                    <box>
79                      <size>0.2 0.5 0.2</size>
80                    </box>
81                  </geometry>
82                  <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
83                </visual>
84                <sensor name="main_bumper" type="contact">
85                  <selfCollide>true</selfCollide>
86                  <alwaysOn>true</alwaysOn>
87                  <updateRate>15.0</updateRate>
88                  <contact>
89                    <collision>book_collision</collision>
90                  </contact>
91                </sensor>
92              </link>
93              <plugin name="target_tf_broadcaster" filename="
                    libtf_broadcaster_plugin.so">
94                <linkName>book_link</linkName>
95                <frameName>book_object_frame</frameName>
96              </plugin>
97              <plugin name="grasp" filename="libTiltGrabPlugin.so">
98                <parentLinkName>book_link</parentLinkName>
99                <childLinkName1>left_ee::link</childLinkName1>
100               <childLinkName2>right_ee::link</childLinkName2>
101               <childLinkName3>right_ee_2::link</childLinkName3>
102               <sensorName>book_contact</sensorName>
103             </plugin>
104           </model>
105
106
107
108           <!-- Left Gripper -->
109           <include>
110               <uri>model://finger</uri>
111               <name>left_ee</name>
```

```
112                    <pose>0.000000  0.000000  0.880000  0.000000  0.000000  1.57080</pose>
113
114
115                    <plugin name="l_force_controller" filename="
                          libvelocity_controller_plugin.so">
116                      <linkName>link</linkName>
117                      <topicName>set_l_ee_twist</topicName>
118                      <gains>
119                        <linear>
120                          <P>100.0</P>
121                          <I>0.0</I>
122                          <D>25.0</D>
123                        </linear>
124                        <angular>
125                          <P>100.0</P>
126                          <I>0.0</I>
127                          <D>25.0</D>
128                        </angular>
129                      </gains>
130                    </plugin>
131
132                    <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
133                      <linkName>link</linkName>
134                      <frameName>l_gripper_tool_frame</frameName>
135                    </plugin>
136              </include>
137
138              <!-- Right Gripper -->
139              <include>
140                    <uri>model://finger</uri>
141                    <name>right_ee</name>
142                    <pose>0.600000  0.500000  0.830000  0.000000  0.000000  1.57080</pose>
143
144                    <plugin name="r_force_controller" filename="
                          libvelocity_controller_plugin.so">
145                      <linkName>link</linkName>
146                      <topicName>set_r_ee_twist</topicName>
147                      <gains>
148                        <linear>
149                          <P>100.0</P>
150                          <I>0.0</I>
151                          <D>25.0</D>
152                        </linear>
153                        <angular>
154                          <P>100.0</P>
155                          <I>0.0</I>
156                          <D>25.0</D>
157                        </angular>
158                      </gains>
159                    </plugin>
160
161                    <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
162                      <linkName>link</linkName>
163                      <frameName>r_gripper_tool_frame</frameName>
164                    </plugin>
```

```xml
165            </include>
166
167            <include>
168                <uri>model://finger</uri>
169                <name>right_ee_2</name>
170                <pose>0.600000 -0.500000 0.830000 0.000000 0.000000 1.57080</pose>
171
172                <plugin name="r_2_force_controller" filename="
                       libvelocity_controller_plugin.so">
173                  <linkName>link</linkName>
174                  <topicName>set_r_ee_2_twist</topicName>
175                  <gains>
176                    <linear>
177                      <P>100.0</P>
178                      <I>0.0</I>
179                      <D>25.0</D>
180                    </linear>
181                    <angular>
182                      <P>100.0</P>
183                      <I>0.0</I>
184                      <D>25.0</D>
185                    </angular>
186                  </gains>
187                </plugin>
188
189                <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                       .so">
190                  <linkName>link</linkName>
191                  <frameName>r_2_gripper_tool_frame</frameName>
192                </plugin>
193            </include>
194
195        <plugin name="feature_visualization_plugin" filename="
               libgiskard_visualization_plugin.so"></plugin>
196
197        <gui>
198            <camera name='user_camera'>
199                <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
200                <view_controller>orbit</view_controller>
201            </camera>
202        </gui>
203
204     </world>
205 </sdf>
```

454

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="b_wildo_bowl_b_serving_spoon_v">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_serving_spoon</uri>
15              <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.198795 0.509112 3.036336 1.368174 -1.866245</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                <parentLinkName>link</parentLinkName>
23                <childLinkName>b_serving_spoon::link</childLinkName>
24                <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_wildo_bowl</uri>
30              <pose>0.078818 -0.501749 0.988186 3.097035 0 0</pose>
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40                <linkName>link</linkName>
41                <topicName>set_l_ee_twist</topicName>
42                <gains>
43                  <linear>
44                    <P>100.0</P>
45                    <I>0.0</I>
46                    <D>25.0</D>
47                  </linear>
48                  <angular>
49                    <P>100.0</P>
50                    <I>0.0</I>
51                    <D>25.0</D>
52                  </angular>
53                </gains>
54              </plugin>
```

```
55
56            <plugin name="l_grip" filename="libGripPlugin.so">
57              <parentLinkName>link</parentLinkName>
58              <childLinkName>b_serving_spoon::link</childLinkName>
59              <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                      1.3828344221275815 0.015398730956486372 0.08077832485708741</
                      relativePose>
60            </plugin>
61
62            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
63              <linkName>link</linkName>
64              <frameName>l_gripper_tool_frame</frameName>
65            </plugin>
66        </include>
67
68        <!-- Right Gripper -->
69        <include>
70            <uri>model://gripper</uri>
71            <name>right_ee</name>
72            <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74            <plugin name="r_force_controller" filename="
                  libvelocity_controller_plugin.so">
75              <linkName>link</linkName>
76              <topicName>set_r_ee_twist</topicName>
77              <gains>
78                <linear>
79                  <P>100.0</P>
80                  <I>0.0</I>
81                  <D>25.0</D>
82                </linear>
83                <angular>
84                  <P>100.0</P>
85                  <I>0.0</I>
86                  <D>25.0</D>
87                </angular>
88              </gains>
89            </plugin>
90
91            <plugin name="r_grip" filename="libGripPlugin.so">
92              <parentLinkName>link</parentLinkName>
93              <childLinkName>b_wildo_bowl::link</childLinkName>
94              <relativePose>0.0089419 0.0135799 0.0780419 1.55636 1.32285
                      -1.41637</relativePose>
95            </plugin>
96
97            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
98              <linkName>link</linkName>
99              <frameName>r_gripper_tool_frame</frameName>
100           </plugin>
101       </include>
102
103       <plugin name="feature_visualization_plugin" filename="
              libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui >
106                <camera  name='user_camera'>
107                    <pose>1.700789  1.175709  1.670612  0  0.375643  -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113  </sdf>
```

```xml
<?xml version='1.0'?>
<sdf version="1.6">
    <world name="b_coffee_cup_b_table_knife_v">

        <include>
            <uri>model://sun</uri>
        </include>

        <include>
            <uri>model://ground_plane</uri>
        </include>

        <include>
            <uri>model://b_table_knife</uri>
            <pose>0.060878 0.497562 1.005864 1.616805 0 0</pose>
        </include>

        <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
            <pose>-0.016492 -0.468631 0.965206 0 0 0</pose>
            <mass>0.001</mass>
            <radius>0.015</radius>
            <quantity>100</quantity>
            <friction>0.4</friction>
            <friction2>0.4</friction2>
            <velocity_decay>0.3</velocity_decay>
        </plugin>

        <include>
            <uri>model://b_coffee_cup</uri>
            <pose>-0.016492 -0.468631 0.965206 2.603069 -1.513021 -2.66073</pose>
        </include>

        <!-- Left Gripper -->
        <include>
            <uri>model://gripper</uri>
            <name>left_ee</name>
            <pose>0 0.5 1 0 0 0</pose>

            <plugin name="l_force_controller" filename="libvelocity_controller_plugin.so">
              <linkName>link</linkName>
              <topicName>set_l_ee_twist</topicName>
              <gains>
                <linear>
                  <P>100.0</P>
                  <I>0.0</I>
                  <D>25.0</D>
                </linear>
                <angular>
                  <P>100.0</P>
                  <I>0.0</I>
                  <D>25.0</D>
                </angular>
              </gains>
```

```
 54                    </plugin>
 55
 56                    <plugin name="l_grip" filename="libGripPlugin.so">
 57                      <parentLinkName>link</parentLinkName>
 58                      <childLinkName>b_table_knife::link</childLinkName>
 59                      <relativePose>0.060878 -0.002438 0.005864 1.6168 0 0</relativePose
                            >
 60                    </plugin>
 61
 62                    <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                            so">
 63                      <linkName>link</linkName>
 64                      <frameName>l_gripper_tool_frame</frameName>
 65                    </plugin>
 66                </include>
 67
 68            <!-- Right Gripper -->
 69            <include>
 70                    <uri>model://gripper</uri>
 71                    <name>right_ee</name>
 72                    <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
 73
 74                    <plugin name="r_force_controller" filename="
                            libvelocity_controller_plugin.so">
 75                      <linkName>link</linkName>
 76                      <topicName>set_r_ee_twist</topicName>
 77                      <gains>
 78                        <linear>
 79                          <P>100.0</P>
 80                          <I>0.0</I>
 81                          <D>25.0</D>
 82                        </linear>
 83                        <angular>
 84                          <P>100.0</P>
 85                          <I>0.0</I>
 86                          <D>25.0</D>
 87                        </angular>
 88                      </gains>
 89                    </plugin>
 90
 91                    <plugin name="r_grip" filename="libGripPlugin.so">
 92                      <parentLinkName>link</parentLinkName>
 93                      <childLinkName>b_coffee_cup::link</childLinkName>
 94                      <relativePose>0.0284501 0.0346428 -0.0213798 2.93848 0.00496188
                            2.88401</relativePose>
 95                    </plugin>
 96
 97                    <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                            so">
 98                      <linkName>link</linkName>
 99                      <frameName>r_gripper_tool_frame</frameName>
100                    </plugin>
101                </include>
102
103            <plugin name="feature_visualization_plugin" filename="
                    libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3       <world name="big_bowl_serving_spoon_p">
4
5           <include>
6               <uri>model://sun</uri>
7           </include>
8
9           <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_serving_spoon</uri>
15              <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.198795 0.509112 3.036336 1.368174 -1.866245</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                <parentLinkName>link</parentLinkName>
23                <childLinkName>b_serving_spoon::link</childLinkName>
24                <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_big_bowl</uri>
30              <pose>0.024164 -0.383989 0.959287 -0.017186 -0.000884 -0.101566</
                    pose>
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_position_controller" filename="
                    libposition_controller_plugin.so">
40                <linkName>link</linkName>
41                <referenceFrameName>base_link</referenceFrameName>
42                <targetFrameName>l_gripper_tool_frame</targetFrameName>
43                <P>100.0</P>
44                <I>0.0</I>
45                <D>50.0</D>
46              </plugin>
47
48              <plugin name="l_grip" filename="libGripPlugin.so">
49                <parentLinkName>link</parentLinkName>
50                <childLinkName>b_serving_spoon::link</childLinkName>
51                <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                      1.3828344221275815 0.015398730956486372 0.08077832485708741</
                      relativePose>
```

```
52                 </plugin>
53              </include>
54
55          <!-- Right Gripper -->
56          <include>
57              <uri>model://gripper</uri>
58              <name>right_ee</name>
59              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
60
61              <plugin name="r_position_controller" filename="
                    libposition_controller_plugin.so">
62                <linkName>link</linkName>
63                <referenceFrameName>base_link</referenceFrameName>
64                <targetFrameName>r_gripper_tool_frame</targetFrameName>
65                <P>100.0</P>
66                <I>0.0</I>
67                <D>50.0</D>
68              </plugin>
69
70              <plugin name="r_grip" filename="libGripPlugin.so">
71                <parentLinkName>link</parentLinkName>
72                <childLinkName>b_big_bowl::link</childLinkName>
73                <relativePose>0.06 0.11 0 -1.57 -1.35 1.3</relativePose>
74              </plugin>
75          </include>
76
77          <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
78
79          <gui>
80              <camera name='user_camera'>
81                  <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
82                  <view_controller>orbit</view_controller>
83              </camera>
84          </gui>
85
86      </world>
87  </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_coffee_cup_b_thin_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_thin_spatula</uri>
15             <pose>0.094321 0.507657 1.009274 -1.637236 0.074980 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.218391 0.495434 1.018867 1.118105 1.524620 2.552731</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_thin_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_coffee_cup</uri>
30             <pose>-0.016492 -0.468631 0.965206 2.603069 -1.513021 -2.66073</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
```

```
54                    </plugin>
55
56                    <plugin name="l_grip" filename="libGripPlugin.so">
57                      <parentLinkName>link</parentLinkName>
58                      <childLinkName>b_thin_spatula::link</childLinkName>
59                      <relativePose>0.094321 0.007657 0.009274 -1.63724 0.07498
                            -3.14159</relativePose>
60                    </plugin>
61
62                    <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                          so">
63                      <linkName>link</linkName>
64                      <frameName>l_gripper_tool_frame</frameName>
65                    </plugin>
66                </include>
67
68            <!-- Right Gripper -->
69            <include>
70                <uri>model://gripper</uri>
71                <name>right_ee</name>
72                <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74                <plugin name="r_force_controller" filename="
                        libvelocity_controller_plugin.so">
75                  <linkName>link</linkName>
76                  <topicName>set_r_ee_twist</topicName>
77                  <gains>
78                    <linear>
79                      <P>100.0</P>
80                      <I>0.0</I>
81                      <D>25.0</D>
82                    </linear>
83                    <angular>
84                      <P>100.0</P>
85                      <I>0.0</I>
86                      <D>25.0</D>
87                    </angular>
88                  </gains>
89                </plugin>
90
91                <plugin name="r_grip" filename="libGripPlugin.so">
92                  <parentLinkName>link</parentLinkName>
93                  <childLinkName>b_coffee_cup::link</childLinkName>
94                  <relativePose>0.0284501 0.0346428 -0.0213798 2.93848 0.00496188
                        2.88401</relativePose>
95                </plugin>
96
97                <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
98                  <linkName>link</linkName>
99                  <frameName>r_gripper_tool_frame</frameName>
100               </plugin>
101            </include>
102
103        <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

247 worlds/freezer$_b$ox.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3
4      <world name="grabbing_book_v">
5
6          <!-- <physics type="ode">
7              <max_step_size>0.001</max_step_size>
8              <real_time_factor>1</real_time_factor>
9              <real_time_update_rate>1000</real_time_update_rate>
10             <bullet>
11                 <solver>
12                     <iters>70</iters>
13                 </solver>
14             </bullet>
15             <ode>
16                 <solver>
17                     <iters>70</iters>
18                 </solver>
19             </ode>
20         </physics> -->
21
22         <include>
23             <uri>model://sun</uri>
24         </include>
25
26         <include>
27             <uri>model://ground_plane</uri>
28         </include>
29  <!--
30         <include>
31             <uri>model://finger</uri>
32             <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33         </include> -->
34
35         <include>
36             <uri>model://freezer_box</uri>
37             <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38         </include>
39
40
41
42         <model name='book_target'>
43           <static>false</static>
44           <pose>0.220000 0.000000 0.300000 1.570796 0.000000 0.000000</pose>
45
46           <link name='book_link'>
47             <pose frame='link'>0.0 0.0 0.0 0.0 0 0</pose>
48             <inertial>
49               <mass>1</mass>
50               <pose frame='link'>0.0 0.0 0.0 0 0 0</pose>
51               <inertia>
52                 <ixx>0.0883333</ixx><!--  1/12 * m * (h^2 + d^2)  -->
53                 <ixy>0</ixy>
54                 <ixz>0</ixz>
55                 <iyy>0.0883333</iyy>
```

466

```
 56                        <iyz>0</iyz>
 57                        <izz>0.0416666</izz>
 58                      </inertia>
 59                    </inertial>
 60                    <collision name='book_collision'>
 61                      <geometry>
 62                        <box>
 63                          <size>0.5 0.5 0.9</size>
 64                        </box>
 65                      </geometry>
 66                      <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
 67                      <surface>
 68                        <friction>
 69                          <ode>
 70                            <mu>0.2</mu>
 71                            <mu2>0.2</mu2>
 72                          </ode>
 73                        </friction>
 74                      </surface>
 75                    </collision>
 76                    <visual name='book_visual'>
 77                      <geometry>
 78                        <box>
 79                          <size>0.5 0.5 0.9</size>
 80                        </box>
 81                      </geometry>
 82                      <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
 83                    </visual>
 84                    <sensor name="main_bumper" type="contact">
 85                      <selfCollide>true</selfCollide>
 86                      <alwaysOn>true</alwaysOn>
 87                      <updateRate>15.0</updateRate>
 88                      <contact>
 89                        <collision>book_collision</collision>
 90                      </contact>
 91                    </sensor>
 92                  </link>
 93                  <plugin name="target_tf_broadcaster" filename="
                        libtf_broadcaster_plugin.so">
 94                    <linkName>book_link</linkName>
 95                    <frameName>book_object_frame</frameName>
 96                  </plugin>
 97                  <plugin name="grasp" filename="libTiltGrabPlugin.so">
 98                    <parentLinkName>book_link</parentLinkName>
 99                    <childLinkName1>left_ee::link</childLinkName1>
100                    <childLinkName2>right_ee::link</childLinkName2>
101                    <childLinkName3>right_ee_2::link</childLinkName3>
102                    <sensorName>book_contact</sensorName>
103                  </plugin>
104                </model>
105
106
107
108            <!-- Left Gripper -->
109            <include>
110                <uri>model://finger</uri>
111                <name>left_ee</name>
```

467

```
112            <pose>0.000000 0.000000 0.880000 0.000000 0.000000 1.57080</pose>
113
114
115            <plugin name="l_force_controller" filename="
                  libvelocity_controller_plugin.so">
116              <linkName>link</linkName>
117              <topicName>set_l_ee_twist</topicName>
118              <gains>
119                <linear>
120                  <P>100.0</P>
121                  <I>0.0</I>
122                  <D>25.0</D>
123                </linear>
124                <angular>
125                  <P>100.0</P>
126                  <I>0.0</I>
127                  <D>25.0</D>
128                </angular>
129              </gains>
130            </plugin>
131
132            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
133              <linkName>link</linkName>
134              <frameName>l_gripper_tool_frame</frameName>
135            </plugin>
136          </include>
137
138          <!-- Right Gripper -->
139          <include>
140            <uri>model://finger</uri>
141            <name>right_ee</name>
142            <pose>0.600000 0.500000 0.830000 0.000000 0.000000 1.57080</pose>
143
144            <plugin name="r_force_controller" filename="
                  libvelocity_controller_plugin.so">
145              <linkName>link</linkName>
146              <topicName>set_r_ee_twist</topicName>
147              <gains>
148                <linear>
149                  <P>100.0</P>
150                  <I>0.0</I>
151                  <D>25.0</D>
152                </linear>
153                <angular>
154                  <P>100.0</P>
155                  <I>0.0</I>
156                  <D>25.0</D>
157                </angular>
158              </gains>
159            </plugin>
160
161            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
162              <linkName>link</linkName>
163              <frameName>r_gripper_tool_frame</frameName>
164            </plugin>
```

```
165            </include>
166
167            <include>
168                <uri>model://finger</uri>
169                <name>right_ee_2</name>
170                <pose>0.600000 -0.500000 0.830000 0.000000 0.000000 1.57080</pose>
171
172                <plugin name="r_2_force_controller" filename="
                       libvelocity_controller_plugin.so">
173                  <linkName>link</linkName>
174                  <topicName>set_r_ee_2_twist</topicName>
175                  <gains>
176                    <linear>
177                      <P>100.0</P>
178                      <I>0.0</I>
179                      <D>25.0</D>
180                    </linear>
181                    <angular>
182                      <P>100.0</P>
183                      <I>0.0</I>
184                      <D>25.0</D>
185                    </angular>
186                  </gains>
187                </plugin>
188
189                <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                       .so">
190                  <linkName>link</linkName>
191                  <frameName>r_2_gripper_tool_frame</frameName>
192                </plugin>
193            </include>
194
195        <plugin name="feature_visualization_plugin" filename="
               libgiskard_visualization_plugin.so"></plugin>
196
197        <gui>
198            <camera name='user_camera'>
199                <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
200                <view_controller>orbit</view_controller>
201            </camera>
202        </gui>
203
204     </world>
205 </sdf>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version="1.6">
 3      <world name="b_pot_b_spatula_v">
 4
 5          <include>
 6              <uri>model://sun</uri>
 7          </include>
 8
 9          <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_spatula</uri>
15              <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16          </include>
17
18          <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19              <pose>0.133471 -0.503990 0.971217 0 0 0</pose>
20              <mass>0.001</mass>
21              <radius>0.015</radius>
22              <quantity>100</quantity>
23              <friction>0.4</friction>
24              <friction2>0.4</friction2>
25              <velocity_decay>0.3</velocity_decay>
26          </plugin>
27
28          <include>
29              <uri>model://b_pot</uri>
30              <pose>0.133471 -0.503990 0.971217 0 0 0</pose>
31          </include>
32
33          <include>
34              <uri>model://table</uri>
35              <pose>0.021929 0.062805 -0.079240 0 0 -1.571974</pose>
36          </include>
37          <!-- Left Gripper -->
38          <include>
39              <uri>model://gripper</uri>
40              <name>left_ee</name>
41              <pose>0 0.5 1 0 0 0</pose>
42
43              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
44                <linkName>link</linkName>
45                <topicName>set_l_ee_twist</topicName>
46                <gains>
47                  <linear>
48                    <P>100.0</P>
49                    <I>0.0</I>
50                    <D>25.0</D>
51                  </linear>
52                  <angular>
53                    <P>100.0</P>
54                    <I>0.0</I>
```

```xml
                    <D>25.0</D>
                  </angular>
                </gains>
              </plugin>

              <plugin name="l_grip" filename="libGripPlugin.so">
                <parentLinkName>link</parentLinkName>
                <childLinkName>b_spatula::link</childLinkName>
                <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                    -3.14159</relativePose>
              </plugin>

              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
                <linkName>link</linkName>
                <frameName>l_gripper_tool_frame</frameName>
              </plugin>
          </include>

          <!-- Right Gripper -->
          <include>
              <uri>model://gripper</uri>
              <name>right_ee</name>
              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>

              <plugin name="r_force_controller" filename="
                  libvelocity_controller_plugin.so">
                <linkName>link</linkName>
                <topicName>set_r_ee_twist</topicName>
                <gains>
                  <linear>
                    <P>100.0</P>
                    <I>0.0</I>
                    <D>25.0</D>
                  </linear>
                  <angular>
                    <P>100.0</P>
                    <I>0.0</I>
                    <D>25.0</D>
                  </angular>
                </gains>
              </plugin>

              <plugin name="r_grip" filename="libGripPlugin.so">
                <parentLinkName>link</parentLinkName>
                <childLinkName>b_pot::link</childLinkName>
                <relativePose>0.023942 0.0237816 0.132364 -1.55141 -1.36676
                    1.3834</relativePose>
              </plugin>

              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
                <linkName>link</linkName>
                <frameName>r_gripper_tool_frame</frameName>
              </plugin>
          </include>
```

```
107          <plugin name="feature_visualization_plugin" filename="
                 libgiskard_visualization_plugin.so"></plugin>
108
109          <gui>
110              <camera name='user_camera'>
111                  <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                  <view_controller>orbit</view_controller>
113              </camera>
114          </gui>
115
116      </world>
117  </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_wildo_bowl_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16         </include>
17
18         <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19             <pose>0.078818 -0.501749 0.988186 0 0 0</pose>
20             <mass>0.001</mass>
21             <radius>0.015</radius>
22             <quantity>100</quantity>
23             <friction>0.4</friction>
24             <friction2>0.4</friction2>
25             <velocity_decay>0.3</velocity_decay>
26         </plugin>
27
28         <include>
29             <uri>model://b_wildo_bowl</uri>
30             <pose>0.078818 -0.501749 0.988186 3.097035 0 0</pose>
31         </include>
32
33         <include>
34             <uri>model://table</uri>
35             <pose>0.021929 0.062805 -0.066428 0 0 -1.571974</pose>
36         </include>
37         <!-- Left Gripper -->
38         <include>
39             <uri>model://gripper</uri>
40             <name>left_ee</name>
41             <pose>0 0.5 1 0 0 0</pose>
42
43             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
44               <linkName>link</linkName>
45               <topicName>set_l_ee_twist</topicName>
46               <gains>
47                 <linear>
48                   <P>100.0</P>
49                   <I>0.0</I>
50                   <D>25.0</D>
51                 </linear>
52                 <angular>
53                   <P>100.0</P>
54                   <I>0.0</I>
```

```
55              <D>25.0</D>
56            </angular>
57          </gains>
58        </plugin>
59
60        <plugin name="l_grip" filename="libGripPlugin.so">
61          <parentLinkName>link</parentLinkName>
62          <childLinkName>b_spatula::link</childLinkName>
63          <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                  -3.14159</relativePose>
64        </plugin>
65
66        <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
67          <linkName>link</linkName>
68          <frameName>l_gripper_tool_frame</frameName>
69        </plugin>
70      </include>
71
72      <!-- Right Gripper -->
73      <include>
74          <uri>model://gripper</uri>
75          <name>right_ee</name>
76          <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
77
78          <plugin name="r_force_controller" filename="
                  libvelocity_controller_plugin.so">
79            <linkName>link</linkName>
80            <topicName>set_r_ee_twist</topicName>
81            <gains>
82              <linear>
83                <P>100.0</P>
84                <I>0.0</I>
85                <D>25.0</D>
86              </linear>
87              <angular>
88                <P>100.0</P>
89                <I>0.0</I>
90                <D>25.0</D>
91              </angular>
92            </gains>
93          </plugin>
94
95          <plugin name="r_grip" filename="libGripPlugin.so">
96            <parentLinkName>link</parentLinkName>
97            <childLinkName>b_wildo_bowl::link</childLinkName>
98            <relativePose>0.0089419 0.0135799 0.0780419 1.55636 1.32285
                  -1.41637</relativePose>
99          </plugin>
100
101         <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
102           <linkName>link</linkName>
103           <frameName>r_gripper_tool_frame</frameName>
104         </plugin>
105     </include>
106
```

```
107            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
108
109            <gui>
110                <camera name='user_camera'>
111                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                    <view_controller>orbit</view_controller>
113                </camera>
114            </gui>
115
116        </world>
117    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3
4      <world name="grabbing_book_v">
5
6          <!-- <physics type="ode">
7              <max_step_size>0.001</max_step_size>
8              <real_time_factor>1</real_time_factor>
9              <real_time_update_rate>1000</real_time_update_rate>
10             <bullet>
11                 <solver>
12                     <iters>70</iters>
13                 </solver>
14             </bullet>
15             <ode>
16                 <solver>
17                     <iters>70</iters>
18                 </solver>
19             </ode>
20         </physics> -->
21
22         <include>
23             <uri>model://sun</uri>
24         </include>
25
26         <include>
27             <uri>model://ground_plane</uri>
28         </include>
29  <!--
30         <include>
31             <uri>model://finger</uri>
32             <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33         </include> -->
34
35         <include>
36             <uri>model://freezer_box</uri>
37             <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38         </include>
39
40
41
42         <model name='book_target'>
43           <static>false</static>
44           <pose>0.220000 0.000000 0.300000 1.570796 0.000000 0.000000</pose>
45
46           <link name='book_link'>
47             <pose frame='link'>0.0 0.0 0.0 0.0 0 0</pose>
48             <inertial>
49               <mass>0.1</mass>
50               <pose frame='link'>0.0 0.0 0.0 0 0 0</pose>
51               <inertia>
52                 <ixx>0.002416667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
53                 <ixy>0</ixy>
54                 <ixz>0</ixz>
55                 <iyy>0.002416667</iyy>
```

```xml
56                          <iyz>0</iyz>
57                          <izz>0.004166667</izz>
58                        </inertia>
59                     </inertial>
60                     <collision name='book_collision'>
61                        <geometry>
62                          <box>
63                            <size>0.5 0.5 0.2</size>
64                          </box>
65                        </geometry>
66                        <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
67                        <surface>
68                          <friction>
69                            <ode>
70                              <mu>0.2</mu>
71                              <mu2>0.2</mu2>
72                            </ode>
73                          </friction>
74                        </surface>
75                     </collision>
76                     <visual name='book_visual'>
77                        <geometry>
78                          <box>
79                            <size>0.5 0.5 0.2</size>
80                          </box>
81                        </geometry>
82                        <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
83                     </visual>
84                     <sensor name="main_bumper" type="contact">
85                        <selfCollide>true</selfCollide>
86                        <alwaysOn>true</alwaysOn>
87                        <updateRate>15.0</updateRate>
88                        <contact>
89                          <collision>book_collision</collision>
90                        </contact>
91                     </sensor>
92                 </link>
93                 <plugin name="target_tf_broadcaster" filename="
                       libtf_broadcaster_plugin.so">
94                    <linkName>book_link</linkName>
95                    <frameName>book_object_frame</frameName>
96                 </plugin>
97                 <plugin name="grasp" filename="libTiltGrabPlugin.so">
98                    <parentLinkName>book_link</parentLinkName>
99                    <childLinkName1>left_ee::link</childLinkName1>
100                   <childLinkName2>right_ee::link</childLinkName2>
101                   <childLinkName3>right_ee_2::link</childLinkName3>
102                   <sensorName>book_contact</sensorName>
103                </plugin>
104            </model>
105
106
107
108            <!-- Left Gripper -->
109            <include>
110                <uri>model://finger</uri>
111                <name>left_ee</name>
```

```
112                      <pose>0.000000 0.000000 0.880000 0.000000 0.000000 1.57080</pose>
113
114
115                      <plugin name="l_force_controller" filename="
                              libvelocity_controller_plugin.so">
116                        <linkName>link</linkName>
117                        <topicName>set_l_ee_twist</topicName>
118                        <gains>
119                          <linear>
120                            <P>100.0</P>
121                            <I>0.0</I>
122                            <D>25.0</D>
123                          </linear>
124                          <angular>
125                            <P>100.0</P>
126                            <I>0.0</I>
127                            <D>25.0</D>
128                          </angular>
129                        </gains>
130                      </plugin>
131
132                      <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                              so">
133                        <linkName>link</linkName>
134                        <frameName>l_gripper_tool_frame</frameName>
135                      </plugin>
136                  </include>
137
138              <!-- Right Gripper -->
139              <include>
140                      <uri>model://finger</uri>
141                      <name>right_ee</name>
142                      <pose>0.600000 0.500000 0.830000 0.000000 0.000000 1.57080</pose>
143
144                      <plugin name="r_force_controller" filename="
                              libvelocity_controller_plugin.so">
145                        <linkName>link</linkName>
146                        <topicName>set_r_ee_twist</topicName>
147                        <gains>
148                          <linear>
149                            <P>100.0</P>
150                            <I>0.0</I>
151                            <D>25.0</D>
152                          </linear>
153                          <angular>
154                            <P>100.0</P>
155                            <I>0.0</I>
156                            <D>25.0</D>
157                          </angular>
158                        </gains>
159                      </plugin>
160
161                      <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                              so">
162                        <linkName>link</linkName>
163                        <frameName>r_gripper_tool_frame</frameName>
164                      </plugin>
```

```
165            </include>
166
167            <include>
168                <uri>model://finger</uri>
169                <name>right_ee_2</name>
170                <pose>0.600000  -0.500000  0.830000  0.000000  0.000000  1.57080</pose>
171
172                <plugin name="r_2_force_controller" filename="
                        libvelocity_controller_plugin.so">
173                  <linkName>link</linkName>
174                  <topicName>set_r_ee_2_twist</topicName>
175                  <gains>
176                    <linear>
177                      <P>100.0</P>
178                      <I>0.0</I>
179                      <D>25.0</D>
180                    </linear>
181                    <angular>
182                      <P>100.0</P>
183                      <I>0.0</I>
184                      <D>25.0</D>
185                    </angular>
186                  </gains>
187                </plugin>
188
189                <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                        .so">
190                  <linkName>link</linkName>
191                  <frameName>r_2_gripper_tool_frame</frameName>
192                </plugin>
193            </include>
194
195        <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
196
197        <gui>
198            <camera name='user_camera'>
199                <pose>1.770789  1.775709  1.500612  0  0.375643  -2.675000</pose>
200                <view_controller>orbit</view_controller>
201            </camera>
202        </gui>
203
204    </world>
205 </sdf>
```

251   worlds/grabbing$_b$ook2.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3
4      <world name="grabbing_book_v">
5
6          <!-- <physics type="ode">
7              <max_step_size>0.001</max_step_size>
8              <real_time_factor>1</real_time_factor>
9              <real_time_update_rate>1000</real_time_update_rate>
10             <bullet>
11                 <solver>
12                     <iters>70</iters>
13                 </solver>
14             </bullet>
15             <ode>
16                 <solver>
17                     <iters>70</iters>
18                 </solver>
19             </ode>
20         </physics> -->
21
22         <include>
23             <uri>model://sun</uri>
24         </include>
25
26         <include>
27             <uri>model://ground_plane</uri>
28         </include>
29  <!--
30         <include>
31             <uri>model://finger</uri>
32             <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33         </include> -->
34
35         <include>
36             <uri>model://bookshelf_</uri>
37             <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38         </include>
39
40         <!-- Books -->
41
42
43         <!--<include>
44             <uri>model://book</uri>
45             <name>book3</name>
46             <pose>0.150000 0.624000 0.475000 0.000000 0.000000 1.57080</pose>
47         </include> -->
48
49
50         <model name='book_target'>
51           <static>false</static>
52           <pose>0.150000 0.861000 0.725000 0.000000 0.000000 1.57080</pose>
53
54           <link name='book_link'>
55             <pose frame='link'>0 0 0 0 0 0</pose>
```

```
56              <inertial>
57                <mass>0.1</mass>
58                <pose frame='link'>0 0 0 0 0 0</pose>
59                <inertia>
60                  <ixx>0.00241667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
61                  <ixy>0</ixy>
62                  <ixz>0</ixz>
63                  <iyy>0.00416667</iyy>
64                  <iyz>0</iyz>
65                  <izz>0.00241667</izz>
66                </inertia>
67              </inertial>
68              <collision name='book_collision'>
69                <geometry>
70                  <box>
71                    <size>0.5 0.2 0.5</size>
72                  </box>
73                </geometry>
74                <pose frame=''>0 0 0 0 0 0</pose>
75                <surface>
76                  <friction>
77                    <ode>
78                      <mu>0.2</mu>
79                      <mu2>0.2</mu2>
80                    </ode>
81                  </friction>
82                </surface>
83              </collision>
84              <visual name='book_visual'>
85                <geometry>
86                  <box>
87                    <size>0.5 0.2 0.5</size>
88                  </box>
89                </geometry>
90                <pose frame=''>0 0 0 0 0 0</pose>
91              </visual>
92              <sensor name="main_bumper" type="contact">
93                <selfCollide>true</selfCollide>
94                <alwaysOn>true</alwaysOn>
95                <updateRate>15.0</updateRate>
96                <contact>
97                  <collision>book_collision</collision>
98                </contact>
99                <!--<plugin name="gazebo_ros_bumper_controller" filename="
                        libgazebo_ros_bumper.so">
100                   <bumperTopicName>bumper_vals</bumperTopicName>
101                   <frameName>book_target</frameName>
102                 </plugin> -->
103               </sensor>
104            </link>
105            <plugin name="target_tf_broadcaster" filename="
                      libtf_broadcaster_plugin.so">
106              <linkName>book_link</linkName>
107              <frameName>book_object_frame</frameName>
108            </plugin>
109            <plugin name="grasp" filename="libTiltGrabPlugin.so">
110              <parentLinkName>book_link</parentLinkName>
```

```
111            <childLinkName1>left_ee::link</childLinkName1>
112            <childLinkName2>right_ee::link</childLinkName2>
113            <childLinkName3>right_ee_2::link</childLinkName3>
114            <sensorName>book_contact</sensorName>
115          </plugin>
116        </model>
117
118
119
120        <!-- Left Gripper -->
121        <include>
122            <uri>model://finger</uri>
123            <name>left_ee</name>
124            <pose>1.150000 0.661000 0.575000 0.000000 0.000000 1.57080</pose>
125
126
127            <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
128              <linkName>link</linkName>
129              <topicName>set_l_ee_twist</topicName>
130              <gains>
131                <linear>
132                  <P>100.0</P>
133                  <I>0.0</I>
134                  <D>25.0</D>
135                </linear>
136                <angular>
137                  <P>100.0</P>
138                  <I>0.0</I>
139                  <D>25.0</D>
140                </angular>
141              </gains>
142            </plugin>
143
144            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
145              <linkName>link</linkName>
146              <frameName>l_gripper_tool_frame</frameName>
147            </plugin>
148        </include>
149
150        <!-- Right Gripper -->
151        <include>
152            <uri>model://finger</uri>
153            <name>right_ee</name>
154            <pose>1.150000 0.600000 0.475000 0.000000 0.000000 1.57080</pose>
155
156            <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
157              <linkName>link</linkName>
158              <topicName>set_r_ee_twist</topicName>
159              <gains>
160                <linear>
161                  <P>100.0</P>
162                  <I>0.0</I>
163                  <D>25.0</D>
164                </linear>
```

```
165                    <angular>
166                      <P>100.0</P>
167                      <I>0.0</I>
168                      <D>25.0</D>
169                    </angular>
170                  </gains>
171                </plugin>
172
173                <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                       so">
174                  <linkName>link</linkName>
175                  <frameName>r_gripper_tool_frame</frameName>
176                </plugin>
177            </include>
178
179            <include>
180                <uri>model://finger</uri>
181                <name>right_ee_2</name>
182                <pose>1.150000 0.7000000 0.475000 0.000000 0.000000 1.57080</pose>
183
184                <plugin name="r_2_force_controller" filename="
                       libvelocity_controller_plugin.so">
185                  <linkName>link</linkName>
186                  <topicName>set_r_ee_2_twist</topicName>
187                  <gains>
188                    <linear>
189                      <P>100.0</P>
190                      <I>0.0</I>
191                      <D>25.0</D>
192                    </linear>
193                    <angular>
194                      <P>100.0</P>
195                      <I>0.0</I>
196                      <D>25.0</D>
197                    </angular>
198                  </gains>
199                </plugin>
200
201                <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                       .so">
202                  <linkName>link</linkName>
203                  <frameName>r_2_gripper_tool_frame</frameName>
204                </plugin>
205            </include>
206
207            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
208
209            <gui>
210                <camera name='user_camera'>
211                    <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
212                    <view_controller>orbit</view_controller>
213                </camera>
214            </gui>
215
216        </world>
217    </sdf>
```

```
1   <?xml version='1.0'?>
2   <sdf version="1.6">
3
4       <world name="grabbing_book_v">
5
6           <!-- <physics type="ode">
7                   <max_step_size>0.001</max_step_size>
8                   <real_time_factor>1</real_time_factor>
9                   <real_time_update_rate>1000</real_time_update_rate>
10                  <bullet>
11                      <solver>
12                          <iters>70</iters>
13                      </solver>
14                  </bullet>
15                  <ode>
16                      <solver>
17                          <iters>70</iters>
18                      </solver>
19                  </ode>
20          </physics> -->
21
22          <include>
23              <uri>model://sun</uri>
24          </include>
25
26          <include>
27              <uri>model://ground_plane</uri>
28          </include>
29  <!--
30          <include>
31              <uri>model://finger</uri>
32              <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
33          </include> -->
34
35          <include>
36              <uri>model://freezer_box</uri>
37              <pose>0.000000 0.000000 0.000000 0.000000 0.0000000 0.000001</pose>
38          </include>
39
40
41
42          <model name='book_target'>
43            <static>false</static>
44            <pose>0.220000 0.000000 0.300000 1.570796 0.000000 0.000000</pose>
45
46            <link name='book_link'>
47              <pose frame='link'>0.0 0.0 0.0 0.0 0 0</pose>
48              <inertial>
49                <mass>0.1</mass>
50                <pose frame='link'>0.0 0.0 0.0 0 0 0</pose>
51                <inertia>
52                  <ixx>0.004166667</ixx><!--  1/12 * m * (h^2 + d^2)  -->
53                  <ixy>0</ixy>
54                  <ixz>0</ixz>
55                  <iyy>0.002416667</iyy>
```

```
56                    <iyz>0</iyz>
57                    <izz>0.002416667</izz>
58                  </inertia>
59                </inertial>
60                <collision name='book_collision'>
61                  <geometry>
62                    <box>
63                      <size>0.2 0.5 0.5</size>
64                    </box>
65                  </geometry>
66                  <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
67                  <surface>
68                    <friction>
69                      <ode>
70                        <mu>0.2</mu>
71                        <mu2>0.2</mu2>
72                      </ode>
73                    </friction>
74                  </surface>
75                </collision>
76                <visual name='book_visual'>
77                  <geometry>
78                    <box>
79                      <size>0.2 0.5 0.5</size>
80                    </box>
81                  </geometry>
82                  <pose frame=''>0.0 0.0 0.0 0 0 0</pose>
83                </visual>
84                <sensor name="main_bumper" type="contact">
85                  <selfCollide>true</selfCollide>
86                  <alwaysOn>true</alwaysOn>
87                  <updateRate>15.0</updateRate>
88                  <contact>
89                    <collision>book_collision</collision>
90                  </contact>
91                </sensor>
92              </link>
93              <plugin name="target_tf_broadcaster" filename="
                   libtf_broadcaster_plugin.so">
94                <linkName>book_link</linkName>
95                <frameName>book_object_frame</frameName>
96              </plugin>
97              <plugin name="grasp" filename="libTiltGrabPlugin.so">
98                <parentLinkName>book_link</parentLinkName>
99                <childLinkName1>left_ee::link</childLinkName1>
100               <childLinkName2>right_ee::link</childLinkName2>
101               <childLinkName3>right_ee_2::link</childLinkName3>
102               <sensorName>book_contact</sensorName>
103             </plugin>
104           </model>
105
106
107
108           <!-- Left Gripper -->
109           <include>
110               <uri>model://finger</uri>
111               <name>left_ee</name>
```

```xml
112                 <pose>0.000000 0.000000 0.880000 0.000000 0.000000 1.57080</pose>
113
114
115             <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
116               <linkName>link</linkName>
117               <topicName>set_l_ee_twist</topicName>
118               <gains>
119                 <linear>
120                   <P>100.0</P>
121                   <I>0.0</I>
122                   <D>25.0</D>
123                 </linear>
124                 <angular>
125                   <P>100.0</P>
126                   <I>0.0</I>
127                   <D>25.0</D>
128                 </angular>
129               </gains>
130             </plugin>
131
132             <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
133               <linkName>link</linkName>
134               <frameName>l_gripper_tool_frame</frameName>
135             </plugin>
136         </include>
137
138         <!-- Right Gripper -->
139         <include>
140             <uri>model://finger</uri>
141             <name>right_ee</name>
142             <pose>0.600000 0.500000 0.830000 0.000000 0.000000 1.57080</pose>
143
144             <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
145               <linkName>link</linkName>
146               <topicName>set_r_ee_twist</topicName>
147               <gains>
148                 <linear>
149                   <P>100.0</P>
150                   <I>0.0</I>
151                   <D>25.0</D>
152                 </linear>
153                 <angular>
154                   <P>100.0</P>
155                   <I>0.0</I>
156                   <D>25.0</D>
157                 </angular>
158               </gains>
159             </plugin>
160
161             <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
162               <linkName>link</linkName>
163               <frameName>r_gripper_tool_frame</frameName>
164             </plugin>
```

```
165            </include>
166
167            <include>
168                <uri>model://finger</uri>
169                <name>right_ee_2</name>
170                <pose>0.600000 -0.500000 0.830000 0.000000 0.000000 1.57080</pose>
171
172                <plugin name="r_2_force_controller" filename="
                       libvelocity_controller_plugin.so">
173                  <linkName>link</linkName>
174                  <topicName>set_r_ee_2_twist</topicName>
175                  <gains>
176                    <linear>
177                      <P>100.0</P>
178                      <I>0.0</I>
179                      <D>25.0</D>
180                    </linear>
181                    <angular>
182                      <P>100.0</P>
183                      <I>0.0</I>
184                      <D>25.0</D>
185                    </angular>
186                  </gains>
187                </plugin>
188
189                <plugin name="r_2_tf_broadcaster" filename="libtf_broadcaster_plugin
                       .so">
190                  <linkName>link</linkName>
191                  <frameName>r_2_gripper_tool_frame</frameName>
192                </plugin>
193            </include>
194
195        <plugin name="feature_visualization_plugin" filename="
               libgiskard_visualization_plugin.so"></plugin>
196
197        <gui>
198            <camera name='user_camera'>
199                <pose>1.770789 1.775709 1.500612 0 0.375643 -2.675000</pose>
200                <view_controller>orbit</view_controller>
201            </camera>
202        </gui>
203
204      </world>
205  </sdf>
```

253 worlds/scraping$_{br}ed_mug_{bk}nife_v$.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_red_mug_b_knife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_knife</uri>
15             <pose>0.090993 0.503448 0.999041 -1.609842 0 0</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.200479 1.549194 2.743074</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_knife::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_red_mug</uri>
30             <pose>0.061612 -0.504614 1.006537 0.423677 0 3.060068</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                 libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```xml
55
56            <plugin name="l_grip" filename="libGripPlugin.so">
57              <parentLinkName>link</parentLinkName>
58              <childLinkName>b_knife::link</childLinkName>
59              <relativePose>0.090993 0.003448 -0.000959 -1.60984 0 0</
                    relativePose>
60            </plugin>
61
62            <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
63              <linkName>link</linkName>
64              <frameName>l_gripper_tool_frame</frameName>
65            </plugin>
66        </include>
67
68        <!-- Right Gripper -->
69        <include>
70            <uri>model://gripper</uri>
71            <name>right_ee</name>
72            <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74            <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
75              <linkName>link</linkName>
76              <topicName>set_r_ee_twist</topicName>
77              <gains>
78                <linear>
79                  <P>100.0</P>
80                  <I>0.0</I>
81                  <D>25.0</D>
82                </linear>
83                <angular>
84                  <P>100.0</P>
85                  <I>0.0</I>
86                  <D>25.0</D>
87                </angular>
88              </gains>
89            </plugin>
90
91            <plugin name="r_grip" filename="libGripPlugin.so">
92              <parentLinkName>link</parentLinkName>
93              <childLinkName>b_red_mug::link</childLinkName>
94              <relativePose>-0.00780861 0.00428533 0.0614876 1.24173 -1.34456
                    1.65836</relativePose>
95            </plugin>
96
97            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
98              <linkName>link</linkName>
99              <frameName>r_gripper_tool_frame</frameName>
100           </plugin>
101       </include>
102
103       <plugin name="feature_visualization_plugin" filename="
                    libgiskard_visualization_plugin.so"></plugin>
104
105       <gui>
```

```
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_frying_pan_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.461945 1.549196 2.743082</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_frying_pan</uri>
30             <pose>0.228443 -0.496122 0.971397 0 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_position_controller" filename="
                    libposition_controller_plugin.so">
40               <linkName>link</linkName>
41               <referenceFrameName>base_link</referenceFrameName>
42               <targetFrameName>l_gripper_tool_frame</targetFrameName>
43               <P>0.0</P>
44               <I>0.0</I>
45               <D>0.0</D>
46             </plugin>
47
48             <plugin name="l_grip" filename="libGripPlugin.so">
49               <parentLinkName>link</parentLinkName>
50               <childLinkName>b_spatula::link</childLinkName>
51               <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                      -3.14159</relativePose>
52             </plugin>
53
```

```
54              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                   so">
55                <linkName>link</linkName>
56                <frameName>l_gripper_tool_frame</frameName>
57              </plugin>
58          </include>
59
60          <!-- Right Gripper -->
61          <include>
62              <uri>model://gripper</uri>
63              <name>right_ee</name>
64              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
65
66              <plugin name="r_position_controller" filename="
                   libposition_controller_plugin.so">
67                <linkName>link</linkName>
68                <referenceFrameName>base_link</referenceFrameName>
69                <targetFrameName>r_gripper_tool_frame</targetFrameName>
70                <P>100.0</P>
71                <I>0.0</I>
72                <D>50.0</D>
73              </plugin>
74
75              <plugin name="r_grip" filename="libGripPlugin.so">
76                <parentLinkName>link</parentLinkName>
77                <childLinkName>b_frying_pan::link</childLinkName>
78                <relativePose>0.0186144 0.0468562 0.224672 -1.55141 -1.36676
                     1.3834</relativePose>
79              </plugin>
80
81              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                   so">
82                <linkName>link</linkName>
83                <frameName>r_gripper_tool_frame</frameName>
84              </plugin>
85          </include>
86
87        <plugin name="feature_visualization_plugin" filename="
                 libgiskard_visualization_plugin.so"></plugin>
88
89        <gui>
90            <camera name='user_camera'>
91                <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
92                <view_controller>orbit</view_controller>
93            </camera>
94        </gui>
95
96      </world>
97  </sdf>
```

255 worlds/scraping$_{bb}ig_bowl_{bs}patula_p$.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="scraping">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.140489 0.527566 0.997957 1.571605 -0.058101 -2.939758</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.208221 0.534198 0.991390 1.634659 1.569999 -0.001148</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_big_bowl</uri>
30             <pose>0.024164 -0.383989 0.959287 -0.017186 -0.000884 -0.101566</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <pose>0 0.5 1 0 0 0</pose>
37
38             <plugin name="l_position_controller" filename="libposition_controller_plugin.so">
39               <linkName>link</linkName>
40               <referenceFrameName>base_link</referenceFrameName>
41               <targetFrameName>l_gripper_tool_frame</targetFrameName>
42               <P>0.0</P>
43               <I>0.0</I>
44               <D>0.0</D>
45             </plugin>
46
47             <plugin name="l_grip" filename="libGripPlugin.so">
48               <parentLinkName>link</parentLinkName>
49               <childLinkName>b_spatula::link</childLinkName>
50               <relativePose>0.14 0.028 -0.002 -1.57 3.20 0.20</relativePose>
51             </plugin>
52         </include>
53
```

```xml
54          <!-- Right Gripper -->
55          <include>
56              <uri>model://gripper</uri>
57              <pose>0 -0.5 1 0 0 0</pose>
58
59              <plugin name="r_position_controller" filename="
                    libposition_controller_plugin.so">
60                <linkName>link</linkName>
61                <referenceFrameName>base_link</referenceFrameName>
62                <targetFrameName>r_gripper_tool_frame</targetFrameName>
63                <P>100.0</P>
64                <I>0.0</I>
65                <D>50.0</D>
66              </plugin>
67
68              <plugin name="r_grip" filename="libGripPlugin.so">
69                <parentLinkName>link</parentLinkName>
70                <childLinkName>b_big_bowl::link</childLinkName>
71                <relativePose>0.06 0.11 0 -1.57 -1.35 1.3</relativePose>
72              </plugin>
73          </include>
74
75
76          <gui>
77              <camera name='user_camera'>
78                  <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
79                  <view_controller>orbit</view_controller>
80              </camera>
81          </gui>
82
83      </world>
84  </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_pot_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.146581 0.505236 0.992013 1.576128 -0.007193 -3.141592</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.461945 1.549196 2.743082</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_spatula::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_pot</uri>
30             <pose>0.133471 -0.503990 0.971217 0 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40               <linkName>link</linkName>
41               <topicName>set_l_ee_twist</topicName>
42               <gains>
43                 <linear>
44                   <P>100.0</P>
45                   <I>0.0</I>
46                   <D>25.0</D>
47                 </linear>
48                 <angular>
49                   <P>100.0</P>
50                   <I>0.0</I>
51                   <D>25.0</D>
52                 </angular>
53               </gains>
54             </plugin>
```

```
55
56        <plugin name="l_grip" filename="libGripPlugin.so">
57          <parentLinkName>link</parentLinkName>
58          <childLinkName>b_spatula::link</childLinkName>
59          <relativePose>0.146581 0.005236 -0.007987 1.57613 -0.007193
                -3.14159</relativePose>
60        </plugin>
61
62        <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
              so">
63          <linkName>link</linkName>
64          <frameName>l_gripper_tool_frame</frameName>
65        </plugin>
66      </include>
67
68      <!-- Right Gripper -->
69      <include>
70        <uri>model://gripper</uri>
71        <name>right_ee</name>
72        <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74        <plugin name="r_force_controller" filename="
              libvelocity_controller_plugin.so">
75          <linkName>link</linkName>
76          <topicName>set_r_ee_twist</topicName>
77          <gains>
78            <linear>
79              <P>100.0</P>
80              <I>0.0</I>
81              <D>25.0</D>
82            </linear>
83            <angular>
84              <P>100.0</P>
85              <I>0.0</I>
86              <D>25.0</D>
87            </angular>
88          </gains>
89        </plugin>
90
91        <plugin name="r_grip" filename="libGripPlugin.so">
92          <parentLinkName>link</parentLinkName>
93          <childLinkName>b_pot::link</childLinkName>
94          <relativePose>0.023942 0.0237816 0.132364 -1.55141 -1.36676
                1.3834</relativePose>
95        </plugin>
96
97        <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
              so">
98          <linkName>link</linkName>
99          <frameName>r_gripper_tool_frame</frameName>
100       </plugin>
101     </include>
102
103     <plugin name="feature_visualization_plugin" filename="
            libgiskard_visualization_plugin.so"></plugin>
104
105     <gui>
```

```
106                    <camera name='user_camera'>
107                        <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                        <view_controller>orbit</view_controller>
109                    </camera>
110                </gui>
111
112        </world>
113    </sdf>
```

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_bucket_b_knife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_knife</uri>
15             <pose>0.090993 0.503448 0.999041 -1.609842 0 0</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.226360 0.495670 0.996721 1.200479 1.549194 2.743074</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22                 <parentLinkName>link</parentLinkName>
23                 <childLinkName>b_knife::link</childLinkName>
24                 <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_bucket</uri>
30             <pose>0.100858 -0.510180 0.939254 -3.128475 -0.140461 3.129033</pose
31                 >
32         </include>
33
34         <!-- Left Gripper -->
35         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                   libvelocity_controller_plugin.so">
40                 <linkName>link</linkName>
41                 <topicName>set_l_ee_twist</topicName>
42                 <gains>
43                   <linear>
44                     <P>100.0</P>
45                     <I>0.0</I>
46                     <D>25.0</D>
47                   </linear>
48                   <angular>
49                     <P>100.0</P>
50                     <I>0.0</I>
51                     <D>25.0</D>
52                   </angular>
53                 </gains>
```

```
54              </plugin>
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_knife::link</childLinkName>
59                <relativePose>0.090993 0.003448 -0.000959 -1.60984 0 0</
                    relativePose>
60              </plugin>
61
62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65              </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_bucket::link</childLinkName>
94                <relativePose>0.0577053 0.0189525 0.101375 2.17015 1.31252
                    2.31211</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

```
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_frying_pan_b_serving_spoon_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_serving_spoon</uri>
15             <pose>0.112572 0.508131 0.984633 1.382835 0.015399 0.080779</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.198795 0.509112 3.036336 1.368174 -1.866245</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22               <parentLinkName>link</parentLinkName>
23               <childLinkName>b_serving_spoon::link</childLinkName>
24               <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_frying_pan</uri>
30             <pose>0.228443 -0.496122 0.971397 0 0 0</pose>
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
40                 libvelocity_controller_plugin.so">
41               <linkName>link</linkName>
42               <topicName>set_l_ee_twist</topicName>
43               <gains>
44                 <linear>
45                   <P>100.0</P>
46                   <I>0.0</I>
47                   <D>25.0</D>
48                 </linear>
49                 <angular>
50                   <P>100.0</P>
51                   <I>0.0</I>
52                   <D>25.0</D>
53                 </angular>
54               </gains>
55             </plugin>
```

```
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_serving_spoon::link</childLinkName>
59                <relativePose>0.112571612 0.00813051871955 -0.0153673645109
                        1.3828344221275815 0.015398730956486372 0.08077832485708741</
                        relativePose>
60              </plugin>
61
62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65              </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                    libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_frying_pan::link</childLinkName>
94                <relativePose>0.0186144 0.0468562 0.224672 -1.55141 -1.36676
                        1.3834</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                    so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
104
```

```
105            <gui>
106                <camera name='user_camera'>
107                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                    <view_controller>orbit</view_controller>
109                </camera>
110            </gui>
111
112        </world>
113    </sdf>
```

259 worlds/scraping$_{bb}ucket_{bt}able_knife_v$.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_bucket_b_table_knife_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_table_knife</uri>
15             <pose>0.060878 0.497562 1.005864 1.616805 0 0</pose>
16         </include>
17
18         <include>
19             <uri>model://butter_box</uri>
20             <pose>0.135713 0.488941 1.003983 0.274231 1.507716 1.875637</pose>
21             <plugin name="stick" filename="libStickPlugin.so">
22                 <parentLinkName>link</parentLinkName>
23                 <childLinkName>b_table_knife::link</childLinkName>
24                 <force>5</force>
25             </plugin>
26         </include>
27
28         <include>
29             <uri>model://b_bucket</uri>
30             <pose>0.100858 -0.510180 0.939254 -3.128475 -0.140461 3.129033</pose
                  >
31         </include>
32
33         <!-- Left Gripper -->
34         <include>
35             <uri>model://gripper</uri>
36             <name>left_ee</name>
37             <pose>0 0.5 1 0 0 0</pose>
38
39             <plugin name="l_force_controller" filename="
                  libvelocity_controller_plugin.so">
40                 <linkName>link</linkName>
41                 <topicName>set_l_ee_twist</topicName>
42             </plugin>
43
44             <plugin name="l_grip" filename="libGripPlugin.so">
45                 <parentLinkName>link</parentLinkName>
46                 <childLinkName>b_table_knife::link</childLinkName>
47                 <relativePose>0.060878 -0.002438 0.005864 1.6168 0 0</relativePose
                      >
48             </plugin>
49
50             <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
51                 <linkName>link</linkName>
```

```
52              <frameName>l_gripper_tool_frame</frameName>
53            </plugin>
54          </include>
55
56          <!-- Right Gripper -->
57          <include>
58            <uri>model://gripper</uri>
59            <name>right_ee</name>
60            <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
61
62            <plugin name="r_force_controller" filename="
                  libvelocity_controller_plugin.so">
63              <linkName>link</linkName>
64              <topicName>set_r_ee_twist</topicName>
65            </plugin>
66
67            <plugin name="r_grip" filename="libGripPlugin.so">
68              <parentLinkName>link</parentLinkName>
69              <childLinkName>b_bucket::link</childLinkName>
70              <relativePose>0.0577053 0.0189525 0.101375 2.17015 1.31252
                    2.31211</relativePose>
71            </plugin>
72
73            <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                  so">
74              <linkName>link</linkName>
75              <frameName>r_gripper_tool_frame</frameName>
76            </plugin>
77          </include>
78
79          <plugin name="feature_visualization_plugin" filename="
                libgiskard_visualization_plugin.so"></plugin>
80
81          <gui>
82            <camera name='user_camera'>
83                <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
84                <view_controller>orbit</view_controller>
85            </camera>
86          </gui>
87
88      </world>
89  </sdf>
```

```
 1  <?xml version='1.0'?>
 2  <sdf version="1.6">
 3      <world name="b_big_bowl_b_table_knife_v">
 4
 5          <include>
 6              <uri>model://sun</uri>
 7          </include>
 8
 9          <include>
10              <uri>model://ground_plane</uri>
11          </include>
12
13          <include>
14              <uri>model://b_table_knife</uri>
15              <pose>0.060878 0.497562 1.005864 1.616805 0 0</pose>
16          </include>
17
18          <include>
19              <uri>model://butter_box</uri>
20              <pose>0.135713 0.488941 1.003983 0.274231 1.507716 1.875637</pose>
21              <plugin name="stick" filename="libStickPlugin.so">
22                <parentLinkName>link</parentLinkName>
23                <childLinkName>b_table_knife::link</childLinkName>
24                <force>5</force>
25              </plugin>
26          </include>
27
28          <include>
29              <uri>model://b_big_bowl</uri>
30              <pose>0.024164 -0.383989 0.959287 -0.017186 -0.000884 -0.101566</
                    pose>
31          </include>
32
33          <!-- Left Gripper -->
34          <include>
35              <uri>model://gripper</uri>
36              <name>left_ee</name>
37              <pose>0 0.5 1 0 0 0</pose>
38
39              <plugin name="l_force_controller" filename="
                    libvelocity_controller_plugin.so">
40                <linkName>link</linkName>
41                <topicName>set_l_ee_twist</topicName>
42                <gains>
43                  <linear>
44                    <P>100.0</P>
45                    <I>0.0</I>
46                    <D>25.0</D>
47                  </linear>
48                  <angular>
49                    <P>100.0</P>
50                    <I>0.0</I>
51                    <D>25.0</D>
52                  </angular>
53                </gains>
```

```
54              </plugin>
55
56              <plugin name="l_grip" filename="libGripPlugin.so">
57                <parentLinkName>link</parentLinkName>
58                <childLinkName>b_table_knife::link</childLinkName>
59                <relativePose>0.060878 -0.002438 0.005864 1.6168 0 0</relativePose
                      >
60              </plugin>
61
62              <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
63                <linkName>link</linkName>
64                <frameName>l_gripper_tool_frame</frameName>
65              </plugin>
66          </include>
67
68          <!-- Right Gripper -->
69          <include>
70              <uri>model://gripper</uri>
71              <name>right_ee</name>
72              <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>
73
74              <plugin name="r_force_controller" filename="
                      libvelocity_controller_plugin.so">
75                <linkName>link</linkName>
76                <topicName>set_r_ee_twist</topicName>
77                <gains>
78                  <linear>
79                    <P>100.0</P>
80                    <I>0.0</I>
81                    <D>25.0</D>
82                  </linear>
83                  <angular>
84                    <P>100.0</P>
85                    <I>0.0</I>
86                    <D>25.0</D>
87                  </angular>
88                </gains>
89              </plugin>
90
91              <plugin name="r_grip" filename="libGripPlugin.so">
92                <parentLinkName>link</parentLinkName>
93                <childLinkName>b_big_bowl::link</childLinkName>
94                <relativePose>0.06 0.11 0 -1.57 -1.35 1.3</relativePose>
95              </plugin>
96
97              <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
                      so">
98                <linkName>link</linkName>
99                <frameName>r_gripper_tool_frame</frameName>
100             </plugin>
101         </include>
102
103         <plugin name="feature_visualization_plugin" filename="
                  libgiskard_visualization_plugin.so"></plugin>
104
105         <gui>
```

```
106                 <camera name='user_camera'>
107                     <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
108                     <view_controller>orbit</view_controller>
109                 </camera>
110             </gui>
111
112         </world>
113     </sdf>
```

261   worlds/scooping$_{bc}offee_cup_{bs}patula_v$.world

```xml
1  <?xml version='1.0'?>
2  <sdf version="1.6">
3      <world name="b_coffee_cup_b_spatula_v">
4
5          <include>
6              <uri>model://sun</uri>
7          </include>
8
9          <include>
10             <uri>model://ground_plane</uri>
11         </include>
12
13         <include>
14             <uri>model://b_spatula</uri>
15             <pose>0.094321 0.507657 1.009274 -1.637236 0.074980 -3.141592</pose>
16         </include>
17
18         <plugin name="grains_factory" filename="libGrainsFactoryPlugin.so">
19             <pose>-0.016492 -0.468631 0.965206 0 0 0</pose>
20             <mass>0.001</mass>
21             <radius>0.015</radius>
22             <quantity>100</quantity>
23             <friction>0.4</friction>
24             <friction2>0.4</friction2>
25             <velocity_decay>0.3</velocity_decay>
26         </plugin>
27
28         <include>
29             <uri>model://b_coffee_cup</uri>
30             <pose>-0.016492 -0.468631 0.965206 2.603069 -1.513021 -2.66073</pose>
31         </include>
32
33         <include>
34             <uri>model://table</uri>
35             <pose>0.021929 0.062805 -0.085745 0 0 -1.571974</pose>
36         </include>
37         <!-- Left Gripper -->
38         <include>
39             <uri>model://gripper</uri>
40             <name>left_ee</name>
41             <pose>0 0.5 1 0 0 0</pose>
42
43             <plugin name="l_force_controller" filename="libvelocity_controller_plugin.so">
44               <linkName>link</linkName>
45               <topicName>set_l_ee_twist</topicName>
46               <gains>
47                 <linear>
48                   <P>100.0</P>
49                   <I>0.0</I>
50                   <D>25.0</D>
51                 </linear>
52                 <angular>
53                   <P>100.0</P>
```

```xml
            <I>0.0</I>
            <D>25.0</D>
          </angular>
        </gains>
      </plugin>

      <plugin name="l_grip" filename="libGripPlugin.so">
        <parentLinkName>link</parentLinkName>
        <childLinkName>b_thin_spatula::link</childLinkName>
        <relativePose>0.094321 0.007657 0.009274 -1.63724 0.07498
            -3.14159</relativePose>
      </plugin>

      <plugin name="l_tf_broadcaster" filename="libtf_broadcaster_plugin.
          so">
        <linkName>link</linkName>
        <frameName>l_gripper_tool_frame</frameName>
      </plugin>
    </include>

    <!-- Right Gripper -->
    <include>
        <uri>model://gripper</uri>
        <name>right_ee</name>
        <pose>0 -0.5 1 1.547368 1.402341 1.343703</pose>

        <plugin name="r_force_controller" filename="
            libvelocity_controller_plugin.so">
          <linkName>link</linkName>
          <topicName>set_r_ee_twist</topicName>
          <gains>
            <linear>
              <P>100.0</P>
              <I>0.0</I>
              <D>25.0</D>
            </linear>
            <angular>
              <P>100.0</P>
              <I>0.0</I>
              <D>25.0</D>
            </angular>
          </gains>
        </plugin>

        <plugin name="r_grip" filename="libGripPlugin.so">
          <parentLinkName>link</parentLinkName>
          <childLinkName>b_coffee_cup::link</childLinkName>
          <relativePose>0.0284501 0.0346428 -0.0213798 2.93848 0.00496188
              2.88401</relativePose>
        </plugin>

        <plugin name="r_tf_broadcaster" filename="libtf_broadcaster_plugin.
            so">
          <linkName>link</linkName>
          <frameName>r_gripper_tool_frame</frameName>
        </plugin>
    </include>
```

```
106
107            <plugin name="feature_visualization_plugin" filename="
                   libgiskard_visualization_plugin.so"></plugin>
108
109            <gui>
110                <camera name='user_camera'>
111                    <pose>1.700789 1.175709 1.670612 0 0.375643 -2.675000</pose>
112                    <view_controller>orbit</view_controller>
113                </camera>
114            </gui>
115
116        </world>
117   </sdf>
```

```
1   0 :
2
3    freezer_box :
4
5    freezer_box :
6
7   Gazebo multi-robot simulator, version 7.9.0
8
9   Copyright (C) 2012 Open Source Robotics Foundation.
10
11  Released under the Apache 2 License.
12
13  http://gazebosim.org
14
15
16
17
18
19  (1523642276 964673653) [Msg] Waiting for master.
20
21  (1523642276 966147446) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
22
23  (1523642276 966256969) [Msg] Publicized address: 10.0.2.15
24
25  (1523642277 308808536) Init world[grabbing_book_v]
26
27  (1523642287 666731768) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
28
29  (1523642287 725817607) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
30
31  (1523642299 575807688) [Dbg] [TiltGrabPlugin.cc:137] made first joint
32
33  (1523642303 862341869) [Dbg] [TiltGrabPlugin.cc:147] made second joints
34
35  (1523642309 649607701) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
36
37  ********************************************************************************
38
39
40
41
42
43   1 :
44
45    freezer_box :
46
47    freezer_box :
48
49  Gazebo multi-robot simulator, version 7.9.0
50
51  Copyright (C) 2012 Open Source Robotics Foundation.
52
```

```
53  Released under the Apache 2 License.
54
55  http://gazebosim.org
56
57
58
59
60
61  (1523642477 378618607) [Msg] Waiting for master.
62
63  (1523642477 380558494) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
64
65  (1523642477 380628305) [Msg] Publicized address: 10.0.2.15
66
67  (1523642477 741297573) Init world[grabbing_book_v]
68
69  (1523642487 973201542) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
70
71  (1523642488 44803320) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
72
73  (1523642500 128981157) [Dbg] [TiltGrabPlugin.cc:137] made first joint
74
75  (1523642504 423595518) [Dbg] [TiltGrabPlugin.cc:147] made second joints
76
77  (1523642509 936825613) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
78
79  ********************************************************************************
80
81
82
83
84
85   2 :
86
87   freezer_box :
88
89   freezer_box :
90
91  Gazebo multi-robot simulator, version 7.9.0
92
93  Copyright (C) 2012 Open Source Robotics Foundation.
94
95  Released under the Apache 2 License.
96
97  http://gazebosim.org
98
99
100
101
102
103  (1523642677 745163755) [Msg] Waiting for master.
104
105  (1523642677 746735432) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
106
```

```
107   (1523642677 746811506) [Msg] Publicized address: 10.0.2.15
108
109   (1523642678 88156644) Init world[grabbing_book_v]
110
111   (1523642688 367554910) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
112
113   (1523642688 426389249) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
114
115   (1523642700 625986893) [Dbg] [TiltGrabPlugin.cc:137] made first joint
116
117   ***********************************************************************************

118
119
120
121
122
123    3 :
124
125    freezer_box :
126
127    freezer_box :
128
129   Gazebo multi-robot simulator, version 7.9.0
130
131   Copyright (C) 2012 Open Source Robotics Foundation.
132
133   Released under the Apache 2 License.
134
135   http://gazebosim.org
136
137
138
139
140
141   (1523642878 332212613) [Msg] Waiting for master.
142
143   (1523642878 342486758) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
144
145   (1523642878 342605801) [Msg] Publicized address: 10.0.2.15
146
147   (1523642878 714967619) Init world[grabbing_book_v]
148
149   (1523642888 657861376) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
150
151   (1523642888 716648569) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
152
153   (1523642900 980116401) [Dbg] [TiltGrabPlugin.cc:137] made first joint
154
155   (1523642905 361042738) [Dbg] [TiltGrabPlugin.cc:147] made second joints
156
157   (1523642911 488291482) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
158
```

```
159  ********************************************************************************

160
161
162
163
164
165    4 :

166
167   freezer_box :

168
169   freezer_box :

170
171  Gazebo multi-robot simulator, version 7.9.0

172
173  Copyright (C) 2012 Open Source Robotics Foundation.

174
175  Released under the Apache 2 License.

176
177  http://gazebosim.org

178
179
180
181
182
183  (1523643078 456690261) [Msg] Waiting for master.

184
185  (1523643078 457727470) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

186
187  (1523643078 457827054) [Msg] Publicized address: 10.0.2.15

188
189  (1523643078 798198052) Init world[grabbing_book_v]

190
191  (1523643088 864373811) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point

192
193  (1523643088 914538882) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point

194
195  (1523643101 50026676) [Dbg] [TiltGrabPlugin.cc:137] made first joint

196
197  (1523643104 988881069) [Dbg] [TiltGrabPlugin.cc:147] made second joints

198
199  (1523643110 715809589) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success

200
201  ********************************************************************************

202
203
204
205
206
207    5 :

208
209   freezer_box :

210
211   freezer_box :
```

```
212
213   Gazebo multi-robot simulator, version 7.9.0
214
215   Copyright (C) 2012 Open Source Robotics Foundation.
216
217   Released under the Apache 2 License.
218
219   http://gazebosim.org
220
221
222
223
224
225   (1523643278 838428370) [Msg] Waiting for master.
226
227   (1523643278 847877575) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
228
229   (1523643278 848000183) [Msg] Publicized address: 10.0.2.15
230
231   (1523643279 185188935) Init world[grabbing_book_v]
232
233   (1523643289 258209315) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
234
235   (1523643289 312374861) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
236
237   (1523643301 254416562) [Dbg] [TiltGrabPlugin.cc:137] made first joint
238
239   (1523643305 503477393) [Dbg] [TiltGrabPlugin.cc:147] made second joints
240
241   (1523643310 993054370) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
242
243   *******************************************************************************

244
245
246
247
248
249    6 :
250
251    freezer_box :
252
253    freezer_box :
254
255   Gazebo multi-robot simulator, version 7.9.0
256
257   Copyright (C) 2012 Open Source Robotics Foundation.
258
259   Released under the Apache 2 License.
260
261   http://gazebosim.org
262
263
264
265
```

```
266
267  (1523643479 142934209) [Msg] Waiting for master.
268
269  (1523643479 144293467) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
270
271  (1523643479 144370982) [Msg] Publicized address: 10.0.2.15
272
273  (1523643479 483719810) Init world[grabbing_book_v]
274
275  (1523643489 760307894) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
276
277  (1523643489 805003820) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
278
279  (1523643501 976438082) [Dbg] [TiltGrabPlugin.cc:137] made first joint
280
281  (1523643506 301505406) [Dbg] [TiltGrabPlugin.cc:147] made second joints
282
283  (1523643511 987345080) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
284
285  ********************************************************************************

286
287
288
289
290
291   7 :
292
293   freezer_box :
294
295   freezer_box :
296
297  Gazebo multi-robot simulator, version 7.9.0
298
299  Copyright (C) 2012 Open Source Robotics Foundation.
300
301  Released under the Apache 2 License.
302
303  http://gazebosim.org
304
305
306
307
308
309  (1523643679 511808570) [Msg] Waiting for master.
310
311  (1523643679 516550747) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
312
313  (1523643679 516631701) [Msg] Publicized address: 10.0.2.15
314
315  (1523643679 875673762) Init world[grabbing_book_v]
316
317  (1523643689 939451040) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
318
```

```
319  (1523643689 999511706) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
320
321  (1523643701 897053695) [Dbg] [TiltGrabPlugin.cc:137] made first joint
322
323  (1523643706 244600115) [Dbg] [TiltGrabPlugin.cc:147] made second joints
324
325  (1523643711 771599985) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
326
327  *********************************************************************************

328
329
330
331
332
333   8 :
334
335   freezer_box :
336
337   freezer_box :
338
339  Gazebo multi-robot simulator, version 7.9.0
340
341  Copyright (C) 2012 Open Source Robotics Foundation.
342
343  Released under the Apache 2 License.
344
345  http://gazebosim.org
346
347
348
349
350
351  (1523643879 865812805) [Msg] Waiting for master.
352
353  (1523643879 868546249) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
354
355  (1523643879 868636638) [Msg] Publicized address: 10.0.2.15
356
357  (1523643880 230515841) Init world[grabbing_book_v]
358
359  (1523643890 385487979) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
360
361  (1523643890 446057703) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
362
363  (1523643902 490121383) [Dbg] [TiltGrabPlugin.cc:137] made first joint
364
365  *********************************************************************************

366
367
368
369
370
```

```
371    9 :
372
373     freezer_box :
374
375     freezer_box :
376
377    Gazebo multi-robot simulator, version 7.9.0
378
379    Copyright (C) 2012 Open Source Robotics Foundation.
380
381    Released under the Apache 2 License.
382
383    http://gazebosim.org
384
385
386
387
388
389    (1523644080 194765458) [Msg] Waiting for master.
390
391    (1523644080 195173200) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
392
393    (1523644080 195249019) [Msg] Publicized address: 10.0.2.15
394
395    (1523644080 533491284) Init world[grabbing_book_v]
396
397    (1523644090 720334409) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
398
399    (1523644090 772206107) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
400
401    (1523644102 881758888) [Dbg] [TiltGrabPlugin.cc:137] made first joint
402
403    (1523644107 172265795) [Dbg] [TiltGrabPlugin.cc:147] made second joints
404
405    (1523644113 41009610) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
406
407    ********************************************************************************
408
409
410
411
412
413    10 :
414
415     freezer_box :
416
417     freezer_box :
418
419    Gazebo multi-robot simulator, version 7.9.0
420
421    Copyright (C) 2012 Open Source Robotics Foundation.
422
423    Released under the Apache 2 License.
424
```

```
425  http://gazebosim.org
426
427
428
429
430
431  (1523644280 557771222) [Msg] Waiting for master.
432
433  (1523644280 559253335) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
434
435  (1523644280 559330304) [Msg] Publicized address: 10.0.2.15
436
437  (1523644280 912818648) Init world[grabbing_book_v]
438
439  (1523644291 159067929) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
440
441  (1523644291 202597130) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
442
443  (1523644303 155987045) [Dbg] [TiltGrabPlugin.cc:137] made first joint
444
445  (1523644307 465801754) [Dbg] [TiltGrabPlugin.cc:147] made second joints
446
447  (1523644313 299778974) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
448
449  ****************************************************************************************
450
451
452
453
454
455   11 :
456
457   freezer_box2 :
458
459   freezer_box2 :
460
461  Gazebo multi-robot simulator, version 7.9.0
462
463  Copyright (C) 2012 Open Source Robotics Foundation.
464
465  Released under the Apache 2 License.
466
467  http://gazebosim.org
468
469
470
471
472
473  (1523644480 950934391) [Msg] Waiting for master.
474
475  (1523644480 951573149) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
476
477  (1523644480 951651496) [Msg] Publicized address: 10.0.2.15
478
```

```
479  (1523644481 295212500) Init world[grabbing_book_v]
480
481  (1523644491 467681910) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
482
483  (1523644491 517494439) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
484
485  (1523644504 293738068) [Dbg] [TiltGrabPlugin.cc:137] made first joint
486
487  ********************************************************************************

488
489
490
491
492
493   12 :
494
495   freezer_box2 :
496
497   freezer_box2 :
498
499  Gazebo multi-robot simulator, version 7.9.0
500
501  Copyright (C) 2012 Open Source Robotics Foundation.
502
503  Released under the Apache 2 License.
504
505  http://gazebosim.org
506
507
508
509
510
511  (1523644681 295332882) [Msg] Waiting for master.
512
513  (1523644681 297615910) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
514
515  (1523644681 297685664) [Msg] Publicized address: 10.0.2.15
516
517  (1523644681 634754552) Init world[grabbing_book_v]
518
519  (1523644691 917819643) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
520
521  (1523644691 967288103) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
522
523  (1523644704 602291766) [Dbg] [TiltGrabPlugin.cc:137] made first joint
524
525  (1523644708 891723099) [Dbg] [TiltGrabPlugin.cc:147] made second joints
526
527  ********************************************************************************

528
529
```

```
  13 :

 freezer_box2 :

 freezer_box2 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523644881 922479096) [Msg] Waiting for master.

(1523644881 924978707) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523644881 925096007) [Msg] Publicized address: 10.0.2.15

(1523644882 262412739) Init world[grabbing_book_v]

(1523644892 390625990) [Dbg] [giskard_visualization_plugin.cpp:133] Created
     Marker: giskard_expressions/target-object-point

(1523644892 441776341) [Dbg] [giskard_visualization_plugin.cpp:133] Created
     Marker: giskard_expressions/tool-point

(1523644905 249398399) [Dbg] [TiltGrabPlugin.cc:137] made first joint

*****************************************************************************




  14 :

 freezer_box2 :

 freezer_box2 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org
```

```
584
585
586
587
588
589   (1523645082 303163206) [Msg] Waiting for master.
590
591   (1523645082 304637951) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
592
593   (1523645082 304733170) [Msg] Publicized address: 10.0.2.15
594
595   (1523645082 641494220) Init world[grabbing_book_v]
596
597   (1523645092 715457717) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
598
599   (1523645092 762664015) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
600
601   (1523645105 766885267) [Dbg] [TiltGrabPlugin.cc:137] made first joint
602
603   **************************************************************************************
604
605
606
607
608
609    15 :
610
611    freezer_box2 :
612
613    freezer_box2 :
614
615   Gazebo multi-robot simulator, version 7.9.0
616
617   Copyright (C) 2012 Open Source Robotics Foundation.
618
619   Released under the Apache 2 License.
620
621   http://gazebosim.org
622
623
624
625
626
627   (1523645282 635213730) [Msg] Waiting for master.
628
629   (1523645282 635835576) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
630
631   (1523645282 635913208) [Msg] Publicized address: 10.0.2.15
632
633   (1523645282 983644191) Init world[grabbing_book_v]
634
635   (1523645293 154291713) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
636
```

```
637  (1523645293 205632970) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
638
639  (1523645305 961279974) [Dbg] [TiltGrabPlugin.cc:137] made first joint
640
641  **********************************************************************************

642
643
644
645
646
647   16 :
648
649   freezer_box2 :
650
651   freezer_box2 :
652
653  Gazebo multi-robot simulator, version 7.9.0
654
655  Copyright (C) 2012 Open Source Robotics Foundation.
656
657  Released under the Apache 2 License.
658
659  http://gazebosim.org
660
661
662
663
664
665  (1523645483 5280914) [Msg] Waiting for master.
666
667  (1523645483 7039452) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
668
669  (1523645483 7120358) [Msg] Publicized address: 10.0.2.15
670
671  (1523645483 351970541) Init world[grabbing_book_v]
672
673  (1523645493 541846814) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
674
675  (1523645493 594899528) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
676
677  (1523645506 455241874) [Dbg] [TiltGrabPlugin.cc:137] made first joint
678
679  **********************************************************************************

680
681
682
683
684
685   17 :
686
687   freezer_box2 :
688
```

```
689   freezer_box2 :
690
691  Gazebo multi-robot simulator , version 7.9.0
692
693  Copyright (C) 2012 Open Source Robotics Foundation .
694
695  Released under the Apache 2 License .
696
697  http ://gazebosim.org
698
699
700
701
702
703  (1523645683 453535431) [Msg] Waiting for master .
704
705  (1523645683 455706651) [Msg] Connected to gazebo master @ http ://127.0.0.1:11345
706
707  (1523645683 455874584) [Msg] Publicized address : 10.0.2.15
708
709  (1523645683 801753391) Init world [grabbing_book_v]
710
711  (1523645693 851436414) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker : giskard_expressions/target -object -point
712
713  (1523645693 897853854) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker : giskard_expressions/tool -point
714
715  (1523645706 735183536) [Dbg] [TiltGrabPlugin.cc:137] made first joint
716
717  ********************************************************************************

718
719
720
721
722
723   18 :
724
725   freezer_box2 :
726
727   freezer_box2 :
728
729  Gazebo multi-robot simulator , version 7.9.0
730
731  Copyright (C) 2012 Open Source Robotics Foundation .
732
733  Released under the Apache 2 License .
734
735  http ://gazebosim.org
736
737
738
739
740
741  (1523645883 755151125) [Msg] Waiting for master .
742
```

```
743  (1523645883 756484574) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
744
745  (1523645883 756553475) [Msg] Publicized address: 10.0.2.15
746
747  (1523645884 101840910) Init world[grabbing_book_v]
748
749  (1523645894 384489214) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
750
751  (1523645894 447541190) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
752
753  (1523645907 318821381) [Dbg] [TiltGrabPlugin.cc:137] made first joint
754
755  *******************************************************************************

756
757
758
759
760
761   19 :
762
763   freezer_box2 :
764
765   freezer_box2 :
766
767  Gazebo multi-robot simulator, version 7.9.0
768
769  Copyright (C) 2012 Open Source Robotics Foundation.
770
771  Released under the Apache 2 License.
772
773  http://gazebosim.org
774
775
776
777
778
779  (1523646084 146308570) [Msg] Waiting for master.
780
781  (1523646084 148170431) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
782
783  (1523646084 148258329) [Msg] Publicized address: 10.0.2.15
784
785  (1523646084 488756483) Init world[grabbing_book_v]
786
787  (1523646094 556529214) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
788
789  (1523646094 598800694) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
790
791  (1523646107 440621076) [Dbg] [TiltGrabPlugin.cc:137] made first joint
792
793  (1523646111 662759442) [Dbg] [TiltGrabPlugin.cc:147] made second joints
794
```

```
795  ********************************************************************************

796
797
798
799
800
801   20 :

802
803   freezer_box2 :

804
805   freezer_box2 :

806
807  Gazebo multi-robot simulator, version 7.9.0

808
809  Copyright (C) 2012 Open Source Robotics Foundation.

810
811  Released under the Apache 2 License.

812
813  http://gazebosim.org

814
815
816
817
818
819  (1523646284 492185477) [Msg] Waiting for master.

820
821  (1523646284 493908250) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

822
823  (1523646284 493984674) [Msg] Publicized address: 10.0.2.15

824
825  (1523646284 835713319) Init world[grabbing_book_v]

826
827  (1523646295 41760180) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point

828
829  (1523646295 120446576) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point

830
831  (1523646308 86158597) [Dbg] [TiltGrabPlugin.cc:137] made first joint

832
833  (1523646312 468870830) [Dbg] [TiltGrabPlugin.cc:147] made second joints

834
835  ********************************************************************************

836
837
838
839
840
841   21 :

842
843   freezer_box2 :

844
845   freezer_box2 :

846
847  Gazebo multi-robot simulator, version 7.9.0
```

```
848
849   Copyright (C) 2012 Open Source Robotics Foundation.
850
851   Released under the Apache 2 License.
852
853   http://gazebosim.org
854
855
856
857
858
859   (1523646484 929998372) [Msg] Waiting for master.
860
861   (1523646484 931249320) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
862
863   (1523646484 931320794) [Msg] Publicized address: 10.0.2.15
864
865   (1523646485 275808397) Init world[grabbing_book_v]
866
867   (1523646495 263843193) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
868
869   (1523646495 322161008) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
870
871   (1523646508 69954827) [Dbg] [TiltGrabPlugin.cc:137] made first joint
872
873   (1523646512 378929934) [Dbg] [TiltGrabPlugin.cc:147] made second joints
874
875   ********************************************************************************

876
877
878
879
880
881    22 :
882
883    freezer_box3 :
884
885    freezer_box3 :
886
887   Gazebo multi-robot simulator, version 7.9.0
888
889   Copyright (C) 2012 Open Source Robotics Foundation.
890
891   Released under the Apache 2 License.
892
893   http://gazebosim.org
894
895
896
897
898
899   (1523646685 103234257) [Msg] Waiting for master.
900
901   (1523646685 104839673) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
```

```
902
903  (1523646685 104910956) [Msg] Publicized address: 10.0.2.15
904
905  (1523646685 447631695) Init world[grabbing_book_v]
906
907  (1523646695 734595500) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
908
909  (1523646695 787430283) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
910
911  (1523646708 724006855) [Dbg] [TiltGrabPlugin.cc:137] made first joint
912
913  (1523646713 70867012) [Dbg] [TiltGrabPlugin.cc:147] made second joints
914
915  ********************************************************************************

916
917
918
919
920
921   23 :
922
923   freezer_box3 :
924
925   freezer_box3 :
926
927  Gazebo multi-robot simulator, version 7.9.0
928
929  Copyright (C) 2012 Open Source Robotics Foundation.
930
931  Released under the Apache 2 License.
932
933  http://gazebosim.org
934
935
936
937
938
939  (1523646885 414298437) [Msg] Waiting for master.
940
941  (1523646885 425348903) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
942
943  (1523646885 425433406) [Msg] Publicized address: 10.0.2.15
944
945  (1523646885 777036951) Init world[grabbing_book_v]
946
947  (1523646895 797592012) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
948
949  (1523646895 853993654) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
950
951  (1523646908 969778450) [Dbg] [TiltGrabPlugin.cc:137] made first joint
952
953  ********************************************************************************
```

```
954
955
956
957
958
959   24 :
960
961   freezer_box3 :
962
963   freezer_box3 :
964
965  Gazebo multi-robot simulator, version 7.9.0
966
967  Copyright (C) 2012 Open Source Robotics Foundation.
968
969  Released under the Apache 2 License.
970
971  http://gazebosim.org
972
973
974
975
976
977  (1523647085 722215771) [Msg] Waiting for master.
978
979  (1523647085 722624513) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
980
981  (1523647085 722693162) [Msg] Publicized address: 10.0.2.15
982
983  (1523647086 72022625) Init world[grabbing_book_v]
984
985  (1523647096 229912270) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
986
987  (1523647096 273008126) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
988
989  (1523647109 227565064) [Dbg] [TiltGrabPlugin.cc:137] made first joint
990
991  *********************************************************************************

992
993
994
995
996
997   25 :
998
999   freezer_box3 :
1000
1001   freezer_box3 :
1002
1003  Gazebo multi-robot simulator, version 7.9.0
1004
1005  Copyright (C) 2012 Open Source Robotics Foundation.
1006
```

```
1007  Released under the Apache 2 License.
1008
1009  http://gazebosim.org
1010
1011
1012
1013
1014
1015  (1523647286 72535902) [Msg] Waiting for master.
1016
1017  (1523647286 83616934) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1018
1019  (1523647286 83751227) [Msg] Publicized address: 10.0.2.15
1020
1021  (1523647286 447791161) Init world[grabbing_book_v]
1022
1023  (1523647296 667930299) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1024
1025  (1523647296 727335513) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1026
1027  (1523647309 587368692) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1028
1029  ********************************************************************************

1030
1031
1032
1033
1034
1035   26 :
1036
1037   freezer_box3 :
1038
1039   freezer_box3 :
1040
1041  Gazebo multi-robot simulator, version 7.9.0
1042
1043  Copyright (C) 2012 Open Source Robotics Foundation.
1044
1045  Released under the Apache 2 License.
1046
1047  http://gazebosim.org
1048
1049
1050
1051
1052
1053  (1523647486 423497510) [Msg] Waiting for master.
1054
1055  (1523647486 426188928) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1056
1057  (1523647486 426279871) [Msg] Publicized address: 10.0.2.15
1058
1059  (1523647486 768472025) Init world[grabbing_book_v]
1060
```

```
1061  (1523647496 984488507) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1062
1063  (1523647497 51392291) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1064
1065  (1523647509 759815802) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1066
1067  ********************************************************************************

1068
1069
1070
1071
1072
1073   27 :
1074
1075   freezer_box3 :
1076
1077   freezer_box3 :
1078
1079  Gazebo multi-robot simulator, version 7.9.0
1080
1081  Copyright (C) 2012 Open Source Robotics Foundation.
1082
1083  Released under the Apache 2 License.
1084
1085  http://gazebosim.org
1086
1087
1088
1089
1090
1091  (1523647686 815676832) [Msg] Waiting for master.
1092
1093  (1523647686 817116650) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1094
1095  (1523647686 817194506) [Msg] Publicized address: 10.0.2.15
1096
1097  (1523647687 160149110) Init world[grabbing_book_v]
1098
1099  (1523647697 254715544) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1100
1101  (1523647697 300076433) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1102
1103  (1523647710 103326283) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1104
1105  ********************************************************************************

1106
1107
1108
1109
1110
1111   28 :
```

```
1112
1113   freezer_box3 :
1114
1115   freezer_box3 :
1116
1117  Gazebo multi-robot simulator, version 7.9.0
1118
1119  Copyright (C) 2012 Open Source Robotics Foundation.
1120
1121  Released under the Apache 2 License.
1122
1123  http://gazebosim.org
1124
1125
1126
1127
1128
1129  (1523647887 109411026) [Msg] Waiting for master.
1130
1131  (1523647887 111154265) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1132
1133  (1523647887 111272661) [Msg] Publicized address: 10.0.2.15
1134
1135  (1523647887 465971788) Init world[grabbing_book_v]
1136
1137  (1523647897 584206398) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1138
1139  (1523647897 634034013) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1140
1141  (1523647910 300932959) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1142
1143  *********************************************************************************
1144
1145
1146
1147
1148
1149   29 :
1150
1151   freezer_box3 :
1152
1153   freezer_box3 :
1154
1155  Gazebo multi-robot simulator, version 7.9.0
1156
1157  Copyright (C) 2012 Open Source Robotics Foundation.
1158
1159  Released under the Apache 2 License.
1160
1161  http://gazebosim.org
1162
1163
1164
1165
```

```
1166
1167  (1523648087 478324310) [Msg] Waiting for master.
1168
1169  (1523648087 479777661) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1170
1171  (1523648087 479848592) [Msg] Publicized address: 10.0.2.15
1172
1173  (1523648087 822558785) Init world[grabbing_book_v]
1174
1175  (1523648098 91463779) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1176
1177  (1523648098 140733983) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1178
1179  (1523648110 882588622) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1180
1181  (1523648115 261445022) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1182
1183  **************************************************************************************

1184
1185
1186
1187
1188
1189   30 :
1190
1191   freezer_box3 :
1192
1193   freezer_box3 :
1194
1195  Gazebo multi-robot simulator, version 7.9.0
1196
1197  Copyright (C) 2012 Open Source Robotics Foundation.
1198
1199  Released under the Apache 2 License.
1200
1201  http://gazebosim.org
1202
1203
1204
1205
1206
1207  (1523648288 38705116) [Msg] Waiting for master.
1208
1209  (1523648288 39116903) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1210
1211  (1523648288 39191529) [Msg] Publicized address: 10.0.2.15
1212
1213  (1523648288 382103143) Init world[grabbing_book_v]
1214
1215  (1523648298 650036646) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1216
1217  (1523648298 697453720) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
```

```
1218
1219   (1523648311 654465676) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1220
1221   (1523648316 88550044) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1222
1223   *******************************************************************************

1224
1225
1226
1227
1228
1229    31 :
1230
1231    freezer_box3 :
1232
1233    freezer_box3 :
1234
1235   Gazebo multi-robot simulator, version 7.9.0
1236
1237   Copyright (C) 2012 Open Source Robotics Foundation.
1238
1239   Released under the Apache 2 License.
1240
1241   http://gazebosim.org
1242
1243
1244
1245
1246
1247   (1523648488 455228085) [Msg] Waiting for master.
1248
1249   (1523648488 457220760) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1250
1251   (1523648488 457298918) [Msg] Publicized address: 10.0.2.15
1252
1253   (1523648488 800290742) Init world[grabbing_book_v]
1254
1255   (1523648498 800587206) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
1256
1257   (1523648498 850093115) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
1258
1259   (1523648511 697092709) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1260
1261   *******************************************************************************

1262
1263
1264
1265
1266
1267    32 :
1268
1269    freezer_box3 :
1270
```

```
1271   freezer_box3 :
1272
1273  Gazebo multi-robot simulator, version 7.9.0
1274
1275  Copyright (C) 2012 Open Source Robotics Foundation.
1276
1277  Released under the Apache 2 License.
1278
1279  http://gazebosim.org
1280
1281
1282
1283
1284
1285  (1523648688 653085863) [Msg] Waiting for master.
1286
1287  (1523648688 655496748) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1288
1289  (1523648688 655623211) [Msg] Publicized address: 10.0.2.15
1290
1291  (1523648688 995825043) Init world[grabbing_book_v]
1292
1293  (1523648699 158432441) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1294
1295  (1523648699 226076036) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1296
1297  (1523648712 167155261) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1298
1299  *********************************************************************************

1300
1301
1302
1303
1304
1305   33 :
1306
1307   freezer_box4 :
1308
1309   freezer_box4 :
1310
1311  Gazebo multi-robot simulator, version 7.9.0
1312
1313  Copyright (C) 2012 Open Source Robotics Foundation.
1314
1315  Released under the Apache 2 License.
1316
1317  http://gazebosim.org
1318
1319
1320
1321
1322
1323  (1523648889 400998791) [Msg] Waiting for master.
1324
```

```
1325  (1523648889 410318821) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1326
1327  (1523648889 410526065) [Msg] Publicized address: 10.0.2.15
1328
1329  (1523648889 778622704) Init world[grabbing_book_v]
1330
1331  (1523648899 372666942) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
1332
1333  (1523648899 420257752) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
1334
1335  (1523648912 182499223) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1336
1337  (1523648916 708751658) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1338
1339  **************************************************************************************

1340
1341
1342
1343
1344
1345   34 :
1346
1347   freezer_box4 :
1348
1349   freezer_box4 :
1350
1351  Gazebo multi-robot simulator, version 7.9.0
1352
1353  Copyright (C) 2012 Open Source Robotics Foundation.
1354
1355  Released under the Apache 2 License.
1356
1357  http://gazebosim.org
1358
1359
1360
1361
1362
1363  (1523649089 238581098) [Msg] Waiting for master.
1364
1365  (1523649089 239314173) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1366
1367  (1523649089 239396742) [Msg] Publicized address: 10.0.2.15
1368
1369  (1523649089 593696065) Init world[grabbing_book_v]
1370
1371  (1523649099 645417531) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
1372
1373  (1523649099 692197245) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
1374
1375  (1523649112 315300064) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1376
```

```
1377  ********************************************************************************

1378
1379
1380
1381
1382
1383    35 :
1384
1385   freezer_box4 :
1386
1387   freezer_box4 :
1388
1389  Gazebo multi-robot simulator, version 7.9.0
1390
1391  Copyright (C) 2012 Open Source Robotics Foundation.
1392
1393  Released under the Apache 2 License.
1394
1395  http://gazebosim.org
1396
1397
1398
1399
1400
1401  (1523649289 483938978) [Msg] Waiting for master.
1402
1403  (1523649289 484434068) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1404
1405  (1523649289 484525346) [Msg] Publicized address: 10.0.2.15
1406
1407  (1523649289 848696470) Init world[grabbing_book_v]
1408
1409  (1523649300 43799186) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
1410
1411  (1523649300 118940037) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
1412
1413  (1523649312 958445826) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1414
1415  ********************************************************************************

1416
1417
1418
1419
1420
1421    36 :
1422
1423   freezer_box4 :
1424
1425   freezer_box4 :
1426
1427  Gazebo multi-robot simulator, version 7.9.0
1428
1429  Copyright (C) 2012 Open Source Robotics Foundation.
```

```
1430
1431  Released under the Apache 2 License.
1432
1433  http://gazebosim.org
1434
1435
1436
1437
1438
1439  (1523649489 853101319) [Msg] Waiting for master.
1440
1441  (1523649489 861909989) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1442
1443  (1523649489 862015742) [Msg] Publicized address: 10.0.2.15
1444
1445  (1523649490 246111464) Init world[grabbing_book_v]
1446
1447  (1523649500 411508199) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1448
1449  (1523649500 455773474) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1450
1451  (1523649513 275143863) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1452
1453  *******************************************************************************

1454
1455
1456
1457
1458
1459   37 :
1460
1461   freezer_box4 :
1462
1463   freezer_box4 :
1464
1465  Gazebo multi-robot simulator, version 7.9.0
1466
1467  Copyright (C) 2012 Open Source Robotics Foundation.
1468
1469  Released under the Apache 2 License.
1470
1471  http://gazebosim.org
1472
1473
1474
1475
1476
1477  (1523649690 273791211) [Msg] Waiting for master.
1478
1479  (1523649690 284830250) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1480
1481  (1523649690 284975272) [Msg] Publicized address: 10.0.2.15
1482
1483  (1523649690 636823685) Init world[grabbing_book_v]
```

```
1484
1485  (1523649700 710763646) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
1486
1487  (1523649700 756082169) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
1488
1489  (1523649713 490374622) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1490
1491  (1523649718 4006516) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1492
1493  *****************************************************************************

1494
1495
1496
1497
1498
1499   38 :
1500
1501   freezer_box4 :
1502
1503   freezer_box4 :
1504
1505  Gazebo multi-robot simulator, version 7.9.0
1506
1507  Copyright (C) 2012 Open Source Robotics Foundation.
1508
1509  Released under the Apache 2 License.
1510
1511  http://gazebosim.org
1512
1513
1514
1515
1516
1517  (1523649890 636702743) [Msg] Waiting for master.
1518
1519  (1523649890 637845402) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1520
1521  (1523649890 637924336) [Msg] Publicized address: 10.0.2.15
1522
1523  (1523649890 987826930) Init world[grabbing_book_v]
1524
1525  (1523649901 393275852) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
1526
1527  (1523649901 442059296) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
1528
1529  (1523649914 242380503) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1530
1531  *****************************************************************************

1532
1533
1534
```

```
39 :

 freezer_box4 :

 freezer_box4 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523650091 72521903) [Msg] Waiting for master.

(1523650091 74616498) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523650091 74696842) [Msg] Publicized address: 10.0.2.15

(1523650091 414835825) Init world[grabbing_book_v]

(1523650101 638216608) [Dbg] [giskard_visualization_plugin.cpp:133] Created
     Marker: giskard_expressions/tool-point

(1523650101 712878992) [Dbg] [giskard_visualization_plugin.cpp:133] Created
     Marker: giskard_expressions/target-object-point

(1523650114 388503541) [Dbg] [TiltGrabPlugin.cc:137] made first joint

(1523650118 958411834) [Dbg] [TiltGrabPlugin.cc:147] made second joints

*******************************************************************************




 40 :

 freezer_box4 :

 freezer_box4 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.
```

```
1589  http://gazebosim.org
1590
1591
1592
1593
1594
1595  (1523650291 458177959) [Msg] Waiting for master.
1596
1597  (1523650291 458801456) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1598
1599  (1523650291 458871353) [Msg] Publicized address: 10.0.2.15
1600
1601  (1523650291 817231192) Init world[grabbing_book_v]
1602
1603  (1523650301 977613313) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
1604
1605  (1523650302 24702875) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
1606
1607  (1523650314 902878285) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1608
1609  (1523650319 540478127) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1610
1611  *****************************************************************************

1612
1613
1614
1615
1616
1617   41 :
1618
1619   freezer_box4 :
1620
1621   freezer_box4 :
1622
1623  Gazebo multi-robot simulator, version 7.9.0
1624
1625  Copyright (C) 2012 Open Source Robotics Foundation.
1626
1627  Released under the Apache 2 License.
1628
1629  http://gazebosim.org
1630
1631
1632
1633
1634
1635  (1523650492 102966713) [Msg] Waiting for master.
1636
1637  (1523650492 112092889) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1638
1639  (1523650492 112266256) [Msg] Publicized address: 10.0.2.15
1640
1641  (1523650492 464805820) Init world[grabbing_book_v]
1642
```

```
1643   (1523650502 303482801) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
1644
1645   (1523650502 365613227) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
1646
1647   (1523650515 296851655) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1648
1649   (1523650519 888213865) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1650
1651   *****************************************************************************

1652
1653
1654
1655
1656
1657    42 :
1658
1659    freezer_box4 :
1660
1661    freezer_box4 :
1662
1663   Gazebo multi-robot simulator, version 7.9.0
1664
1665   Copyright (C) 2012 Open Source Robotics Foundation.
1666
1667   Released under the Apache 2 License.
1668
1669   http://gazebosim.org
1670
1671
1672
1673
1674
1675   (1523650692 99995384) [Msg] Waiting for master.
1676
1677   (1523650692 100528988) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1678
1679   (1523650692 100648754) [Msg] Publicized address: 10.0.2.15
1680
1681   (1523650692 444400165) Init world[grabbing_book_v]
1682
1683   (1523650702 700338169) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
1684
1685   (1523650702 743007085) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
1686
1687   (1523650715 632382144) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1688
1689   (1523650720 170360457) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1690
1691   *****************************************************************************

1692
1693
```

```
1694
1695
1696
1697    43 :
1698
1699   freezer_box4 :
1700
1701   freezer_box4 :
1702
1703  Gazebo multi-robot simulator, version 7.9.0
1704
1705  Copyright (C) 2012 Open Source Robotics Foundation.
1706
1707  Released under the Apache 2 License.
1708
1709  http://gazebosim.org
1710
1711
1712
1713
1714
1715  (1523650892 448533954) [Msg] Waiting for master.
1716
1717  (1523650892 450443484) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1718
1719  (1523650892 450518755) [Msg] Publicized address: 10.0.2.15
1720
1721  (1523650892 812431450) Init world[grabbing_book_v]
1722
1723  (1523650903 39335703) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1724
1725  (1523650903 108753300) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1726
1727  (1523650915 838588360) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1728
1729  (1523650920 459785567) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1730
1731  ********************************************************************************

1732
1733
1734
1735
1736
1737    44 :
1738
1739   freezer_box5 :
1740
1741   freezer_box5 :
1742
1743  Gazebo multi-robot simulator, version 7.9.0
1744
1745  Copyright (C) 2012 Open Source Robotics Foundation.
1746
1747  Released under the Apache 2 License.
```

```
1748
1749   http://gazebosim.org
1750
1751
1752
1753
1754
1755   (1523651092 882914301) [Msg] Waiting for master.
1756
1757   (1523651092 884401130) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1758
1759   (1523651092 884482212) [Msg] Publicized address: 10.0.2.15
1760
1761   (1523651093 247442125) Init world[grabbing_book_v]
1762
1763   (1523651103 493478939) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1764
1765   (1523651103 559692379) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1766
1767   (1523651115 991008171) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1768
1769   (1523651119 800306657) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1770
1771   ********************************************************************************

1772
1773
1774
1775
1776
1777    45 :
1778
1779    freezer_box5 :
1780
1781    freezer_box5 :
1782
1783   Gazebo multi-robot simulator, version 7.9.0
1784
1785   Copyright (C) 2012 Open Source Robotics Foundation.
1786
1787   Released under the Apache 2 License.
1788
1789   http://gazebosim.org
1790
1791
1792
1793
1794
1795   (1523651293 207569887) [Msg] Waiting for master.
1796
1797   (1523651293 210056111) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1798
1799   (1523651293 210123943) [Msg] Publicized address: 10.0.2.15
1800
1801   (1523651293 551333513) Init world[grabbing_book_v]
```

```
1802
1803  (1523651303 814880804) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1804
1805  (1523651303 880685946) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1806
1807  (1523651316 471576720) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1808
1809  ********************************************************************************

1810
1811
1812
1813
1814
1815   46 :
1816
1817   freezer_box5 :
1818
1819   freezer_box5 :
1820
1821  Gazebo multi-robot simulator, version 7.9.0
1822
1823  Copyright (C) 2012 Open Source Robotics Foundation.
1824
1825  Released under the Apache 2 License.
1826
1827  http://gazebosim.org
1828
1829
1830
1831
1832
1833  (1523651493 603692757) [Msg] Waiting for master.
1834
1835  (1523651493 604993587) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1836
1837  (1523651493 605083261) [Msg] Publicized address: 10.0.2.15
1838
1839  (1523651493 945752519) Init world[grabbing_book_v]
1840
1841  (1523651504 1212876) [Dbg] [giskard_visualization_plugin.cpp:133] Created Marker
          : giskard_expressions/target-object-point
1842
1843  (1523651504 45827630) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1844
1845  (1523651516 548298987) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1846
1847  (1523651520 422511481) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1848
1849  ********************************************************************************

1850
1851
1852
```

```
1853
1854
1855   47 :
1856
1857   freezer_box5 :
1858
1859   freezer_box5 :
1860
1861  Gazebo multi-robot simulator , version 7.9.0
1862
1863  Copyright (C) 2012 Open Source Robotics Foundation .
1864
1865  Released under the Apache 2 License .
1866
1867  http://gazebosim.org
1868
1869
1870
1871
1872
1873  (1523651694 134254377) [Msg] Waiting for master .
1874
1875  (1523651694 134695264) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1876
1877  (1523651694 134766773) [Msg] Publicized address: 10.0.2.15
1878
1879  (1523651694 477480906) Init world[grabbing_book_v]
1880
1881  (1523651704 502282891) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
1882
1883  (1523651704 560982492) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
1884
1885  (1523651717 45981991) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1886
1887  *****************************************************************************
1888
1889
1890
1891
1892
1893   48 :
1894
1895   freezer_box5 :
1896
1897   freezer_box5 :
1898
1899  Gazebo multi-robot simulator , version 7.9.0
1900
1901  Copyright (C) 2012 Open Source Robotics Foundation .
1902
1903  Released under the Apache 2 License .
1904
1905  http://gazebosim.org
1906
```

547

```
1907
1908
1909
1910
1911  (1523651894 282872659) [Msg] Waiting for master.
1912
1913  (1523651894 283544560) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1914
1915  (1523651894 283631802) [Msg] Publicized address: 10.0.2.15
1916
1917  (1523651894 622687688) Init world[grabbing_book_v]
1918
1919  (1523651904 631160061) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
1920
1921  (1523651904 682759831) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1922
1923  (1523651917 190625121) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1924
1925  (1523651921 93167923) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1926
1927  *********************************************************************************

1928
1929
1930
1931
1932
1933   49 :
1934
1935   freezer_box5 :
1936
1937   freezer_box5 :
1938
1939  Gazebo multi-robot simulator, version 7.9.0
1940
1941  Copyright (C) 2012 Open Source Robotics Foundation.
1942
1943  Released under the Apache 2 License.
1944
1945  http://gazebosim.org
1946
1947
1948
1949
1950
1951  (1523652094 659547562) [Msg] Waiting for master.
1952
1953  (1523652094 660026709) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1954
1955  (1523652094 660119959) [Msg] Publicized address: 10.0.2.15
1956
1957  (1523652095 11948331) Init world[grabbing_book_v]
1958
1959  (1523652104 979785810) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
```

```
1960
1961  (1523652105 29083168) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
1962
1963  (1523652117 479791347) [Dbg] [TiltGrabPlugin.cc:137] made first joint
1964
1965  (1523652121 354361682) [Dbg] [TiltGrabPlugin.cc:147] made second joints
1966
1967  *************************************************************************************

1968
1969
1970
1971
1972
1973   50 :
1974
1975   freezer_box5 :
1976
1977   freezer_box5 :
1978
1979  Gazebo multi-robot simulator, version 7.9.0
1980
1981  Copyright (C) 2012 Open Source Robotics Foundation.
1982
1983  Released under the Apache 2 License.
1984
1985  http://gazebosim.org
1986
1987
1988
1989
1990
1991  (1523652295 67326973) [Msg] Waiting for master.
1992
1993  (1523652295 81017348) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
1994
1995  (1523652295 81146795) [Msg] Publicized address: 10.0.2.15
1996
1997  (1523652295 421732293) Init world[grabbing_book_v]
1998
1999  (1523652305 544239891) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2000
2001  (1523652305 594140831) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2002
2003  (1523652318 182767167) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2004
2005  (1523652322 77896809) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2006
2007  *************************************************************************************

2008
2009
2010
2011
```

```
2012
2013   51 :
2014
2015    freezer_box5 :
2016
2017    freezer_box5 :
2018
2019  Gazebo multi-robot simulator, version 7.9.0
2020
2021  Copyright (C) 2012 Open Source Robotics Foundation.
2022
2023  Released under the Apache 2 License.
2024
2025  http://gazebosim.org
2026
2027
2028
2029
2030
2031  (1523652495 284259959) [Msg] Waiting for master.
2032
2033  (1523652495 289835802) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2034
2035  (1523652495 289922536) [Msg] Publicized address: 10.0.2.15
2036
2037  (1523652495 630994623) Init world[grabbing_book_v]
2038
2039  (1523652505 803815949) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
2040
2041  (1523652505 852869957) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
2042
2043  (1523652518 375583327) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2044
2045  (1523652522 264442679) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2046
2047  *************************************************************************************

2048
2049
2050
2051
2052
2053   52 :
2054
2055    freezer_box5 :
2056
2057    freezer_box5 :
2058
2059  Gazebo multi-robot simulator, version 7.9.0
2060
2061  Copyright (C) 2012 Open Source Robotics Foundation.
2062
2063  Released under the Apache 2 License.
2064
2065  http://gazebosim.org
```

```
2066
2067
2068
2069
2070
2071  (1523652695 759514505) [Msg] Waiting for master.
2072
2073  (1523652695 761118858) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2074
2075  (1523652695 761187344) [Msg] Publicized address: 10.0.2.15
2076
2077  (1523652696 113351051) Init world[grabbing_book_v]
2078
2079  (1523652706 121468580) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2080
2081  (1523652706 195946826) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2082
2083  (1523652718 849836493) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2084
2085  ********************************************************************************

2086
2087
2088
2089
2090
2091   53 :
2092
2093   freezer_box5 :
2094
2095   freezer_box5 :
2096
2097  Gazebo multi-robot simulator, version 7.9.0
2098
2099  Copyright (C) 2012 Open Source Robotics Foundation.
2100
2101  Released under the Apache 2 License.
2102
2103  http://gazebosim.org
2104
2105
2106
2107
2108
2109  (1523652896 90054009) [Msg] Waiting for master.
2110
2111  (1523652896 91587050) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2112
2113  (1523652896 91668395) [Msg] Publicized address: 10.0.2.15
2114
2115  (1523652896 448090596) Init world[grabbing_book_v]
2116
2117  (1523652906 595143425) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2118
```

```
2119  (1523652906 646684579) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
2120
2121  (1523652919 149398550) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2122
2123  ********************************************************************************

2124
2125
2126
2127
2128
2129   54 :
2130
2131   freezer_box5 :
2132
2133   freezer_box5 :
2134
2135  Gazebo multi-robot simulator, version 7.9.0
2136
2137  Copyright (C) 2012 Open Source Robotics Foundation.
2138
2139  Released under the Apache 2 License.
2140
2141  http://gazebosim.org
2142
2143
2144
2145
2146
2147  (1523653096 470704566) [Msg] Waiting for master.
2148
2149  (1523653096 471243629) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2150
2151  (1523653096 471336716) [Msg] Publicized address: 10.0.2.15
2152
2153  (1523653096 829245917) Init world[grabbing_book_v]
2154
2155  (1523653106 979779672) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
2156
2157  (1523653107 32804409) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
2158
2159  (1523653119 713242018) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2160
2161  ********************************************************************************

2162
2163
2164
2165
2166
2167   55 :
2168
2169   freezer_box6 :
2170
```

```
2171   freezer_box6 :
2172
2173  Gazebo multi-robot simulator , version 7.9.0
2174
2175  Copyright (C) 2012 Open Source Robotics Foundation.
2176
2177  Released under the Apache 2 License.
2178
2179  http://gazebosim.org
2180
2181
2182
2183
2184
2185  (1523653296 884820548) [Msg] Waiting for master.
2186
2187  (1523653296 896756906) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2188
2189  (1523653296 896856567) [Msg] Publicized address: 10.0.2.15
2190
2191  (1523653297 251957867) Init world[grabbing_book_v]
2192
2193  (1523653307 266861193) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
2194
2195  (1523653307 315021590) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
2196
2197  (1523653321 369502254) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2198
2199  ********************************************************************************

2200
2201
2202
2203
2204
2205   56 :
2206
2207   freezer_box6 :
2208
2209   freezer_box6 :
2210
2211  Gazebo multi-robot simulator , version 7.9.0
2212
2213  Copyright (C) 2012 Open Source Robotics Foundation.
2214
2215  Released under the Apache 2 License.
2216
2217  http://gazebosim.org
2218
2219
2220
2221
2222
2223  (1523653497 185067171) [Msg] Waiting for master.
2224
```

```
2225  (1523653497 185549619) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2226
2227  (1523653497 185624906) [Msg] Publicized address: 10.0.2.15
2228
2229  (1523653497 533983667) Init world[grabbing_book_v]
2230
2231  (1523653507 694422326) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2232
2233  (1523653507 735974197) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2234
2235  (1523653524 244439887) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2236
2237  (1523653524 247991026) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2238
2239  ********************************************************************************

2240
2241
2242
2243
2244
2245   57 :
2246
2247   freezer_box6 :
2248
2249   freezer_box6 :
2250
2251  Gazebo multi-robot simulator, version 7.9.0
2252
2253  Copyright (C) 2012 Open Source Robotics Foundation.
2254
2255  Released under the Apache 2 License.
2256
2257  http://gazebosim.org
2258
2259
2260
2261
2262
2263  (1523653697 536143144) [Msg] Waiting for master.
2264
2265  (1523653697 547163414) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2266
2267  (1523653697 547267795) [Msg] Publicized address: 10.0.2.15
2268
2269  (1523653697 893149988) Init world[grabbing_book_v]
2270
2271  (1523653708 103164889) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2272
2273  (1523653708 149587930) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2274
2275  (1523653722 500864031) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2276
```

```
2277  (1523653724 418468994) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2278
2279  ********************************************************************************

2280
2281
2282
2283
2284
2285    58 :
2286
2287    freezer_box6 :
2288
2289    freezer_box6 :
2290
2291  Gazebo multi-robot simulator, version 7.9.0
2292
2293  Copyright (C) 2012 Open Source Robotics Foundation.
2294
2295  Released under the Apache 2 License.
2296
2297  http://gazebosim.org
2298
2299
2300
2301
2302
2303  (1523653897 999684647) [Msg] Waiting for master.
2304
2305  (1523653898 1825702) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2306
2307  (1523653898 1905605) [Msg] Publicized address: 10.0.2.15
2308
2309  (1523653898 346083953) Init world[grabbing_book_v]
2310
2311  (1523653908 382041721) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2312
2313  (1523653908 448029311) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2314
2315  (1523653925 72098579) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2316
2317  (1523653925 76704906) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2318
2319  ********************************************************************************

2320
2321
2322
2323
2324
2325    59 :
2326
2327    freezer_box6 :
2328
2329    freezer_box6 :
```

```
2330
2331  Gazebo multi-robot simulator, version 7.9.0
2332
2333  Copyright (C) 2012 Open Source Robotics Foundation.
2334
2335  Released under the Apache 2 License.
2336
2337  http://gazebosim.org
2338
2339
2340
2341
2342
2343  (1523654098 563360027) [Msg] Waiting for master.
2344
2345  (1523654098 571044613) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2346
2347  (1523654098 571157353) [Msg] Publicized address: 10.0.2.15
2348
2349  (1523654098 915513133) Init world[grabbing_book_v]
2350
2351  (1523654108 852963185) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
2352
2353  (1523654108 896253196) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
2354
2355  (1523654122 954452337) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2356
2357  (1523654125 359323516) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2358
2359  ******************************************************************************

2360
2361
2362
2363
2364
2365   60 :
2366
2367   freezer_box6 :
2368
2369   freezer_box6 :
2370
2371  Gazebo multi-robot simulator, version 7.9.0
2372
2373  Copyright (C) 2012 Open Source Robotics Foundation.
2374
2375  Released under the Apache 2 License.
2376
2377  http://gazebosim.org
2378
2379
2380
2381
2382
2383  (1523654298 686305066) [Msg] Waiting for master.
```

```
2384
2385  (1523654298 688893495) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2386
2387  (1523654298 688977468) [Msg] Publicized address: 10.0.2.15
2388
2389  (1523654299 31458974) Init world[grabbing_book_v]
2390
2391  (1523654309 121340019) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2392
2393  (1523654309 176591872) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2394
2395  (1523654323 290446898) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2396
2397  (1523654325 476503250) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2398
2399  **************************************************************************************
2400
2401
2402
2403
2404
2405   61 :
2406
2407   freezer_box6 :
2408
2409   freezer_box6 :
2410
2411  Gazebo multi-robot simulator, version 7.9.0
2412
2413  Copyright (C) 2012 Open Source Robotics Foundation.
2414
2415  Released under the Apache 2 License.
2416
2417  http://gazebosim.org
2418
2419
2420
2421
2422
2423  (1523654499 112088385) [Msg] Waiting for master.
2424
2425  (1523654499 113248944) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2426
2427  (1523654499 113326114) [Msg] Publicized address: 10.0.2.15
2428
2429  (1523654499 454466275) Init world[grabbing_book_v]
2430
2431  (1523654509 600433392) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2432
2433  (1523654509 652050900) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2434
2435  (1523654523 788991877) [Dbg] [TiltGrabPlugin.cc:137] made first joint
```

```
2436
2437   **********************************************************************************

2438
2439
2440
2441
2442
2443    62 :

2444
2445    freezer_box6 :

2446
2447    freezer_box6 :

2448
2449   Gazebo multi-robot simulator, version 7.9.0

2450
2451   Copyright (C) 2012 Open Source Robotics Foundation.

2452
2453   Released under the Apache 2 License.

2454
2455   http://gazebosim.org

2456
2457
2458
2459
2460
2461   (1523654699 564457693) [Msg] Waiting for master.

2462
2463   (1523654699 567211654) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

2464
2465   (1523654699 567292442) [Msg] Publicized address: 10.0.2.15

2466
2467   (1523654699 914712284) Init world[grabbing_book_v]

2468
2469   (1523654710 76495461) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point

2470
2471   (1523654710 119727061) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point

2472
2473   (1523654726 612712697) [Dbg] [TiltGrabPlugin.cc:137] made first joint

2474
2475   (1523654726 615601684) [Dbg] [TiltGrabPlugin.cc:147] made second joints

2476
2477   **********************************************************************************

2478
2479
2480
2481
2482
2483    63 :

2484
2485    freezer_box6 :

2486
2487    freezer_box6 :

2488
```

```
2489  Gazebo multi-robot simulator, version 7.9.0
2490
2491  Copyright (C) 2012 Open Source Robotics Foundation.
2492
2493  Released under the Apache 2 License.
2494
2495  http://gazebosim.org
2496
2497
2498
2499
2500
2501  (1523654900 296277891) [Msg] Waiting for master.
2502
2503  (1523654900 296910783) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2504
2505  (1523654900 296979987) [Msg] Publicized address: 10.0.2.15
2506
2507  (1523654900 639480924) Init world[grabbing_book_v]
2508
2509  (1523654910 461393806) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2510
2511  (1523654910 509967006) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2512
2513  (1523654924 456340549) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2514
2515  **********************************************************************************

2516
2517
2518
2519
2520
2521   64 :
2522
2523   freezer_box6 :
2524
2525   freezer_box6 :
2526
2527  Gazebo multi-robot simulator, version 7.9.0
2528
2529  Copyright (C) 2012 Open Source Robotics Foundation.
2530
2531  Released under the Apache 2 License.
2532
2533  http://gazebosim.org
2534
2535
2536
2537
2538
2539  (1523655100 377182666) [Msg] Waiting for master.
2540
2541  (1523655100 386766125) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2542
```

```
2543  (1523655100 386912868) [Msg] Publicized address: 10.0.2.15
2544
2545  (1523655100 730225386) Init world[grabbing_book_v]
2546
2547  (1523655110 844483911) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2548
2549  (1523655110 889746295) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2550
2551  **********************************************************************************

2552
2553
2554
2555
2556
2557   65 :
2558
2559   freezer_box6 :
2560
2561   freezer_box6 :
2562
2563  Gazebo multi-robot simulator, version 7.9.0
2564
2565  Copyright (C) 2012 Open Source Robotics Foundation.
2566
2567  Released under the Apache 2 License.
2568
2569  http://gazebosim.org
2570
2571
2572
2573
2574
2575  (1523655300 590792112) [Msg] Waiting for master.
2576
2577  (1523655300 601198299) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2578
2579  (1523655300 601311939) [Msg] Publicized address: 10.0.2.15
2580
2581  (1523655300 956434666) Init world[grabbing_book_v]
2582
2583  (1523655311 213866535) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2584
2585  (1523655311 290937405) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2586
2587  **********************************************************************************

2588
2589
2590
2591
2592
2593   66 :
```

```
2594
2595   freezer_box7 :
2596
2597   freezer_box7 :
2598
2599   Gazebo multi-robot simulator, version 7.9.0
2600
2601   Copyright (C) 2012 Open Source Robotics Foundation.
2602
2603   Released under the Apache 2 License.
2604
2605   http://gazebosim.org
2606
2607
2608
2609
2610
2611   (1523655501 68593568) [Msg] Waiting for master.
2612
2613   (1523655501 69769104) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2614
2615   (1523655501 69840255) [Msg] Publicized address: 10.0.2.15
2616
2617   (1523655501 421434913) Init world[grabbing_book_v]
2618
2619   (1523655511 807175749) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2620
2621   (1523655511 860998384) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2622
2623   (1523655526 27140425) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2624
2625   (1523655531 107041246) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2626
2627   (1523655537 379943034) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
2628
2629   **************************************************************************************

2630
2631
2632
2633
2634
2635   67 :
2636
2637   freezer_box7 :
2638
2639   freezer_box7 :
2640
2641   Gazebo multi-robot simulator, version 7.9.0
2642
2643   Copyright (C) 2012 Open Source Robotics Foundation.
2644
2645   Released under the Apache 2 License.
2646
2647   http://gazebosim.org
```

```
2648
2649
2650
2651
2652
2653   (1523655701 553573805) [Msg] Waiting for master.
2654
2655   (1523655701 564131067) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2656
2657   (1523655701 564273061) [Msg] Publicized address: 10.0.2.15
2658
2659   (1523655701 910069987) Init world[grabbing_book_v]
2660
2661   (1523655712 71737574) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2662
2663   (1523655712 116231299) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2664
2665   (1523655725 945437660) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2666
2667   (1523655730 960822925) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2668
2669   (1523655737 359319775) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
2670
2671   ********************************************************************************

2672
2673
2674
2675
2676
2677    68 :
2678
2679    freezer_box7 :
2680
2681    freezer_box7 :
2682
2683   Gazebo multi-robot simulator, version 7.9.0
2684
2685   Copyright (C) 2012 Open Source Robotics Foundation.
2686
2687   Released under the Apache 2 License.
2688
2689   http://gazebosim.org
2690
2691
2692
2693
2694
2695   (1523655901 823984014) [Msg] Waiting for master.
2696
2697   (1523655901 825657481) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2698
2699   (1523655901 825734189) [Msg] Publicized address: 10.0.2.15
2700
2701   (1523655902 191990783) Init world[grabbing_book_v]
```

```
2702
2703   (1523655912 264792056) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
2704
2705   (1523655912 318491775) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
2706
2707   (1523655926 401479410) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2708
2709   ********************************************************************************

2710
2711
2712
2713
2714
2715    69 :
2716
2717    freezer_box7 :
2718
2719    freezer_box7 :
2720
2721   Gazebo multi-robot simulator, version 7.9.0
2722
2723   Copyright (C) 2012 Open Source Robotics Foundation.
2724
2725   Released under the Apache 2 License.
2726
2727   http://gazebosim.org
2728
2729
2730
2731
2732
2733   (1523656102 119928851) [Msg] Waiting for master.
2734
2735   (1523656102 120410321) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2736
2737   (1523656102 120477916) [Msg] Publicized address: 10.0.2.15
2738
2739   (1523656102 465563248) Init world[grabbing_book_v]
2740
2741   (1523656112 747679510) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
2742
2743   (1523656112 803359536) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
2744
2745   (1523656126 757044605) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2746
2747   ********************************************************************************

2748
2749
2750
2751
2752
```

```
2753   70 :
2754
2755    freezer_box7 :
2756
2757    freezer_box7 :
2758
2759  Gazebo multi-robot simulator, version 7.9.0
2760
2761  Copyright (C) 2012 Open Source Robotics Foundation.
2762
2763  Released under the Apache 2 License.
2764
2765  http://gazebosim.org
2766
2767
2768
2769
2770
2771  (1523656302 496804925) [Msg] Waiting for master.
2772
2773  (1523656302 498327099) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2774
2775  (1523656302 498414374) [Msg] Publicized address: 10.0.2.15
2776
2777  (1523656302 840461397) Init world[grabbing_book_v]
2778
2779  (1523656313 114418728) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
2780
2781  (1523656313 167279517) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
2782
2783  (1523656327 280209951) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2784
2785  (1523656332 173493507) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2786
2787  (1523656334 880124180) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
2788
2789  ********************************************************************************

2790
2791
2792
2793
2794
2795   71 :
2796
2797    freezer_box7 :
2798
2799    freezer_box7 :
2800
2801  Gazebo multi-robot simulator, version 7.9.0
2802
2803  Copyright (C) 2012 Open Source Robotics Foundation.
2804
2805  Released under the Apache 2 License.
2806
```

```
2807  http://gazebosim.org
2808
2809
2810
2811
2812
2813  (1523656502 934414449) [Msg] Waiting for master.
2814
2815  (1523656502 935719863) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2816
2817  (1523656502 935787968) [Msg] Publicized address: 10.0.2.15
2818
2819  (1523656503 280715208) Init world[grabbing_book_v]
2820
2821  (1523656513 546267615) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2822
2823  (1523656513 588993126) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2824
2825  (1523656527 656427486) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2826
2827  *********************************************************************************

2828
2829
2830
2831
2832
2833   72 :
2834
2835   freezer_box7 :
2836
2837   freezer_box7 :
2838
2839  Gazebo multi-robot simulator, version 7.9.0
2840
2841  Copyright (C) 2012 Open Source Robotics Foundation.
2842
2843  Released under the Apache 2 License.
2844
2845  http://gazebosim.org
2846
2847
2848
2849
2850
2851  (1523656703 308366944) [Msg] Waiting for master.
2852
2853  (1523656703 309084087) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2854
2855  (1523656703 309163705) [Msg] Publicized address: 10.0.2.15
2856
2857  (1523656703 659848165) Init world[grabbing_book_v]
2858
2859  (1523656713 731912332) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
```

```
2860
2861   (1523656713 791751094) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
2862
2863   (1523656727 921566756) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2864
2865   *********************************************************************************

2866
2867
2868
2869
2870
2871    73 :
2872
2873    freezer_box7 :
2874
2875    freezer_box7 :
2876
2877   Gazebo multi-robot simulator, version 7.9.0
2878
2879   Copyright (C) 2012 Open Source Robotics Foundation.
2880
2881   Released under the Apache 2 License.
2882
2883   http://gazebosim.org

2884
2885
2886
2887
2888
2889   (1523656903 633781665) [Msg] Waiting for master.
2890
2891   (1523656903 645473008) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2892
2893   (1523656903 645614551) [Msg] Publicized address: 10.0.2.15
2894
2895   (1523656903 990075381) Init world[grabbing_book_v]
2896
2897   (1523656913 946812782) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
2898
2899   (1523656914 11372166) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
2900
2901   (1523656927 978407683) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2902
2903   (1523656932 975429098) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2904
2905   (1523656935 721901690) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
2906
2907   *********************************************************************************

2908
2909
2910
2911
```

```
2912
2913    74 :
2914
2915   freezer_box7 :
2916
2917   freezer_box7 :
2918
2919  Gazebo multi-robot simulator, version 7.9.0
2920
2921  Copyright (C) 2012 Open Source Robotics Foundation.
2922
2923  Released under the Apache 2 License.
2924
2925  http://gazebosim.org
2926
2927
2928
2929
2930
2931  (1523657103 905136771) [Msg] Waiting for master.
2932
2933  (1523657103 905728457) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2934
2935  (1523657103 905798698) [Msg] Publicized address: 10.0.2.15
2936
2937  (1523657104 279238837) Init world[grabbing_book_v]
2938
2939  (1523657114 383061362) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
2940
2941  (1523657114 435828518) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
2942
2943  (1523657128 410607468) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2944
2945  (1523657133 417390308) [Dbg] [TiltGrabPlugin.cc:147] made second joints
2946
2947  (1523657136 95302482) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
2948
2949  ********************************************************************************

2950
2951
2952
2953
2954
2955    75 :
2956
2957   freezer_box7 :
2958
2959   freezer_box7 :
2960
2961  Gazebo multi-robot simulator, version 7.9.0
2962
2963  Copyright (C) 2012 Open Source Robotics Foundation.
2964
2965  Released under the Apache 2 License.
```

```
2966
2967   http://gazebosim.org
2968
2969
2970
2971
2972
2973   (1523657304 265619574) [Msg] Waiting for master.
2974
2975   (1523657304 276351598) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
2976
2977   (1523657304 276511113) [Msg] Publicized address: 10.0.2.15
2978
2979   (1523657304 638284416) Init world[grabbing_book_v]
2980
2981   (1523657314 968399483) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
2982
2983   (1523657315 29392891) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
2984
2985   (1523657328 961309168) [Dbg] [TiltGrabPlugin.cc:137] made first joint
2986
2987   *********************************************************************************
2988
2989
2990
2991
2992
2993    76 :
2994
2995    freezer_box7 :
2996
2997    freezer_box7 :
2998
2999   Gazebo multi-robot simulator, version 7.9.0
3000
3001   Copyright (C) 2012 Open Source Robotics Foundation.
3002
3003   Released under the Apache 2 License.
3004
3005   http://gazebosim.org
3006
3007
3008
3009
3010
3011   (1523657504 584304100) [Msg] Waiting for master.
3012
3013   (1523657504 593249022) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3014
3015   (1523657504 593366763) [Msg] Publicized address: 10.0.2.15
3016
3017   (1523657504 938045888) Init world[grabbing_book_v]
3018
3019   (1523657515 147318127) [Dbg] [giskard_visualization_plugin.cpp:133] Created
```

```
         Marker: giskard_expressions/tool-point

(1523657515 214305807) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point

(1523657529 264688346) [Dbg] [TiltGrabPlugin.cc:137] made first joint

*******************************************************************************




  77 :

  grabbing_book :

  book_on_shelf :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523657704 986705397) [Msg] Waiting for master.

(1523657704 988477756) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523657704 988651621) [Msg] Publicized address: 10.0.2.15

(1523657705 454164997) Init world[grabbing_book_v]

(1523657715 589332483) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point

(1523657715 637694416) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point

(1523657732 282923623) [Dbg] [TiltGrabPlugin.cc:137] made first joint

(1523657733 917998964) [Dbg] [TiltGrabPlugin.cc:147] made second joints

(1523657738 587850343) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success

*******************************************************************************
```

```
3071
3072
3073   78 :
3074
3075   grabbing_book :
3076
3077   book_on_shelf :
3078
3079  Gazebo multi-robot simulator, version 7.9.0
3080
3081  Copyright (C) 2012 Open Source Robotics Foundation.
3082
3083  Released under the Apache 2 License.
3084
3085  http://gazebosim.org
3086
3087
3088
3089
3090
3091  (1523657905 746234216) [Msg] Waiting for master.
3092
3093  (1523657905 757729627) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3094
3095  (1523657905 757848220) [Msg] Publicized address: 10.0.2.15
3096
3097  (1523657906 196371701) Init world[grabbing_book_v]
3098
3099  (1523657916 10982488) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
3100
3101  (1523657916 80546662) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
3102
3103  (1523657932 939887777) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3104
3105  ********************************************************************************

3106
3107
3108
3109
3110
3111   79 :
3112
3113   grabbing_book :
3114
3115   book_on_shelf :
3116
3117  Gazebo multi-robot simulator, version 7.9.0
3118
3119  Copyright (C) 2012 Open Source Robotics Foundation.
3120
3121  Released under the Apache 2 License.
3122
3123  http://gazebosim.org
3124
```

```
3125
3126
3127
3128
3129  (1523658105 719348174) [Msg] Waiting for master.
3130
3131  (1523658105 729999558) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3132
3133  (1523658105 730094714) [Msg] Publicized address: 10.0.2.15
3134
3135  (1523658106 159688044) Init world[grabbing_book_v]
3136
3137  (1523658116 335832520) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
3138
3139  (1523658116 390407187) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
3140
3141  (1523658133 201259069) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3142
3143  *****************************************************************************

3144
3145
3146
3147
3148
3149   80 :
3150
3151   grabbing_book :
3152
3153   book_on_shelf :
3154
3155  Gazebo multi-robot simulator, version 7.9.0
3156
3157  Copyright (C) 2012 Open Source Robotics Foundation.
3158
3159  Released under the Apache 2 License.
3160
3161  http://gazebosim.org
3162
3163
3164
3165
3166
3167  (1523658306 42945617) [Msg] Waiting for master.
3168
3169  (1523658306 44667645) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3170
3171  (1523658306 44744397) [Msg] Publicized address: 10.0.2.15
3172
3173  (1523658306 483783374) Init world[grabbing_book_v]
3174
3175  (1523658316 605370462) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
3176
3177  (1523658316 650089350) [Dbg] [giskard_visualization_plugin.cpp:133] Created
```

```
              Marker: giskard_expressions/tool-point
3178
3179   (1523658333 164273866) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3180
3181   (1523658338 5065953) [Dbg] [TiltGrabPlugin.cc:147] made second joints
3182
3183   (1523658339 754787824) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
3184
3185   *******************************************************************************

3186
3187
3188
3189
3190
3191    81 :
3192
3193    grabbing_book :
3194
3195    book_on_shelf :
3196
3197   Gazebo multi-robot simulator, version 7.9.0
3198
3199   Copyright (C) 2012 Open Source Robotics Foundation.
3200
3201   Released under the Apache 2 License.
3202
3203   http://gazebosim.org
3204
3205
3206
3207
3208
3209   (1523658506 378015930) [Msg] Waiting for master.
3210
3211   (1523658506 388656965) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3212
3213   (1523658506 388784226) [Msg] Publicized address: 10.0.2.15
3214
3215   (1523658506 836573217) Init world[grabbing_book_v]
3216
3217   (1523658516 975624683) [Dbg] [giskard_visualization_plugin.cpp:133] Created
              Marker: giskard_expressions/target-object-point
3218
3219   (1523658517 28160526) [Dbg] [giskard_visualization_plugin.cpp:133] Created
              Marker: giskard_expressions/tool-point
3220
3221   (1523658533 770706819) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3222
3223   (1523658538 530106910) [Dbg] [TiltGrabPlugin.cc:147] made second joints
3224
3225   (1523658543 978710940) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
3226
3227   *******************************************************************************

3228
3229
```

```
  82 :

  grabbing_book :

  book_on_shelf :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523658706 784179500) [Msg] Waiting for master.

(1523658706 784839297) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523658706 784908332) [Msg] Publicized address: 10.0.2.15

(1523658707 214366603) Init world[grabbing_book_v]

(1523658717 80991654) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523658717 122962944) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523658733 605820997) [Dbg] [TiltGrabPlugin.cc:137] made first joint

************************************************************************************




  83 :

  grabbing_book :

  book_on_shelf :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org
```

```
3284
3285
3286
3287
3288
3289  (1523658907 232190749) [Msg] Waiting for master.
3290
3291  (1523658907 234092490) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3292
3293  (1523658907 234163975) [Msg] Publicized address: 10.0.2.15
3294
3295  (1523658907 653874823) Init world[grabbing_book_v]
3296
3297  (1523658917 747215175) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
3298
3299  (1523658917 791499977) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
3300
3301  (1523658934 373019680) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3302
3303  ********************************************************************************

3304
3305
3306
3307
3308
3309   84 :
3310
3311   grabbing_book :
3312
3313   book_on_shelf :
3314
3315  Gazebo multi-robot simulator, version 7.9.0
3316
3317  Copyright (C) 2012 Open Source Robotics Foundation.
3318
3319  Released under the Apache 2 License.
3320
3321  http://gazebosim.org
3322
3323
3324
3325
3326
3327  (1523659107 405454414) [Msg] Waiting for master.
3328
3329  (1523659107 416088372) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3330
3331  (1523659107 416226988) [Msg] Publicized address: 10.0.2.15
3332
3333  (1523659107 855869845) Init world[grabbing_book_v]
3334
3335  (1523659118 25279526) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
3336
```

```
3337  (1523659118 78441705) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
3338
3339  (1523659134 594601656) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3340
3341  (1523659139 315569809) [Dbg] [TiltGrabPlugin.cc:147] made second joints
3342
3343  (1523659141 76527373) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
3344
3345  ********************************************************************************

3346
3347
3348
3349
3350
3351   85 :
3352
3353   grabbing_book :
3354
3355   book_on_shelf :
3356
3357  Gazebo multi-robot simulator, version 7.9.0
3358
3359  Copyright (C) 2012 Open Source Robotics Foundation.
3360
3361  Released under the Apache 2 License.
3362
3363  http://gazebosim.org
3364
3365
3366
3367
3368
3369  (1523659307 712118314) [Msg] Waiting for master.
3370
3371  (1523659307 713323419) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3372
3373  (1523659307 713408753) [Msg] Publicized address: 10.0.2.15
3374
3375  (1523659308 152980124) Init world[grabbing_book_v]
3376
3377  (1523659318 207041799) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
3378
3379  (1523659318 274750875) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
3380
3381  (1523659335 147903814) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3382
3383  (1523659340 20440544) [Dbg] [TiltGrabPlugin.cc:147] made second joints
3384
3385  (1523659341 841174451) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
3386
3387  ********************************************************************************

3388
```

```
  86 :

  grabbing_book :

  book_on_shelf :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523659508 50675158) [Msg] Waiting for master.

(1523659508 51052165) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523659508 51118138) [Msg] Publicized address: 10.0.2.15

(1523659508 483236565) Init world[grabbing_book_v]

(1523659518 694529985) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523659518 753649689) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523659535 244931193) [Dbg] [TiltGrabPlugin.cc:137] made first joint

(1523659536 844413661) [Dbg] [TiltGrabPlugin.cc:147] made second joints

(1523659541 537748953) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success

*********************************************************************************


  87 :

  grabbing_book2 :

  book_on_shelf :

Gazebo multi-robot simulator, version 7.9.0
```

```
3443   Copyright (C) 2012 Open Source Robotics Foundation.
3444
3445   Released under the Apache 2 License.
3446
3447   http://gazebosim.org
3448
3449
3450
3451
3452
3453   (1523659708 373024399) [Msg] Waiting for master.
3454
3455   (1523659708 375605921) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3456
3457   (1523659708 375703425) [Msg] Publicized address: 10.0.2.15
3458
3459   (1523659708 752297174) Init world[grabbing_book_v]
3460
3461   (1523659718 862805122) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
3462
3463   (1523659718 906256763) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
3464
3465   (1523659722 687432307) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3466
3467   (1523659738 841580637) [Dbg] [TiltGrabPlugin.cc:147] made second joints
3468
3469   (1523659747 428507759) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
3470
3471   ********************************************************************************

3472
3473
3474
3475
3476
3477    88 :
3478
3479    grabbing_book2 :
3480
3481    book_on_shelf2 :
3482
3483   Gazebo multi-robot simulator, version 7.9.0
3484
3485   Copyright (C) 2012 Open Source Robotics Foundation.
3486
3487   Released under the Apache 2 License.
3488
3489   http://gazebosim.org
3490
3491
3492
3493
3494
3495   (1523659908 713909908) [Msg] Waiting for master.
3496
```

```
3497  (1523659908 714548778) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3498
3499  (1523659908 714621217) [Msg] Publicized address: 10.0.2.15
3500
3501  (1523659909 68322644) Init world[grabbing_book_v]
3502
3503  (1523659919 140320879) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
3504
3505  (1523659919 195021283) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
3506
3507  (1523659935 484934130) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3508
3509  *******************************************************************************

3510
3511
3512
3513
3514
3515   89 :
3516
3517   grabbing_book2 :
3518
3519   book_on_shelf2 :
3520
3521  Gazebo multi-robot simulator, version 7.9.0
3522
3523  Copyright (C) 2012 Open Source Robotics Foundation.
3524
3525  Released under the Apache 2 License.
3526
3527  http://gazebosim.org
3528
3529
3530
3531
3532
3533  (1523660109 45452002) [Msg] Waiting for master.
3534
3535  (1523660109 46812682) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3536
3537  (1523660109 46880404) [Msg] Publicized address: 10.0.2.15
3538
3539  (1523660109 409295464) Init world[grabbing_book_v]
3540
3541  (1523660119 546070853) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
3542
3543  (1523660119 599101016) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
3544
3545  (1523660135 670776029) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3546
3547  (1523660139 689750297) [Dbg] [TiltGrabPlugin.cc:147] made second joints
3548
```

```
3549  **********************************************************************************

3550
3551
3552
3553
3554
3555   90 :
3556
3557   grabbing_book2 :
3558
3559   book_on_shelf2 :
3560
3561  Gazebo multi-robot simulator, version 7.9.0
3562
3563  Copyright (C) 2012 Open Source Robotics Foundation.
3564
3565  Released under the Apache 2 License.
3566
3567  http://gazebosim.org
3568
3569
3570
3571
3572
3573  (1523660309 437875724) [Msg] Waiting for master.
3574
3575  (1523660309 439549863) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3576
3577  (1523660309 439623371) [Msg] Publicized address: 10.0.2.15
3578
3579  (1523660309 788276828) Init world[grabbing_book_v]
3580
3581  (1523660319 982330953) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
3582
3583  (1523660320 33488784) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
3584
3585  (1523660336 274136146) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3586
3587  **********************************************************************************

3588
3589
3590
3591
3592
3593   91 :
3594
3595   grabbing_book2 :
3596
3597   book_on_shelf2 :
3598
3599  Gazebo multi-robot simulator, version 7.9.0
3600
3601  Copyright (C) 2012 Open Source Robotics Foundation.
```

```
3602
3603   Released under the Apache 2 License.
3604
3605   http://gazebosim.org
3606
3607
3608
3609
3610
3611   (1523660509 673851511) [Msg] Waiting for master.
3612
3613   (1523660509 674833458) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3614
3615   (1523660509 674907340) [Msg] Publicized address: 10.0.2.15
3616
3617   (1523660510 53680549) Init world[grabbing_book_v]
3618
3619   (1523660519 973573716) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
3620
3621   (1523660520 17601499) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
3622
3623   (1523660536 219108425) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3624
3625   ********************************************************************************

3626
3627
3628
3629
3630
3631    92 :
3632
3633    grabbing_book2 :
3634
3635    book_on_shelf2 :
3636
3637   Gazebo multi-robot simulator, version 7.9.0
3638
3639   Copyright (C) 2012 Open Source Robotics Foundation.
3640
3641   Released under the Apache 2 License.
3642
3643   http://gazebosim.org
3644
3645
3646
3647
3648
3649   (1523660710 65994) [Msg] Waiting for master.
3650
3651   (1523660710 2052927) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3652
3653   (1523660710 2130034) [Msg] Publicized address: 10.0.2.15
3654
3655   (1523660710 351970379) Init world[grabbing_book_v]
```

```
3656
3657  (1523660720 687022415) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
3658
3659  (1523660720 736254899) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
3660
3661  (1523660737 419025016) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3662
3663  (1523660741 451462505) [Dbg] [TiltGrabPlugin.cc:147] made second joints
3664
3665  *********************************************************************************

3666
3667
3668
3669
3670
3671   93 :
3672
3673   grabbing_book2 :
3674
3675   book_on_shelf2 :
3676
3677  Gazebo multi-robot simulator, version 7.9.0
3678
3679  Copyright (C) 2012 Open Source Robotics Foundation.
3680
3681  Released under the Apache 2 License.
3682
3683  http://gazebosim.org
3684
3685
3686
3687
3688
3689  (1523660910 264094397) [Msg] Waiting for master.
3690
3691  (1523660910 265748565) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3692
3693  (1523660910 265827126) [Msg] Publicized address: 10.0.2.15
3694
3695  (1523660910 609092474) Init world[grabbing_book_v]
3696
3697  (1523660921 106224841) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
3698
3699  (1523660921 173349739) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
3700
3701  (1523660937 901629422) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3702
3703  *********************************************************************************

3704
3705
3706
```

```
 94 :

 grabbing_book2 :

 book_on_shelf2 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523661110 648320488) [Msg] Waiting for master.

(1523661110 650386681) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523661110 650478282) [Msg] Publicized address: 10.0.2.15

(1523661111 18965546) Init world[grabbing_book_v]

(1523661121 298140045) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523661121 370656389) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523661137 744617941) [Dbg] [TiltGrabPlugin.cc:137] made first joint

(1523661141 762445427) [Dbg] [TiltGrabPlugin.cc:147] made second joints

*********************************************************************************




 95 :

 grabbing_book2 :

 book_on_shelf2 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.
```

```
3761  http://gazebosim.org
3762
3763
3764
3765
3766
3767  (1523661311 28801414) [Msg] Waiting for master.
3768
3769  (1523661311 29603117) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3770
3771  (1523661311 29704148) [Msg] Publicized address: 10.0.2.15
3772
3773  (1523661311 382195086) Init world[grabbing_book_v]
3774
3775  (1523661321 703604751) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
3776
3777  (1523661321 755035918) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
3778
3779  (1523661338 26442982) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3780
3781  ***********************************************************************************

3782
3783
3784
3785
3786
3787   96 :
3788
3789   grabbing_book2 :
3790
3791   book_on_shelf2 :
3792
3793  Gazebo multi-robot simulator, version 7.9.0
3794
3795  Copyright (C) 2012 Open Source Robotics Foundation.
3796
3797  Released under the Apache 2 License.
3798
3799  http://gazebosim.org
3800
3801
3802
3803
3804
3805  (1523661511 378558827) [Msg] Waiting for master.
3806
3807  (1523661511 379516237) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3808
3809  (1523661511 379592980) [Msg] Publicized address: 10.0.2.15
3810
3811  (1523661511 734295190) Init world[grabbing_book_v]
3812
3813  (1523661522 71626376) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
```

```
3814
3815  (1523661522 125748804) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
3816
3817  (1523661538 343465405) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3818
3819  (1523661542 305615230) [Dbg] [TiltGrabPlugin.cc:147] made second joints
3820
3821  ********************************************************************************

3822
3823
3824
3825
3826
3827   97 :
3828
3829   grabbing_book3 :
3830
3831   book_on_shelf2 :
3832
3833  Gazebo multi-robot simulator, version 7.9.0
3834
3835  Copyright (C) 2012 Open Source Robotics Foundation.
3836
3837  Released under the Apache 2 License.
3838
3839  http://gazebosim.org
3840
3841
3842
3843
3844
3845  (1523661711 685655765) [Msg] Waiting for master.
3846
3847  (1523661711 686591170) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3848
3849  (1523661711 686669294) [Msg] Publicized address: 10.0.2.15
3850
3851  (1523661712 55009832) Init world[grabbing_book_v]
3852
3853  (1523661722 414607562) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
3854
3855  (1523661722 473640075) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
3856
3857  ********************************************************************************

3858
3859
3860
3861
3862
3863   98 :
3864
3865   grabbing_book3 :
```

```
3866
3867   book_on_shelf2 :
3868
3869  Gazebo multi-robot simulator , version 7.9.0
3870
3871  Copyright (C) 2012 Open Source Robotics Foundation .
3872
3873  Released under the Apache 2 License .
3874
3875  http://gazebosim.org
3876
3877
3878
3879
3880
3881  (1523661912 70915118) [Msg] Waiting for master .
3882
3883  (1523661912 72666247) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3884
3885  (1523661912 72823531) [Msg] Publicized address : 10.0.2.15
3886
3887  (1523661912 433504906) Init world[grabbing_book_v]
3888
3889  (1523661922 699934618) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
3890
3891  (1523661922 753932640) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
3892
3893  *******************************************************************************

3894
3895
3896
3897
3898
3899   99 :
3900
3901   grabbing_book3 :
3902
3903   book_on_shelf3 :
3904
3905  Gazebo multi-robot simulator , version 7.9.0
3906
3907  Copyright (C) 2012 Open Source Robotics Foundation .
3908
3909  Released under the Apache 2 License .
3910
3911  http://gazebosim.org
3912
3913
3914
3915
3916
3917  (1523662112 463843547) [Msg] Waiting for master .
3918
3919  (1523662112 465758288) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
```

```
3920
3921   (1523662112 465849221) [Msg] Publicized address: 10.0.2.15
3922
3923   (1523662112 820692776) Init world[grabbing_book_v]
3924
3925   (1523662122 834615712) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
3926
3927   (1523662122 889137224) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
3928
3929   (1523662139 353545214) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3930
3931   (1523662143 442101022) [Dbg] [TiltGrabPlugin.cc:147] made second joints
3932
3933   *****************************************************************************************

3934
3935
3936
3937
3938
3939    100 :
3940
3941    grabbing_book3 :
3942
3943    book_on_shelf3 :
3944
3945   Gazebo multi-robot simulator, version 7.9.0
3946
3947   Copyright (C) 2012 Open Source Robotics Foundation.
3948
3949   Released under the Apache 2 License.
3950
3951   http://gazebosim.org
3952
3953
3954
3955
3956
3957   (1523662312 769256096) [Msg] Waiting for master.
3958
3959   (1523662312 779788830) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
3960
3961   (1523662312 779914514) [Msg] Publicized address: 10.0.2.15
3962
3963   (1523662313 137823441) Init world[grabbing_book_v]
3964
3965   (1523662323 291415033) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
3966
3967   (1523662323 344320587) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
3968
3969   (1523662339 741404837) [Dbg] [TiltGrabPlugin.cc:137] made first joint
3970
3971   (1523662343 820800642) [Dbg] [TiltGrabPlugin.cc:147] made second joints
```

```
3972
3973  *****************************************************************************

3974
3975
3976
3977
3978
3979   101 :

3980
3981   grabbing_book3 :

3982
3983   book_on_shelf3 :

3984
3985  Gazebo multi-robot simulator, version 7.9.0

3986
3987  Copyright (C) 2012 Open Source Robotics Foundation.

3988
3989  Released under the Apache 2 License.

3990
3991  http://gazebosim.org

3992
3993
3994
3995
3996
3997  (1523662513 133356326) [Msg] Waiting for master.

3998
3999  (1523662513 135728238) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

4000
4001  (1523662513 135798192) [Msg] Publicized address: 10.0.2.15

4002
4003  (1523662513 483499820) Init world[grabbing_book_v]

4004
4005  (1523662523 747991975) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point

4006
4007  (1523662523 792278195) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point

4008
4009  (1523662539 974607726) [Dbg] [TiltGrabPlugin.cc:137] made first joint

4010
4011  *****************************************************************************

4012
4013
4014
4015
4016
4017   102 :

4018
4019   grabbing_book3 :

4020
4021   book_on_shelf3 :

4022
4023  Gazebo multi-robot simulator, version 7.9.0
4024
```

```
4025    Copyright (C) 2012 Open Source Robotics Foundation.
4026
4027    Released under the Apache 2 License.
4028
4029    http://gazebosim.org
4030
4031
4032
4033
4034
4035    (1523662713 537410457) [Msg] Waiting for master.
4036
4037    (1523662713 538741030) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4038
4039    (1523662713 538849237) [Msg] Publicized address: 10.0.2.15
4040
4041    (1523662713 909484099) Init world[grabbing_book_v]
4042
4043    (1523662723 978774430) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
4044
4045    (1523662724 24247831) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
4046
4047    (1523662740 286090218) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4048
4049    (1523662744 504438857) [Dbg] [TiltGrabPlugin.cc:147] made second joints
4050
4051    *******************************************************************************
4052
4053
4054
4055
4056
4057     103 :
4058
4059     grabbing_book3 :
4060
4061     book_on_shelf3 :
4062
4063    Gazebo multi-robot simulator, version 7.9.0
4064
4065    Copyright (C) 2012 Open Source Robotics Foundation.
4066
4067    Released under the Apache 2 License.
4068
4069    http://gazebosim.org
4070
4071
4072
4073
4074
4075    (1523662913 886358107) [Msg] Waiting for master.
4076
4077    (1523662913 887947331) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4078
```

```
4079  (1523662913 888037083) [Msg] Publicized address: 10.0.2.15
4080
4081  (1523662914 234252417) Init world[grabbing_book_v]
4082
4083  (1523662924 329228568) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
4084
4085  (1523662924 382221237) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
4086
4087  (1523662940 739745751) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4088
4089  (1523662944 732745528) [Dbg] [TiltGrabPlugin.cc:147] made second joints
4090
4091  ********************************************************************************

4092
4093
4094
4095
4096
4097   104 :
4098
4099   grabbing_book3 :
4100
4101   book_on_shelf3 :
4102
4103  Gazebo multi-robot simulator, version 7.9.0
4104
4105  Copyright (C) 2012 Open Source Robotics Foundation.
4106
4107  Released under the Apache 2 License.
4108
4109  http://gazebosim.org
4110
4111
4112
4113
4114
4115  (1523663114 343124130) [Msg] Waiting for master.
4116
4117  (1523663114 343598824) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4118
4119  (1523663114 343720333) [Msg] Publicized address: 10.0.2.15
4120
4121  (1523663114 697604019) Init world[grabbing_book_v]
4122
4123  (1523663124 857164266) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
4124
4125  (1523663124 901071758) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
4126
4127  (1523663141 164458905) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4128
4129  ********************************************************************************
```

```
4130
4131
4132
4133
4134
4135   105 :
4136
4137   grabbing_book3 :
4138
4139   book_on_shelf3 :
4140
4141  Gazebo multi-robot simulator, version 7.9.0
4142
4143  Copyright (C) 2012 Open Source Robotics Foundation.
4144
4145  Released under the Apache 2 License.
4146
4147  http://gazebosim.org
4148
4149
4150
4151
4152
4153  (1523663314 724753483) [Msg] Waiting for master.
4154
4155  (1523663314 725954221) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4156
4157  (1523663314 726031828) [Msg] Publicized address: 10.0.2.15
4158
4159  (1523663315 81588184) Init world[grabbing_book_v]
4160
4161  (1523663325 279014801) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
4162
4163  (1523663325 323007250) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
4164
4165  (1523663341 534522297) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4166
4167  *******************************************************************************

4168
4169
4170
4171
4172
4173   106 :
4174
4175   grabbing_book3 :
4176
4177   book_on_shelf3 :
4178
4179  Gazebo multi-robot simulator, version 7.9.0
4180
4181  Copyright (C) 2012 Open Source Robotics Foundation.
4182
4183  Released under the Apache 2 License.
```

```
4184
4185  http://gazebosim.org
4186
4187
4188
4189
4190
4191  (1523663515 100811069) [Msg] Waiting for master.
4192
4193  (1523663515 101941761) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4194
4195  (1523663515 102020180) [Msg] Publicized address: 10.0.2.15
4196
4197  (1523663515 446199912) Init world[grabbing_book_v]
4198
4199  (1523663525 630664190) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
4200
4201  (1523663525 680991276) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
4202
4203  (1523663541 930655803) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4204
4205  (1523663545 897304559) [Dbg] [TiltGrabPlugin.cc:147] made second joints
4206
4207  *******************************************************************************

4208
4209
4210
4211
4212
4213   107 :
4214
4215   grabbing_book4 :
4216
4217   book_on_shelf3 :
4218
4219  Gazebo multi-robot simulator, version 7.9.0
4220
4221  Copyright (C) 2012 Open Source Robotics Foundation.
4222
4223  Released under the Apache 2 License.
4224
4225  http://gazebosim.org
4226
4227
4228
4229
4230
4231  (1523663715 437945796) [Msg] Waiting for master.
4232
4233  (1523663715 440146975) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4234
4235  (1523663715 440217074) [Msg] Publicized address: 10.0.2.15
4236
4237  (1523663715 790732601) Init world[grabbing_book_v]
```

```
4238
4239   (1523663725 943452864) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
4240
4241   (1523663725 988411582) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
4242
4243   (1523663742 332699796) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4244
4245   ********************************************************************************

4246
4247
4248
4249
4250
4251    108 :
4252
4253    grabbing_book4 :
4254
4255    book_on_shelf3 :
4256
4257   Gazebo multi-robot simulator, version 7.9.0
4258
4259   Copyright (C) 2012 Open Source Robotics Foundation.
4260
4261   Released under the Apache 2 License.
4262
4263   http://gazebosim.org
4264
4265
4266
4267
4268
4269   (1523663915 782220801) [Msg] Waiting for master.
4270
4271   (1523663915 783744239) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4272
4273   (1523663915 783868949) [Msg] Publicized address: 10.0.2.15
4274
4275   (1523663916 136821502) Init world[grabbing_book_v]
4276
4277   (1523663926 292822308) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
4278
4279   (1523663926 336081412) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
4280
4281   (1523663942 824095897) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4282
4283   ********************************************************************************

4284
4285
4286
4287
4288
```

```
4289    109 :

4290

4291     grabbing_book4 :

4292

4293     book_on_shelf3 :

4294

4295    Gazebo multi-robot simulator, version 7.9.0

4296

4297    Copyright (C) 2012 Open Source Robotics Foundation.

4298

4299    Released under the Apache 2 License.

4300

4301    http://gazebosim.org

4302

4303

4304

4305

4306

4307    (1523664116 193512843) [Msg] Waiting for master.

4308

4309    (1523664116 195664343) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

4310

4311    (1523664116 195766928) [Msg] Publicized address: 10.0.2.15

4312

4313    (1523664116 541293707) Init world[grabbing_book_v]

4314

4315    (1523664126 696734935) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point

4316

4317    (1523664126 757424110) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point

4318

4319    (1523664143 258109237) [Dbg] [TiltGrabPlugin.cc:137] made first joint

4320

4321    (1523664148 112683889) [Dbg] [TiltGrabPlugin.cc:147] made second joints

4322

4323    *****************************************************************************

4324

4325

4326

4327

4328

4329     110 :

4330

4331     grabbing_book4 :

4332

4333     book_on_shelf4 :

4334

4335    Gazebo multi-robot simulator, version 7.9.0

4336

4337    Copyright (C) 2012 Open Source Robotics Foundation.

4338

4339    Released under the Apache 2 License.

4340

4341    http://gazebosim.org

4342
```

```
4343
4344
4345
4346
4347  (1523664316 532211684) [Msg] Waiting for master.
4348
4349  (1523664316 542720871) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4350
4351  (1523664316 542839035) [Msg] Publicized address: 10.0.2.15
4352
4353  (1523664316 897721787) Init world[grabbing_book_v]
4354
4355  (1523664327 126413993) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
4356
4357  (1523664327 187238857) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
4358
4359  (1523664341 776397860) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4360
4361  (1523664346 253783061) [Dbg] [TiltGrabPlugin.cc:147] made second joints
4362
4363  ********************************************************************************

4364
4365
4366
4367
4368
4369   111 :
4370
4371   grabbing_book4 :
4372
4373   book_on_shelf4 :
4374
4375  Gazebo multi-robot simulator, version 7.9.0
4376
4377  Copyright (C) 2012 Open Source Robotics Foundation.
4378
4379  Released under the Apache 2 License.
4380
4381  http://gazebosim.org
4382
4383
4384
4385
4386
4387  (1523664516 874516719) [Msg] Waiting for master.
4388
4389  (1523664516 875468140) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4390
4391  (1523664516 875547182) [Msg] Publicized address: 10.0.2.15
4392
4393  (1523664517 223398051) Init world[grabbing_book_v]
4394
4395  (1523664527 497487457) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
```

```
4396
4397  (1523664527 541668117) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
4398
4399  (1523664544 79775069) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4400
4401  *******************************************************************************

4402
4403
4404
4405
4406
4407    112 :
4408
4409    grabbing_book4 :
4410
4411    book_on_shelf4 :
4412
4413  Gazebo multi-robot simulator, version 7.9.0
4414
4415  Copyright (C) 2012 Open Source Robotics Foundation.
4416
4417  Released under the Apache 2 License.
4418
4419  http://gazebosim.org
4420
4421
4422
4423
4424
4425  (1523664717 253171011) [Msg] Waiting for master.
4426
4427  (1523664717 261798001) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4428
4429  (1523664717 261933481) [Msg] Publicized address: 10.0.2.15
4430
4431  (1523664717 622548755) Init world[grabbing_book_v]
4432
4433  *******************************************************************************

4434
4435
4436
4437
4438
4439    113 :
4440
4441    grabbing_book4 :
4442
4443    book_on_shelf4 :
4444
4445  Gazebo multi-robot simulator, version 7.9.0
4446
4447  Copyright (C) 2012 Open Source Robotics Foundation.
4448
4449  Released under the Apache 2 License.
```

```
4450
4451  http://gazebosim.org
4452
4453
4454
4455
4456
4457  (1523664917 571654921) [Msg] Waiting for master.
4458
4459  (1523664917 572567957) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4460
4461  (1523664917 572645842) [Msg] Publicized address: 10.0.2.15
4462
4463  (1523664917 957251929) Init world[grabbing_book_v]
4464
4465  (1523664928 80944981) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
4466
4467  (1523664928 138937219) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
4468
4469  (1523664944 539729277) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4470
4471  **********************************************************************************

4472
4473
4474
4475
4476
4477   114 :
4478
4479   grabbing_book4 :
4480
4481   book_on_shelf4 :
4482
4483  Gazebo multi-robot simulator, version 7.9.0
4484
4485  Copyright (C) 2012 Open Source Robotics Foundation.
4486
4487  Released under the Apache 2 License.
4488
4489  http://gazebosim.org
4490
4491
4492
4493
4494
4495  (1523665117 867362751) [Msg] Waiting for master.
4496
4497  (1523665117 868679030) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4498
4499  (1523665117 868813000) [Msg] Publicized address: 10.0.2.15
4500
4501  (1523665118 219578040) Init world[grabbing_book_v]
4502
4503  (1523665128 464382891) [Dbg] [giskard_visualization_plugin.cpp:133] Created
```

```
        Marker: giskard_expressions/target-object-point
4504
4505  (1523665128 508303833) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
4506
4507  (1523665144 881404936) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4508
4509  ********************************************************************************

4510
4511
4512
4513
4514
4515   115 :
4516
4517   grabbing_book4 :
4518
4519   book_on_shelf4 :
4520
4521  Gazebo multi-robot simulator, version 7.9.0
4522
4523  Copyright (C) 2012 Open Source Robotics Foundation.
4524
4525  Released under the Apache 2 License.
4526
4527  http://gazebosim.org

4528
4529
4530
4531
4532
4533  (1523665318 336694851) [Msg] Waiting for master.
4534
4535  (1523665318 338701193) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4536
4537  (1523665318 338778292) [Msg] Publicized address: 10.0.2.15
4538
4539  (1523665318 686529563) Init world[grabbing_book_v]
4540
4541  (1523665328 772759567) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
4542
4543  (1523665328 818108823) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
4544
4545  (1523665345 311260444) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4546
4547  ********************************************************************************

4548
4549
4550
4551
4552
4553   116 :
4554
```

```
4555   grabbing_book4 :
4556
4557   book_on_shelf4 :
4558
4559  Gazebo multi-robot simulator, version 7.9.0
4560
4561  Copyright (C) 2012 Open Source Robotics Foundation.
4562
4563  Released under the Apache 2 License.
4564
4565  http://gazebosim.org
4566
4567
4568
4569
4570
4571  (1523665518 527672325) [Msg] Waiting for master.
4572
4573  (1523665518 529002680) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4574
4575  (1523665518 529085784) [Msg] Publicized address: 10.0.2.15
4576
4577  (1523665518 900228283) Init world[grabbing_book_v]
4578
4579  (1523665529 240445576) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
4580
4581  (1523665529 290809810) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
4582
4583  (1523665545 592683557) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4584
4585  (1523665549 758176759) [Dbg] [TiltGrabPlugin.cc:147] made second joints
4586
4587  ********************************************************************************

4588
4589
4590
4591
4592
4593   117 :
4594
4595   grabbing_book5 :
4596
4597   book_on_shelf4 :
4598
4599  Gazebo multi-robot simulator, version 7.9.0
4600
4601  Copyright (C) 2012 Open Source Robotics Foundation.
4602
4603  Released under the Apache 2 License.
4604
4605  http://gazebosim.org
4606
4607
4608
```

```
4609
4610
4611  (1523665718 902182410) [Msg] Waiting for master.
4612
4613  (1523665718 904353489) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4614
4615  (1523665718 904433431) [Msg] Publicized address: 10.0.2.15
4616
4617  (1523665719 253076984) Init world[grabbing_book_v]
4618
4619  (1523665729 550849819) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
4620
4621  (1523665729 596817984) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
4622
4623  (1523665745 839810118) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4624
4625  ************************************************************************************

4626
4627
4628
4629
4630
4631   118 :
4632
4633   grabbing_book5 :
4634
4635   book_on_shelf4 :
4636
4637  Gazebo multi-robot simulator, version 7.9.0
4638
4639  Copyright (C) 2012 Open Source Robotics Foundation.
4640
4641  Released under the Apache 2 License.
4642
4643  http://gazebosim.org
4644
4645
4646
4647
4648
4649  (1523665919 263645267) [Msg] Waiting for master.
4650
4651  (1523665919 264806121) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4652
4653  (1523665919 264894088) [Msg] Publicized address: 10.0.2.15
4654
4655  (1523665919 626493706) Init world[grabbing_book_v]
4656
4657  (1523665929 689653151) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
4658
4659  (1523665929 768059245) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
4660
```

```
4661  (1523665946 64705250) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4662
4663  ********************************************************************************

4664
4665
4666
4667
4668
4669    119 :
4670
4671   grabbing_book5 :
4672
4673   book_on_shelf4 :
4674
4675  Gazebo multi-robot simulator, version 7.9.0
4676
4677  Copyright (C) 2012 Open Source Robotics Foundation.
4678
4679  Released under the Apache 2 License.
4680
4681  http://gazebosim.org
4682
4683
4684
4685
4686
4687  (1523666119 596739815) [Msg] Waiting for master.
4688
4689  (1523666119 607452789) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4690
4691  (1523666119 607577201) [Msg] Publicized address: 10.0.2.15
4692
4693  (1523666119 961005603) Init world[grabbing_book_v]
4694
4695  (1523666130 2969050) [Dbg] [giskard_visualization_plugin.cpp:133] Created Marker
          : giskard_expressions/tool-point
4696
4697  (1523666130 69312673) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
4698
4699  (1523666146 369589936) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4700
4701  (1523666151 957991325) [Dbg] [TiltGrabPlugin.cc:147] made second joints
4702
4703  (1523666156 745543852) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
4704
4705  ********************************************************************************

4706
4707
4708
4709
4710
4711    120 :
4712
4713   grabbing_book5 :
```

```
4714
4715   book_on_shelf4 :
4716
4717  Gazebo multi-robot simulator, version 7.9.0
4718
4719  Copyright (C) 2012 Open Source Robotics Foundation.
4720
4721  Released under the Apache 2 License.
4722
4723  http://gazebosim.org
4724
4725
4726
4727
4728
4729  (1523666319 865529539) [Msg] Waiting for master.
4730
4731  (1523666319 867162756) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4732
4733  (1523666319 867239309) [Msg] Publicized address: 10.0.2.15
4734
4735  (1523666320 227475801) Init world[grabbing_book_v]
4736
4737  (1523666330 595318463) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
4738
4739  (1523666330 654609549) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
4740
4741  (1523666346 959454022) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4742
4743  ********************************************************************************

4744
4745
4746
4747
4748
4749   121 :
4750
4751   grabbing_book5 :
4752
4753   book_on_shelf5 :
4754
4755  Gazebo multi-robot simulator, version 7.9.0
4756
4757  Copyright (C) 2012 Open Source Robotics Foundation.
4758
4759  Released under the Apache 2 License.
4760
4761  http://gazebosim.org
4762
4763
4764
4765
4766
4767  (1523666520 238062791) [Msg] Waiting for master.
```

```
4768
4769  (1523666520 239580024) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4770
4771  (1523666520 239652928) [Msg] Publicized address: 10.0.2.15
4772
4773  (1523666520 605654346) Init world[grabbing_book_v]
4774
4775  (1523666530 712750307) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
4776
4777  (1523666530 759130043) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
4778
4779  (1523666547 5364565) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4780
4781  ********************************************************************************

4782
4783
4784
4785
4786
4787   122 :
4788
4789   grabbing_book5 :
4790
4791   book_on_shelf5 :
4792
4793  Gazebo multi-robot simulator, version 7.9.0
4794
4795  Copyright (C) 2012 Open Source Robotics Foundation.
4796
4797  Released under the Apache 2 License.
4798
4799  http://gazebosim.org
4800
4801
4802
4803
4804
4805  (1523666720 562416574) [Msg] Waiting for master.
4806
4807  (1523666720 562938691) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4808
4809  (1523666720 563025370) [Msg] Publicized address: 10.0.2.15
4810
4811  (1523666720 915795382) Init world[grabbing_book_v]
4812
4813  (1523666731 167781778) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
4814
4815  (1523666731 242623097) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
4816
4817  (1523666747 537178980) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4818
4819  ********************************************************************************
```

```
4820
4821
4822
4823
4824
4825   123 :
4826
4827   grabbing_book5 :
4828
4829   book_on_shelf5 :
4830
4831  Gazebo multi-robot simulator, version 7.9.0
4832
4833  Copyright (C) 2012 Open Source Robotics Foundation.
4834
4835  Released under the Apache 2 License.
4836
4837  http://gazebosim.org
4838
4839
4840
4841
4842
4843  (1523666920 937867733) [Msg] Waiting for master.
4844
4845  (1523666920 947751969) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4846
4847  (1523666920 947968001) [Msg] Publicized address: 10.0.2.15
4848
4849  (1523666921 312070146) Init world[grabbing_book_v]
4850
4851  (1523666931 335961355) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
4852
4853  (1523666931 397675031) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
4854
4855  (1523666947 791536355) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4856
4857  ********************************************************************************
4858
4859
4860
4861
4862
4863   124 :
4864
4865   grabbing_book5 :
4866
4867   book_on_shelf5 :
4868
4869  Gazebo multi-robot simulator, version 7.9.0
4870
4871  Copyright (C) 2012 Open Source Robotics Foundation.
4872
```

```
4873  Released under the Apache 2 License.
4874
4875  http://gazebosim.org
4876
4877
4878
4879
4880
4881  (1523667121 219458424) [Msg] Waiting for master.
4882
4883  (1523667121 230774635) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4884
4885  (1523667121 230904862) [Msg] Publicized address: 10.0.2.15
4886
4887  (1523667121 592851768) Init world[grabbing_book_v]
4888
4889  (1523667131 729748508) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
4890
4891  (1523667131 787794490) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
4892
4893  (1523667148 93909343) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4894
4895  (1523667152 819289947) [Dbg] [TiltGrabPlugin.cc:147] made second joints
4896
4897  (1523667154 774281303) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
4898
4899  *****************************************************************************

4900
4901
4902
4903
4904
4905   125 :
4906
4907   grabbing_book5 :
4908
4909   book_on_shelf5 :
4910
4911  Gazebo multi-robot simulator, version 7.9.0
4912
4913  Copyright (C) 2012 Open Source Robotics Foundation.
4914
4915  Released under the Apache 2 License.
4916
4917  http://gazebosim.org
4918
4919
4920
4921
4922
4923  (1523667321 597893728) [Msg] Waiting for master.
4924
4925  (1523667321 609576709) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4926
```

```
4927  (1523667321 609690612) [Msg] Publicized address: 10.0.2.15
4928
4929  (1523667321 970768447) Init world[grabbing_book_v]
4930
4931  (1523667332 189250683) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
4932
4933  (1523667332 251793241) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
4934
4935  (1523667348 516743586) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4936
4937  (1523667353 71102255) [Dbg] [TiltGrabPlugin.cc:147] made second joints
4938
4939  (1523667355 29980150) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
4940
4941  ********************************************************************************
4942
4943
4944
4945
4946
4947   126 :
4948
4949   grabbing_book5 :
4950
4951   book_on_shelf5 :
4952
4953  Gazebo multi-robot simulator, version 7.9.0
4954
4955  Copyright (C) 2012 Open Source Robotics Foundation.
4956
4957  Released under the Apache 2 License.
4958
4959  http://gazebosim.org
4960
4961
4962
4963
4964
4965  (1523667522 14516800) [Msg] Waiting for master.
4966
4967  (1523667522 15785165) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
4968
4969  (1523667522 15861725) [Msg] Publicized address: 10.0.2.15
4970
4971  (1523667522 390541458) Init world[grabbing_book_v]
4972
4973  (1523667532 560162179) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
4974
4975  (1523667532 610483729) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
4976
4977  (1523667548 928823855) [Dbg] [TiltGrabPlugin.cc:137] made first joint
4978
```

```
4979  (1523667553 431371418) [Dbg] [TiltGrabPlugin.cc:147] made second joints
4980
4981  (1523667555 378938524) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
4982
4983  ********************************************************************************

4984
4985
4986
4987
4988
4989   127 :
4990
4991   grabbing_book6 :
4992
4993   book_on_shelf5 :
4994
4995  Gazebo multi-robot simulator, version 7.9.0
4996
4997  Copyright (C) 2012 Open Source Robotics Foundation.
4998
4999  Released under the Apache 2 License.
5000
5001  http://gazebosim.org
5002
5003
5004
5005
5006
5007  (1523667722 400533874) [Msg] Waiting for master.
5008
5009  (1523667722 402337319) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5010
5011  (1523667722 402414176) [Msg] Publicized address: 10.0.2.15
5012
5013  (1523667722 772982459) Init world[grabbing_book_v]
5014
5015  (1523667732 916330700) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
5016
5017  (1523667732 967032560) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5018
5019  ********************************************************************************

5020
5021
5022
5023
5024
5025   128 :
5026
5027   grabbing_book6 :
5028
5029   book_on_shelf5 :
5030
5031  Gazebo multi-robot simulator, version 7.9.0
```

(1523667922 733282964) [Msg] Waiting for master.

(1523667922 733906729) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523667922 734002995) [Msg] Publicized address: 10.0.2.15

(1523667923 83155996) Init world[grabbing_book_v]

(1523667933 233481881) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523667933 286424070) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

****

  129 :

 grabbing_book6 :

 book_on_shelf5 :

Gazebo multi-robot simulator, version 7.9.0

(1523668123 112864959) [Msg] Waiting for master.

(1523668123 123219385) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523668123 123356345) [Msg] Publicized address: 10.0.2.15

(1523668123 477642064) Init world[grabbing_book_v]

```
5086
5087  (1523668133 608131138) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
5088
5089  (1523668133 665000286) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
5090
5091  *********************************************************************************

5092
5093
5094
5095
5096
5097    130 :
5098
5099   grabbing_book6 :
5100
5101   book_on_shelf5 :
5102
5103  Gazebo multi-robot simulator, version 7.9.0
5104
5105  Copyright (C) 2012 Open Source Robotics Foundation.
5106
5107  Released under the Apache 2 License.
5108
5109  http://gazebosim.org
5110
5111
5112
5113
5114
5115  (1523668323 454174633) [Msg] Waiting for master.
5116
5117  (1523668323 455642834) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5118
5119  (1523668323 455812214) [Msg] Publicized address: 10.0.2.15
5120
5121  (1523668323 805808651) Init world[grabbing_book_v]
5122
5123  (1523668333 989408926) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
5124
5125  (1523668334 45719562) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
5126
5127  *********************************************************************************

5128
5129
5130
5131
5132
5133    131 :
5134
5135   grabbing_book6 :
5136
```

```
5137   book_on_shelf5 :
5138
5139  Gazebo multi-robot simulator, version 7.9.0
5140
5141  Copyright (C) 2012 Open Source Robotics Foundation.
5142
5143  Released under the Apache 2 License.
5144
5145  http://gazebosim.org
5146
5147
5148
5149
5150
5151  (1523668523 811765137) [Msg] Waiting for master.
5152
5153  (1523668523 821570874) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5154
5155  (1523668523 821673793) [Msg] Publicized address: 10.0.2.15
5156
5157  (1523668524 186260999) Init world[grabbing_book_v]
5158
5159  (1523668534 209454993) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
5160
5161  (1523668534 296550890) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5162
5163  ********************************************************************************

5164
5165
5166
5167
5168
5169   132 :
5170
5171   grabbing_book6 :
5172
5173   book_on_shelf6 :
5174
5175  Gazebo multi-robot simulator, version 7.9.0
5176
5177  Copyright (C) 2012 Open Source Robotics Foundation.
5178
5179  Released under the Apache 2 License.
5180
5181  http://gazebosim.org
5182
5183
5184
5185
5186
5187  (1523668724 270285540) [Msg] Waiting for master.
5188
5189  (1523668724 281101329) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5190
```

```
5191  (1523668724 281214173) [Msg] Publicized address: 10.0.2.15
5192
5193  (1523668724 637940322) Init world[grabbing_book_v]
5194
5195  (1523668734 634492699) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5196
5197  (1523668734 693902487) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
5198
5199  (1523668751 94437562) [Dbg] [TiltGrabPlugin.cc:137] made first joint
5200
5201  ************************************************************************************

5202
5203
5204
5205
5206
5207    133 :
5208
5209    grabbing_book6 :
5210
5211    book_on_shelf6 :
5212
5213  Gazebo multi-robot simulator, version 7.9.0
5214
5215  Copyright (C) 2012 Open Source Robotics Foundation.
5216
5217  Released under the Apache 2 License.
5218
5219  http://gazebosim.org
5220
5221
5222
5223
5224
5225  (1523668924 359554951) [Msg] Waiting for master.
5226
5227  (1523668924 360910075) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5228
5229  (1523668924 360989583) [Msg] Publicized address: 10.0.2.15
5230
5231  (1523668924 714697685) Init world[grabbing_book_v]
5232
5233  (1523668934 774415094) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
5234
5235  (1523668934 823449415) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5236
5237  (1523668951 122535082) [Dbg] [TiltGrabPlugin.cc:137] made first joint
5238
5239  (1523668955 842836085) [Dbg] [TiltGrabPlugin.cc:147] made second joints
5240
5241  (1523668961 608680721) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
5242
```

```
5243   **********************************************************************************


5244
5245
5246
5247
5248
5249   134 :

5250
5251   grabbing_book6 :

5252
5253   book_on_shelf6 :

5254
5255   Gazebo multi-robot simulator, version 7.9.0

5256
5257   Copyright (C) 2012 Open Source Robotics Foundation.

5258
5259   Released under the Apache 2 License.

5260
5261   http://gazebosim.org

5262
5263
5264
5265
5266
5267   (1523669124 743482290) [Msg] Waiting for master.

5268
5269   (1523669124 754026877) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

5270
5271   (1523669124 754159892) [Msg] Publicized address: 10.0.2.15

5272
5273   (1523669125 104711210) Init world[grabbing_book_v]

5274
5275   (1523669135 161015871) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point

5276
5277   (1523669135 207778353) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point

5278
5279   (1523669151 529170421) [Dbg] [TiltGrabPlugin.cc:137] made first joint

5280
5281   **********************************************************************************


5282
5283
5284
5285
5286
5287   135 :

5288
5289   grabbing_book6 :

5290
5291   book_on_shelf6 :

5292
5293   Gazebo multi-robot simulator, version 7.9.0

5294
5295   Copyright (C) 2012 Open Source Robotics Foundation.
```

```
(1523669325 67747679) [Msg] Waiting for master.

(1523669325 68871484) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523669325 68953830) [Msg] Publicized address: 10.0.2.15

(1523669325 420474278) Init world[grabbing_book_v]

(1523669335 456378354) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523669335 505839912) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523669351 779283728) [Dbg] [TiltGrabPlugin.cc:137] made first joint

(1523669356 406634994) [Dbg] [TiltGrabPlugin.cc:147] made second joints

(1523669362 42801098) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success

********************************************************************************
```

```
 136 :

 grabbing_book6 :

 book_on_shelf6 :
```

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

```
(1523669525 462085838) [Msg] Waiting for master.

(1523669525 463933052) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
```

```
5350
5351  (1523669525 464009804) [Msg] Publicized address: 10.0.2.15
5352
5353  (1523669525 817469712) Init world[grabbing_book_v]
5354
5355  (1523669535 991754443) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
5356
5357  (1523669536 43677512) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
5358
5359  (1523669552 325207919) [Dbg] [TiltGrabPlugin.cc:137] made first joint
5360
5361  ********************************************************************************

5362
5363
5364
5365
5366
5367    137 :
5368
5369   grabbing_book7 :
5370
5371   book_on_shelf6 :
5372
5373  Gazebo multi-robot simulator, version 7.9.0
5374
5375  Copyright (C) 2012 Open Source Robotics Foundation.
5376
5377  Released under the Apache 2 License.
5378
5379  http://gazebosim.org
5380
5381
5382
5383
5384
5385  (1523669725 747522702) [Msg] Waiting for master.
5386
5387  (1523669725 749206596) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5388
5389  (1523669725 749347824) [Msg] Publicized address: 10.0.2.15
5390
5391  (1523669726 96222195) Init world[grabbing_book_v]
5392
5393  (1523669736 254791987) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
5394
5395  (1523669736 324986085) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
5396
5397  ********************************************************************************

5398
5399
5400
```

```
5401
5402
5403    138 :
5404
5405   grabbing_book7 :
5406
5407   book_on_shelf6 :
5408
5409   Gazebo multi-robot simulator, version 7.9.0
5410
5411   Copyright (C) 2012 Open Source Robotics Foundation.
5412
5413   Released under the Apache 2 License.
5414
5415   http://gazebosim.org
5416
5417
5418
5419
5420
5421   (1523669926 115070694) [Msg] Waiting for master.
5422
5423   (1523669926 116881254) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5424
5425   (1523669926 116951499) [Msg] Publicized address: 10.0.2.15
5426
5427   (1523669926 467113087) Init world[grabbing_book_v]
5428
5429   (1523669936 698042087) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
5430
5431   (1523669936 746459071) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
5432
5433   ********************************************************************************

5434
5435
5436
5437
5438
5439    139 :
5440
5441   grabbing_book7 :
5442
5443   book_on_shelf6 :
5444
5445   Gazebo multi-robot simulator, version 7.9.0
5446
5447   Copyright (C) 2012 Open Source Robotics Foundation.
5448
5449   Released under the Apache 2 License.
5450
5451   http://gazebosim.org
5452
5453
5454
```

```
(1523670126 466087877) [Msg] Waiting for master.

(1523670126 468131817) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523670126 468202495) [Msg] Publicized address: 10.0.2.15

(1523670126 819447978) Init world[grabbing_book_v]

(1523670137 47259265) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523670137 89499920) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

*******************************************************************************




 140 :

 grabbing_book7 :

 book_on_shelf6 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523670326 805208929) [Msg] Waiting for master.

(1523670326 805649129) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523670326 805735974) [Msg] Publicized address: 10.0.2.15

(1523670327 152977427) Init world[grabbing_book_v]

(1523670337 293867944) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523670337 338702050) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

*******************************************************************************
```

```
 141 :

 grabbing_book7 :

 book_on_shelf6 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523670527 132071023) [Msg] Waiting for master.

(1523670527 132514187) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523670527 132583028) [Msg] Publicized address: 10.0.2.15

(1523670527 484243740) Init world[grabbing_book_v]

(1523670537 761860881) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523670537 820288639) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

*********************************************************************************



 142 :

 grabbing_book7 :

 book_on_shelf6 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org
```

```
5560
5561
5562
5563
5564
5565  (1523670727 462721760) [Msg] Waiting for master.
5566
5567  (1523670727 464081961) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5568
5569  (1523670727 464154515) [Msg] Publicized address: 10.0.2.15
5570
5571  (1523670727 812975845) Init world[grabbing_book_v]
5572
5573  (1523670738 92271759) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5574
5575  (1523670738 136388963) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
5576
5577  **********************************************************************************

5578
5579
5580
5581
5582
5583   143 :
5584
5585   grabbing_book7 :
5586
5587   book_on_shelf7 :
5588
5589  Gazebo multi-robot simulator, version 7.9.0
5590
5591  Copyright (C) 2012 Open Source Robotics Foundation.
5592
5593  Released under the Apache 2 License.
5594
5595  http://gazebosim.org
5596
5597
5598
5599
5600
5601  (1523670927 786105801) [Msg] Waiting for master.
5602
5603  (1523670927 786828245) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5604
5605  (1523670927 786896994) [Msg] Publicized address: 10.0.2.15
5606
5607  (1523670928 133721489) Init world[grabbing_book_v]
5608
5609  (1523670938 335603767) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5610
5611  (1523670938 391195166) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
```

```
5612
5613  (1523670955 365609548) [Dbg] [TiltGrabPlugin.cc:137] made first joint
5614
5615  *********************************************************************************

5616
5617
5618
5619
5620
5621    144 :
5622
5623   grabbing_book7 :
5624
5625   book_on_shelf7 :
5626
5627  Gazebo multi-robot simulator, version 7.9.0
5628
5629  Copyright (C) 2012 Open Source Robotics Foundation.
5630
5631  Released under the Apache 2 License.
5632
5633  http://gazebosim.org
5634
5635
5636
5637
5638
5639  (1523671128 130768003) [Msg] Waiting for master.
5640
5641  (1523671128 131246750) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5642
5643  (1523671128 131377623) [Msg] Publicized address: 10.0.2.15
5644
5645  (1523671128 486268251) Init world[grabbing_book_v]
5646
5647  (1523671138 771401260) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5648
5649  (1523671138 819828335) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
5650
5651  (1523671155 984808505) [Dbg] [TiltGrabPlugin.cc:137] made first joint
5652
5653  *********************************************************************************

5654
5655
5656
5657
5658
5659    145 :
5660
5661   grabbing_book7 :
5662
5663   book_on_shelf7 :
5664
```

618

```
5665   Gazebo multi-robot simulator, version 7.9.0
5666
5667   Copyright (C) 2012 Open Source Robotics Foundation.
5668
5669   Released under the Apache 2 License.
5670
5671   http://gazebosim.org
5672
5673
5674
5675
5676
5677   (1523671328 495689233) [Msg] Waiting for master.
5678
5679   (1523671328 496195424) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5680
5681   (1523671328 496273248) [Msg] Publicized address: 10.0.2.15
5682
5683   (1523671328 855977511) Init world[grabbing_book_v]
5684
5685   (1523671339 105025849) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
5686
5687   (1523671339 154712628) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
5688
5689   (1523671356 364294135) [Dbg] [TiltGrabPlugin.cc:137] made first joint
5690
5691   ********************************************************************************

5692
5693
5694
5695
5696
5697    146 :
5698
5699    grabbing_book7 :
5700
5701    book_on_shelf7 :
5702
5703   Gazebo multi-robot simulator, version 7.9.0
5704
5705   Copyright (C) 2012 Open Source Robotics Foundation.
5706
5707   Released under the Apache 2 License.
5708
5709   http://gazebosim.org
5710
5711
5712
5713
5714
5715   (1523671528 764137718) [Msg] Waiting for master.
5716
5717   (1523671528 765662698) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5718
```

```
5719  (1523671528 765755532) [Msg] Publicized address: 10.0.2.15
5720
5721  (1523671529 107152765) Init world[grabbing_book_v]
5722
5723  (1523671539 251303967) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
5724
5725  (1523671539 305555894) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5726
5727  (1523671556 284365719) [Dbg] [TiltGrabPlugin.cc:137] made first joint
5728
5729  **********************************************************************************

5730
5731
5732
5733
5734
5735    147 :
5736
5737   grabbing_book8 :
5738
5739   book_on_shelf7 :
5740
5741  Gazebo multi-robot simulator, version 7.9.0
5742
5743  Copyright (C) 2012 Open Source Robotics Foundation.
5744
5745  Released under the Apache 2 License.
5746
5747  http://gazebosim.org
5748
5749
5750
5751
5752
5753  (1523671729 87679422) [Msg] Waiting for master.
5754
5755  (1523671729 88130587) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5756
5757  (1523671729 88199279) [Msg] Publicized address: 10.0.2.15
5758
5759  (1523671729 441463635) Init world[grabbing_book_v]
5760
5761  (1523671739 580659010) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
5762
5763  (1523671739 634699331) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5764
5765  **********************************************************************************

5766
5767
5768
5769
```

```
148 :

grabbing_book8 :

book_on_shelf7 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523671929 430984029) [Msg] Waiting for master.

(1523671929 442048194) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523671929 442204067) [Msg] Publicized address: 10.0.2.15

(1523671929 796513380) Init world[grabbing_book_v]

(1523671939 805118714) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523671939 849126106) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

********************************************************************************




149 :

grabbing_book8 :

book_on_shelf7 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org


```

```
5824
5825  (1523672129 753672980) [Msg] Waiting for master.
5826
5827  (1523672129 754737732) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5828
5829  (1523672129 754825573) [Msg] Publicized address: 10.0.2.15
5830
5831  (1523672130 107361050) Init world[grabbing_book_v]
5832
5833  (1523672140 250687974) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
5834
5835  (1523672140 300850237) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
5836
5837  *******************************************************************************

5838
5839
5840
5841
5842
5843   0 :
5844
5845  Gazebo multi-robot simulator, version 7.9.0
5846
5847  Copyright (C) 2012 Open Source Robotics Foundation.
5848
5849  Released under the Apache 2 License.
5850
5851  http://gazebosim.org
5852
5853
5854
5855
5856
5857  (1523705173 664053289) [Msg] Waiting for master.
5858
5859  (1523705173 673212399) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5860
5861  (1523705173 673350346) [Msg] Publicized address: 10.0.2.15
5862
5863  (1523705174 97236199) Init world[grabbing_book_v]
5864
5865  (1523705184 116172632) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
5866
5867  (1523705184 175360762) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
5868
5869  (1523705201 355332900) [Dbg] [TiltGrabPlugin.cc:137] made first joint
5870
5871  (1523705203 425240017) [Dbg] [TiltGrabPlugin.cc:147] made second joints
5872
5873  (1523705204 96965781) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
5874
5875  *******************************************************************************
```

```
1 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523705374 86621898) [Msg] Waiting for master.

(1523705374 87857909) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523705374 87932565) [Msg] Publicized address: 10.0.2.15

(1523705374 526504764) Init world[grabbing_book_v]

(1523705384 529376270) [Dbg] [giskard_visualization_plugin.cpp:133] Created
     Marker: giskard_expressions/tool-point

(1523705384 625222071) [Dbg] [giskard_visualization_plugin.cpp:133] Created
     Marker: giskard_expressions/target-object-point

(1523705401 661040048) [Dbg] [TiltGrabPlugin.cc:137] made first joint

(1523705406 577558726) [Dbg] [TiltGrabPlugin.cc:147] made second joints

(1523705408 325446313) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success

*******************************************************************************




2 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org
```

```
5929
5930
5931
5932
5933  (1523705574 449484673) [Msg] Waiting for master.
5934
5935  (1523705574 450439353) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5936
5937  (1523705574 450508768) [Msg] Publicized address: 10.0.2.15
5938
5939  (1523705574 899646095) Init world[grabbing_book_v]
5940
5941  (1523705585 168208730) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5942
5943  (1523705585 220071158) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
5944
5945  (1523705601 879663362) [Dbg] [TiltGrabPlugin.cc:137] made first joint
5946
5947  (1523705603 513398712) [Dbg] [TiltGrabPlugin.cc:147] made second joints
5948
5949  (1523705608 200662209) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
5950
5951  ********************************************************************************

5952
5953
5954
5955
5956
5957   3 :
5958
5959  Gazebo multi-robot simulator, version 7.9.0
5960
5961  Copyright (C) 2012 Open Source Robotics Foundation.
5962
5963  Released under the Apache 2 License.
5964
5965  http://gazebosim.org
5966
5967
5968
5969
5970
5971  (1523705774 792507864) [Msg] Waiting for master.
5972
5973  (1523705774 793173474) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
5974
5975  (1523705774 793250106) [Msg] Publicized address: 10.0.2.15
5976
5977  (1523705775 223377522) Init world[grabbing_book_v]
5978
5979  (1523705785 426057558) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
5980
5981  (1523705785 474527821) [Dbg] [giskard_visualization_plugin.cpp:133] Created
```

```
              Marker : giskard_expressions / tool - point
5982
5983    (1523705802  274728368) [Dbg] [TiltGrabPlugin.cc:137] made first joint
5984
5985    ********************************************************************************

5986
5987
5988
5989
5990
5991     4 :
5992
5993    Gazebo multi - robot simulator , version 7.9.0
5994
5995    Copyright (C) 2012 Open Source Robotics Foundation .
5996
5997    Released under the Apache 2 License .
5998
5999    http :// gazebosim . org
6000
6001
6002
6003
6004
6005    (1523705975  203494231) [Msg] Waiting for master .
6006
6007    (1523705975  204127061) [Msg] Connected to gazebo master @ http :// 127 .0.0.1:11345
6008
6009    (1523705975  204206631) [Msg] Publicized address : 10.0.2.15
6010
6011    (1523705975  628899075) Init world [ grabbing_book_v ]
6012
6013    (1523705985  921393813) [Dbg] [giskard_visualization_plugin.cpp:133] Created
              Marker : giskard_expressions / tool - point
6014
6015    (1523705985  983428287) [Dbg] [giskard_visualization_plugin.cpp:133] Created
              Marker : giskard_expressions / target - object - point
6016
6017    (1523706002  564407001) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6018
6019    (1523706007  270592631) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6020
6021    (1523706012  717965589) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
6022
6023    ********************************************************************************

6024
6025
6026
6027
6028
6029     5 :
6030
6031    Gazebo multi - robot simulator , version 7.9.0
6032
6033    Copyright (C) 2012 Open Source Robotics Foundation .
```

```
6034
6035  Released under the Apache 2 License.
6036
6037  http://gazebosim.org
6038
6039
6040
6041
6042
6043  (1523706175 611107498) [Msg] Waiting for master.
6044
6045  (1523706175 612670669) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6046
6047  (1523706175 612809595) [Msg] Publicized address: 10.0.2.15
6048
6049  (1523706176 44225767) Init world[grabbing_book_v]
6050
6051  (1523706186 274460881) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
6052
6053  (1523706186 320550102) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
6054
6055  (1523706203 75135815) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6056
6057  (1523706205 43212471) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6058
6059  (1523706209 263977417) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
6060
6061  ************************************************************************************

6062
6063
6064
6065
6066
6067   6 :
6068
6069  Gazebo multi-robot simulator, version 7.9.0
6070
6071  Copyright (C) 2012 Open Source Robotics Foundation.
6072
6073  Released under the Apache 2 License.
6074
6075  http://gazebosim.org
6076
6077
6078
6079
6080
6081  (1523706375 981065396) [Msg] Waiting for master.
6082
6083  (1523706375 992110132) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6084
6085  (1523706375 992245502) [Msg] Publicized address: 10.0.2.15
6086
6087  (1523706376 445855656) Init world[grabbing_book_v]
```

```
6088
6089  (1523706386 732591822) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
6090
6091  (1523706386 784085457) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
6092
6093  (1523706403 385311110) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6094
6095  **********************************************************************************

6096
6097
6098
6099
6100
6101   7 :
6102
6103  Gazebo multi-robot simulator, version 7.9.0
6104
6105  Copyright (C) 2012 Open Source Robotics Foundation.
6106
6107  Released under the Apache 2 License.
6108
6109  http://gazebosim.org
6110
6111
6112
6113
6114
6115  (1523706576 408545920) [Msg] Waiting for master.
6116
6117  (1523706576 418945224) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6118
6119  (1523706576 419905697) [Msg] Publicized address: 10.0.2.15
6120
6121  (1523706576 866041316) Init world[grabbing_book_v]
6122
6123  (1523706587 19772583) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
6124
6125  (1523706587 70314947) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
6126
6127  (1523706603 563587144) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6128
6129  **********************************************************************************

6130
6131
6132
6133
6134
6135   8 :
6136
6137  Gazebo multi-robot simulator, version 7.9.0
6138
```

(1523706776 713277738) [Msg] Waiting for master.

(1523706776 715198839) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523706776 715275650) [Msg] Publicized address: 10.0.2.15

(1523706777 142845230) Init world[grabbing_book_v]

(1523706787 480472172) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523706787 537740884) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523706804 110039037) [Dbg] [TiltGrabPlugin.cc:137] made first joint

(1523706808 922440045) [Dbg] [TiltGrabPlugin.cc:147] made second joints

(1523706814 420046414) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success

****

  9 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org

(1523706977 171609084) [Msg] Waiting for master.

(1523706977 172955812) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523706977 173094709) [Msg] Publicized address: 10.0.2.15

```
6193   (1523706977 612145164) Init world[grabbing_book_v]
6194
6195   (1523706987 595302987) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
6196
6197   (1523706987 652469018) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
6198
6199   (1523707004 40706087) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6200
6201   (1523707005 826999199) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6202
6203   (1523707010 311029180) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
6204
6205   ********************************************************************************
6206
6207
6208
6209
6210
6211    10 :
6212
6213   Gazebo multi-robot simulator, version 7.9.0
6214
6215   Copyright (C) 2012 Open Source Robotics Foundation.
6216
6217   Released under the Apache 2 License.
6218
6219   http://gazebosim.org
6220
6221
6222
6223
6224
6225   (1523707177 532518854) [Msg] Waiting for master.
6226
6227   (1523707177 532994782) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6228
6229   (1523707177 533072328) [Msg] Publicized address: 10.0.2.15
6230
6231   (1523707177 964755191) Init world[grabbing_book_v]
6232
6233   (1523707187 940531890) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
6234
6235   (1523707188 6958811) [Dbg] [giskard_visualization_plugin.cpp:133] Created Marker
            : giskard_expressions/target-object-point
6236
6237   (1523707204 642296518) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6238
6239   (1523707209 537374634) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6240
6241   (1523707214 939635618) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
6242
6243   ********************************************************************************
```

```
11 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523707377 820061291) [Msg] Waiting for master.

(1523707377 821381635) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523707377 821453770) [Msg] Publicized address: 10.0.2.15

(1523707378 166362057) Init world[grabbing_book_v]

(1523707388 358491117) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523707388 422647541) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523707404 871639917) [Dbg] [TiltGrabPlugin.cc:137] made first joint

********************************************************************************


12 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523707578 211024832) [Msg] Waiting for master.
```

```
6298
6299  (1523707578 223941401) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6300
6301  (1523707578 224137921) [Msg] Publicized address: 10.0.2.15
6302
6303  (1523707578 593072587) Init world[grabbing_book_v]
6304
6305  (1523707588 843181906) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
6306
6307  (1523707588 935957656) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
6308
6309  (1523707605 631622970) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6310
6311  (1523707609 665109070) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6312
6313  *********************************************************************************

6314
6315
6316
6317
6318
6319   13 :
6320
6321  Gazebo multi-robot simulator, version 7.9.0
6322
6323  Copyright (C) 2012 Open Source Robotics Foundation.
6324
6325  Released under the Apache 2 License.
6326
6327  http://gazebosim.org
6328
6329
6330
6331
6332
6333  (1523707778 589249027) [Msg] Waiting for master.
6334
6335  (1523707778 589936660) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6336
6337  (1523707778 590020455) [Msg] Publicized address: 10.0.2.15
6338
6339  (1523707778 950374543) Init world[grabbing_book_v]
6340
6341  (1523707789 326346601) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
6342
6343  (1523707789 375238278) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
6344
6345  (1523707805 987795871) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6346
6347  *********************************************************************************

6348
```

```
  14 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523707978 911824300) [Msg] Waiting for master.

(1523707978 921181429) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523707978 921326276) [Msg] Publicized address: 10.0.2.15

(1523707979 296344560) Init world[grabbing_book_v]

(1523707989 548779843) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523707989 596631007) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523708006 32982437) [Dbg] [TiltGrabPlugin.cc:137] made first joint

********************************************************************************



  15 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523708179 274806790) [Msg] Waiting for master.
```

```
6403  (1523708179 284400034) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6404
6405  (1523708179 284875055) [Msg] Publicized address: 10.0.2.15
6406
6407  (1523708179 661337487) Init world[grabbing_book_v]
6408
6409  (1523708189 936302391) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
6410
6411  (1523708189 984872861) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
6412
6413  (1523708206 470159959) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6414
6415  ********************************************************************************

6416
6417
6418
6419
6420
6421   16 :
6422
6423  Gazebo multi-robot simulator, version 7.9.0
6424
6425  Copyright (C) 2012 Open Source Robotics Foundation.
6426
6427  Released under the Apache 2 License.
6428
6429  http://gazebosim.org
6430
6431
6432
6433
6434
6435  (1523708379 755784733) [Msg] Waiting for master.
6436
6437  (1523708379 765810632) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6438
6439  (1523708379 765938338) [Msg] Publicized address: 10.0.2.15
6440
6441  (1523708380 131966903) Init world[grabbing_book_v]
6442
6443  (1523708390 499848005) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
6444
6445  (1523708390 557704602) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
6446
6447  (1523708407 43306332) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6448
6449  ********************************************************************************

6450
6451
6452
6453
```

```
6454
6455    17 :
6456
6457   Gazebo multi-robot simulator, version 7.9.0
6458
6459   Copyright (C) 2012 Open Source Robotics Foundation.
6460
6461   Released under the Apache 2 License.
6462
6463   http://gazebosim.org
6464
6465
6466
6467
6468
6469   (1523708580 158047504) [Msg] Waiting for master.
6470
6471   (1523708580 158405466) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6472
6473   (1523708580 158482152) [Msg] Publicized address: 10.0.2.15
6474
6475   (1523708580 570892071) Init world[grabbing_book_v]
6476
6477   (1523708590 715103325) [Dbg] [giskard_visualization_plugin.cpp:133] Created
             Marker: giskard_expressions/tool-point
6478
6479   (1523708590 767987702) [Dbg] [giskard_visualization_plugin.cpp:133] Created
             Marker: giskard_expressions/target-object-point
6480
6481   (1523708607 212318172) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6482
6483   (1523708611 250102008) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6484
6485   ********************************************************************************

6486
6487
6488
6489
6490
6491    18 :
6492
6493   Gazebo multi-robot simulator, version 7.9.0
6494
6495   Copyright (C) 2012 Open Source Robotics Foundation.
6496
6497   Released under the Apache 2 License.
6498
6499   http://gazebosim.org
6500
6501
6502
6503
6504
6505   (1523708780 415934864) [Msg] Waiting for master.
6506
6507   (1523708780 417348111) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
```

```
6508
6509  (1523708780 417425354) [Msg] Publicized address: 10.0.2.15
6510
6511  (1523708780 769286161) Init world[grabbing_book_v]
6512
6513  (1523708790 972592054) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
6514
6515  (1523708791 37486558) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
6516
6517  (1523708807 434918095) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6518
6519  (1523708811 438318128) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6520
6521  *********************************************************************************
6522
6523
6524
6525
6526
6527   19 :
6528
6529  Gazebo multi-robot simulator, version 7.9.0
6530
6531  Copyright (C) 2012 Open Source Robotics Foundation.
6532
6533  Released under the Apache 2 License.
6534
6535  http://gazebosim.org
6536
6537
6538
6539
6540
6541  (1523708980 856097987) [Msg] Waiting for master.
6542
6543  (1523708980 864788613) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6544
6545  (1523708980 864926869) [Msg] Publicized address: 10.0.2.15
6546
6547  (1523708981 255348994) Init world[grabbing_book_v]
6548
6549  (1523708991 466139568) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
6550
6551  (1523708991 558885613) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
6552
6553  (1523709007 932362508) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6554
6555  (1523709011 938782413) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6556
6557  *********************************************************************************
6558
```

```
  20 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523709181 195993917) [Msg] Waiting for master.

(1523709181 197649779) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523709181 197731023) [Msg] Publicized address: 10.0.2.15

(1523709181 543481175) Init world[grabbing_book_v]

(1523709191 783929748) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523709191 864812911) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523709208 127429795) [Dbg] [TiltGrabPlugin.cc:137] made first joint

********************************************************************************


  21 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523709381 501062081) [Msg] Waiting for master.
```

```
6613  (1523709381 511813584) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6614
6615  (1523709381 511939591) [Msg] Publicized address: 10.0.2.15
6616
6617  (1523709381 876423079) Init world[grabbing_book_v]
6618
6619  (1523709392 252802092) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
6620
6621  (1523709392 308874966) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
6622
6623  (1523709408 662959693) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6624
6625  (1523709412 732488778) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6626
6627  (1523709416 589709089) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
6628
6629  **************************************************************************************


6630
6631
6632
6633
6634
6635   22 :
6636
6637  Gazebo multi-robot simulator, version 7.9.0
6638
6639  Copyright (C) 2012 Open Source Robotics Foundation.
6640
6641  Released under the Apache 2 License.
6642
6643  http://gazebosim.org
6644
6645
6646
6647
6648
6649  (1523709581 902192648) [Msg] Waiting for master.
6650
6651  (1523709581 902809195) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6652
6653  (1523709581 902900026) [Msg] Publicized address: 10.0.2.15
6654
6655  (1523709582 253478745) Init world[grabbing_book_v]
6656
6657  (1523709592 409474857) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
6658
6659  (1523709592 460623606) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
6660
6661  (1523709609 9816639) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6662
6663  **************************************************************************************
```

```
  23 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523709782 212345840) [Msg] Waiting for master.

(1523709782 212803658) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523709782 212876973) [Msg] Publicized address: 10.0.2.15

(1523709782 569325160) Init world[grabbing_book_v]

(1523709792 683160886) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523709792 729801968) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523709808 963481487) [Dbg] [TiltGrabPlugin.cc:137] made first joint

********************************************************************************


  24 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523709982 663828087) [Msg] Waiting for master.
```

```
6718
6719   (1523709982 665308616) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6720
6721   (1523709982 665382439) [Msg] Publicized address: 10.0.2.15
6722
6723   (1523709983 35291206) Init world[grabbing_book_v]
6724
6725   (1523709993 302635873) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
6726
6727   (1523709993 373182458) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
6728
6729   (1523710009 577216221) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6730
6731   *********************************************************************************

6732
6733
6734
6735
6736
6737    25 :
6738
6739   Gazebo multi-robot simulator, version 7.9.0
6740
6741   Copyright (C) 2012 Open Source Robotics Foundation.
6742
6743   Released under the Apache 2 License.
6744
6745   http://gazebosim.org
6746
6747
6748
6749
6750
6751   (1523710182 942396886) [Msg] Waiting for master.
6752
6753   (1523710182 942855838) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6754
6755   (1523710182 942934543) [Msg] Publicized address: 10.0.2.15
6756
6757   (1523710183 295092887) Init world[grabbing_book_v]
6758
6759   (1523710193 367422340) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
6760
6761   (1523710193 420445904) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
6762
6763   (1523710209 990508379) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6764
6765   (1523710214 128365431) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6766
6767   (1523710218 53272007) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
6768
6769   *********************************************************************************
```

```
  26 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523710383 264879334) [Msg] Waiting for master.

(1523710383 265301830) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523710383 265371254) [Msg] Publicized address: 10.0.2.15

(1523710383 625760213) Init world[grabbing_book_v]

(1523710393 881559675) [Dbg] [giskard_visualization_plugin.cpp:133] Created
      Marker: giskard_expressions/tool-point

(1523710393 935212619) [Dbg] [giskard_visualization_plugin.cpp:133] Created
      Marker: giskard_expressions/target-object-point

(1523710410 420568292) [Dbg] [TiltGrabPlugin.cc:137] made first joint

*********************************************************************************




  27 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org
```

```
6823  (1523710583 566705536) [Msg] Waiting for master.
6824
6825  (1523710583 567441672) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6826
6827  (1523710583 567517044) [Msg] Publicized address: 10.0.2.15
6828
6829  (1523710583 923798522) Init world[grabbing_book_v]
6830
6831  (1523710594 85211347) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
6832
6833  (1523710594 141273827) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
6834
6835  (1523710610 398951929) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6836
6837  ***********************************************************************************

6838
6839
6840
6841
6842
6843   28 :
6844
6845  Gazebo multi-robot simulator, version 7.9.0
6846
6847  Copyright (C) 2012 Open Source Robotics Foundation.
6848
6849  Released under the Apache 2 License.
6850
6851  http://gazebosim.org
6852
6853
6854
6855
6856
6857  (1523710783 888119795) [Msg] Waiting for master.
6858
6859  (1523710783 898899506) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6860
6861  (1523710783 899065299) [Msg] Publicized address: 10.0.2.15
6862
6863  (1523710784 249449993) Init world[grabbing_book_v]
6864
6865  (1523710794 438290108) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
6866
6867  (1523710794 506665269) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
6868
6869  (1523710810 953472971) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6870
6871  ***********************************************************************************

6872
6873
```

```
  29 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523710984 278151776) [Msg] Waiting for master.

(1523710984 278761905) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523710984 278830624) [Msg] Publicized address: 10.0.2.15

(1523710984 631835510) Init world[grabbing_book_v]

(1523710994 789303212) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523710994 849686270) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523711011 247544178) [Dbg] [TiltGrabPlugin.cc:137] made first joint

********************************************************************************




  30 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523711184 606178745) [Msg] Waiting for master.

(1523711184 617213338) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
```

```
6928
6929  (1523711184 617349770) [Msg] Publicized address: 10.0.2.15
6930
6931  (1523711184 979114630) Init world[grabbing_book_v]
6932
6933  (1523711195 121821859) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
6934
6935  (1523711195 179107131) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
6936
6937  (1523711211 427237335) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6938
6939  *****************************************************************************

6940
6941
6942
6943
6944
6945   31 :
6946
6947  Gazebo multi-robot simulator, version 7.9.0
6948
6949  Copyright (C) 2012 Open Source Robotics Foundation.
6950
6951  Released under the Apache 2 License.
6952
6953  http://gazebosim.org
6954
6955
6956
6957
6958
6959  (1523711384 944046088) [Msg] Waiting for master.
6960
6961  (1523711384 944507246) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
6962
6963  (1523711384 944595629) [Msg] Publicized address: 10.0.2.15
6964
6965  (1523711385 298118785) Init world[grabbing_book_v]
6966
6967  (1523711395 680503374) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
6968
6969  (1523711395 730944971) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
6970
6971  (1523711412 157426931) [Dbg] [TiltGrabPlugin.cc:137] made first joint
6972
6973  (1523711416 86135039) [Dbg] [TiltGrabPlugin.cc:147] made second joints
6974
6975  (1523711420 38323048) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
6976
6977  *****************************************************************************

6978
```

```
6979
6980
6981
6982
6983   32 :
6984
6985   Gazebo multi-robot simulator, version 7.9.0
6986
6987   Copyright (C) 2012 Open Source Robotics Foundation.
6988
6989   Released under the Apache 2 License.
6990
6991   http://gazebosim.org
6992
6993
6994
6995
6996
6997   (1523711585 323591335) [Msg] Waiting for master.
6998
6999   (1523711585 333472397) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7000
7001   (1523711585 333611449) [Msg] Publicized address: 10.0.2.15
7002
7003   (1523711585 690967234) Init world[grabbing_book_v]
7004
7005   (1523711595 978314816) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7006
7007   (1523711596 36791753) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7008
7009   (1523711612 310218861) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7010
7011   ********************************************************************************

7012
7013
7014
7015
7016
7017   33 :
7018
7019   Gazebo multi-robot simulator, version 7.9.0
7020
7021   Copyright (C) 2012 Open Source Robotics Foundation.
7022
7023   Released under the Apache 2 License.
7024
7025   http://gazebosim.org
7026
7027
7028
7029
7030
7031   (1523711785 662655755) [Msg] Waiting for master.
7032
```

```
7033  (1523711785 674327346) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7034
7035  (1523711785 674567490) [Msg] Publicized address: 10.0.2.15
7036
7037  (1523711786 30419107) Init world[grabbing_book_v]
7038
7039  (1523711796 318060097) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7040
7041  (1523711796 368521851) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7042
7043  (1523711812 804938971) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7044
7045  *******************************************************************************

7046
7047
7048
7049
7050
7051   34 :
7052
7053  Gazebo multi-robot simulator, version 7.9.0
7054
7055  Copyright (C) 2012 Open Source Robotics Foundation.
7056
7057  Released under the Apache 2 License.
7058
7059  http://gazebosim.org
7060
7061
7062
7063
7064
7065  (1523711986 13760529) [Msg] Waiting for master.
7066
7067  (1523711986 14245021) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7068
7069  (1523711986 14328590) [Msg] Publicized address: 10.0.2.15
7070
7071  (1523711986 375264826) Init world[grabbing_book_v]
7072
7073  (1523711996 644945436) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7074
7075  (1523711996 702625258) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7076
7077  (1523712013 178131494) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7078
7079  *******************************************************************************

7080
7081
7082
7083
```

```
7084
7085    35 :
7086
7087  Gazebo multi-robot simulator, version 7.9.0
7088
7089  Copyright (C) 2012 Open Source Robotics Foundation.
7090
7091  Released under the Apache 2 License.
7092
7093  http://gazebosim.org
7094
7095
7096
7097
7098
7099  (1523712186 270592904) [Msg] Waiting for master.
7100
7101  (1523712186 271222915) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7102
7103  (1523712186 271300401) [Msg] Publicized address: 10.0.2.15
7104
7105  (1523712186 633945637) Init world[grabbing_book_v]
7106
7107  (1523712197 34084745) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/tool-point
7108
7109  (1523712197 99577992) [Dbg] [giskard_visualization_plugin.cpp:133] Created
        Marker: giskard_expressions/target-object-point
7110
7111  (1523712213 812947708) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7112
7113  *********************************************************************************

7114
7115
7116
7117
7118
7119    36 :
7120
7121  Gazebo multi-robot simulator, version 7.9.0
7122
7123  Copyright (C) 2012 Open Source Robotics Foundation.
7124
7125  Released under the Apache 2 License.
7126
7127  http://gazebosim.org
7128
7129
7130
7131
7132
7133  (1523712386 809794697) [Msg] Waiting for master.
7134
7135  (1523712386 810508743) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7136
7137  (1523712386 810583506) [Msg] Publicized address: 10.0.2.15
```

```
7138
7139  (1523712387 201617511) Init world[grabbing_book_v]
7140
7141  (1523712397 180298498) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
7142
7143  (1523712397 229157210) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
7144
7145  (1523712413 900957187) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7146
7147  ********************************************************************************

7148
7149
7150
7151
7152
7153   37 :
7154
7155  Gazebo multi-robot simulator, version 7.9.0
7156
7157  Copyright (C) 2012 Open Source Robotics Foundation.
7158
7159  Released under the Apache 2 License.
7160
7161  http://gazebosim.org
7162
7163
7164
7165
7166
7167  (1523712587 14979593) [Msg] Waiting for master.
7168
7169  (1523712587 24918008) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7170
7171  (1523712587 25039335) [Msg] Publicized address: 10.0.2.15
7172
7173  (1523712587 376043761) Init world[grabbing_book_v]
7174
7175  (1523712597 672755865) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
7176
7177  (1523712597 719703444) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
7178
7179  (1523712614 144693072) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7180
7181  (1523712618 354591518) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7182
7183  ********************************************************************************

7184
7185
7186
7187
7188
```

```
7189    38 :
7190
7191   Gazebo multi-robot simulator, version 7.9.0
7192
7193   Copyright (C) 2012 Open Source Robotics Foundation.
7194
7195   Released under the Apache 2 License.
7196
7197   http://gazebosim.org
7198
7199
7200
7201
7202
7203   (1523712787 352962221) [Msg] Waiting for master.
7204
7205   (1523712787 353469941) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7206
7207   (1523712787 353617353) [Msg] Publicized address: 10.0.2.15
7208
7209   (1523712787 733209607) Init world[grabbing_book_v]
7210
7211   (1523712798 97659215) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
7212
7213   (1523712798 140914142) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
7214
7215   (1523712814 710748620) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7216
7217   ********************************************************************************

7218
7219
7220
7221
7222
7223    39 :
7224
7225   Gazebo multi-robot simulator, version 7.9.0
7226
7227   Copyright (C) 2012 Open Source Robotics Foundation.
7228
7229   Released under the Apache 2 License.
7230
7231   http://gazebosim.org
7232
7233
7234
7235
7236
7237   (1523712987 803130809) [Msg] Waiting for master.
7238
7239   (1523712987 803918022) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7240
7241   (1523712987 803994213) [Msg] Publicized address: 10.0.2.15
7242
```

```
7243  (1523712988 154826204) Init world[grabbing_book_v]
7244
7245  (1523712998 310942470) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7246
7247  (1523712998 360148440) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7248
7249  (1523713014 780654446) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7250
7251  (1523713018 934260961) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7252
7253  **********************************************************************************

7254
7255
7256
7257
7258
7259    40 :
7260
7261  Gazebo multi-robot simulator, version 7.9.0
7262
7263  Copyright (C) 2012 Open Source Robotics Foundation.
7264
7265  Released under the Apache 2 License.
7266
7267  http://gazebosim.org
7268
7269
7270
7271
7272
7273  (1523713188 215398345) [Msg] Waiting for master.
7274
7275  (1523713188 217002709) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7276
7277  (1523713188 217082815) [Msg] Publicized address: 10.0.2.15
7278
7279  (1523713188 573605912) Init world[grabbing_book_v]
7280
7281  (1523713198 672820638) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7282
7283  (1523713198 714511367) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7284
7285  (1523713215 194839120) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7286
7287  (1523713219 322108226) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7288
7289  **********************************************************************************

7290
7291
7292
7293
```

```
7294
7295   41 :
7296
7297  Gazebo multi-robot simulator, version 7.9.0
7298
7299  Copyright (C) 2012 Open Source Robotics Foundation.
7300
7301  Released under the Apache 2 License.
7302
7303  http://gazebosim.org
7304
7305
7306
7307
7308
7309  (1523713388 591236154) [Msg] Waiting for master.
7310
7311  (1523713388 592728728) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7312
7313  (1523713388 592801880) [Msg] Publicized address: 10.0.2.15
7314
7315  (1523713388 950621356) Init world[grabbing_book_v]
7316
7317  (1523713399 227735302) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7318
7319  (1523713399 275553203) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7320
7321  (1523713415 779058915) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7322
7323  ********************************************************************************

7324
7325
7326
7327
7328
7329   42 :
7330
7331  Gazebo multi-robot simulator, version 7.9.0
7332
7333  Copyright (C) 2012 Open Source Robotics Foundation.
7334
7335  Released under the Apache 2 License.
7336
7337  http://gazebosim.org
7338
7339
7340
7341
7342
7343  (1523713588 916593378) [Msg] Waiting for master.
7344
7345  (1523713588 917460838) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7346
7347  (1523713588 917533454) [Msg] Publicized address: 10.0.2.15
```

```
7348
7349  (1523713589 262410088) Init world[grabbing_book_v]
7350
7351  (1523713599 449015733) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
7352
7353  (1523713599 493565828) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
7354
7355  (1523713615 829435095) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7356
7357  (1523713619 954629883) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7358
7359  *********************************************************************************

7360
7361
7362
7363
7364
7365   43 :
7366
7367  Gazebo multi-robot simulator, version 7.9.0
7368
7369  Copyright (C) 2012 Open Source Robotics Foundation.
7370
7371  Released under the Apache 2 License.
7372
7373  http://gazebosim.org
7374
7375
7376
7377
7378
7379  (1523713789 282063056) [Msg] Waiting for master.
7380
7381  (1523713789 283849501) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7382
7383  (1523713789 283928839) [Msg] Publicized address: 10.0.2.15
7384
7385  (1523713789 633856282) Init world[grabbing_book_v]
7386
7387  (1523713799 808673648) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
7388
7389  (1523713799 878608441) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
7390
7391  (1523713816 292833237) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7392
7393  (1523713820 426373106) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7394
7395  *********************************************************************************

7396
7397
7398
```

```
7399
7400
7401   44 :
7402
7403  Gazebo multi-robot simulator, version 7.9.0
7404
7405  Copyright (C) 2012 Open Source Robotics Foundation.
7406
7407  Released under the Apache 2 License.
7408
7409  http://gazebosim.org
7410
7411
7412
7413
7414
7415  (1523713989 648336246) [Msg] Waiting for master.
7416
7417  (1523713989 659053797) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7418
7419  (1523713989 659178807) [Msg] Publicized address: 10.0.2.15
7420
7421  (1523713990 19407003) Init world[grabbing_book_v]
7422
7423  (1523714000 299601134) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7424
7425  (1523714000 353053102) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7426
7427  (1523714016 654765288) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7428
7429  (1523714021 210003349) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7430
7431  (1523714026 919320932) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
7432
7433  **********************************************************************************

7434
7435
7436
7437
7438
7439   45 :
7440
7441  Gazebo multi-robot simulator, version 7.9.0
7442
7443  Copyright (C) 2012 Open Source Robotics Foundation.
7444
7445  Released under the Apache 2 License.
7446
7447  http://gazebosim.org
7448
7449
7450
7451
7452
```

```
7453  (1523714190 43261178) [Msg] Waiting for master.
7454
7455  (1523714190 51117096) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7456
7457  (1523714190 51247082) [Msg] Publicized address: 10.0.2.15
7458
7459  (1523714190 423154856) Init world[grabbing_book_v]
7460
7461  (1523714200 601468518) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7462
7463  (1523714200 647881745) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7464
7465  (1523714216 976622320) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7466
7467  (1523714221 555215720) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7468
7469  (1523714227 152172944) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
7470
7471  **********************************************************************************

7472
7473
7474
7475
7476
7477   46 :
7478
7479  Gazebo multi-robot simulator, version 7.9.0
7480
7481  Copyright (C) 2012 Open Source Robotics Foundation.
7482
7483  Released under the Apache 2 License.
7484
7485  http://gazebosim.org
7486
7487
7488
7489
7490
7491  (1523714390 335196562) [Msg] Waiting for master.
7492
7493  (1523714390 335851881) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7494
7495  (1523714390 335924294) [Msg] Publicized address: 10.0.2.15
7496
7497  (1523714390 691410933) Init world[grabbing_book_v]
7498
7499  (1523714400 874470386) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7500
7501  (1523714400 938984945) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7502
7503  (1523714417 290163834) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7504
```

```
7505  (1523714421 822085329) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7506
7507  (1523714427 455750951) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
7508
7509  ********************************************************************************

7510
7511
7512
7513
7514
7515   47 :
7516
7517  Gazebo multi-robot simulator, version 7.9.0
7518
7519  Copyright (C) 2012 Open Source Robotics Foundation.
7520
7521  Released under the Apache 2 License.
7522
7523  http://gazebosim.org
7524
7525
7526
7527
7528
7529  (1523714590 652842494) [Msg] Waiting for master.
7530
7531  (1523714590 654427911) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7532
7533  (1523714590 654501314) [Msg] Publicized address: 10.0.2.15
7534
7535  (1523714591 16726214) Init world[grabbing_book_v]
7536
7537  (1523714601 198511920) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7538
7539  (1523714601 255311397) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7540
7541  (1523714617 772749106) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7542
7543  ********************************************************************************

7544
7545
7546
7547
7548
7549   48 :
7550
7551  Gazebo multi-robot simulator, version 7.9.0
7552
7553  Copyright (C) 2012 Open Source Robotics Foundation.
7554
7555  Released under the Apache 2 License.
7556
7557  http://gazebosim.org
```

```
7558
7559
7560
7561
7562
7563  (1523714791 52098326) [Msg] Waiting for master.
7564
7565  (1523714791 53937399) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7566
7567  (1523714791 54010635) [Msg] Publicized address: 10.0.2.15
7568
7569  (1523714791 402395390) Init world[grabbing_book_v]
7570
7571  (1523714801 572437562) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7572
7573  (1523714801 631458967) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7574
7575  (1523714818 1779310) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7576
7577  **************************************************************************************

7578
7579
7580
7581
7582
7583    49 :
7584
7585  Gazebo multi-robot simulator, version 7.9.0
7586
7587  Copyright (C) 2012 Open Source Robotics Foundation.
7588
7589  Released under the Apache 2 License.
7590
7591  http://gazebosim.org
7592
7593
7594
7595
7596
7597  (1523714991 826212083) [Msg] Waiting for master.
7598
7599  (1523714991 828503343) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7600
7601  (1523714991 828629997) [Msg] Publicized address: 10.0.2.15
7602
7603  (1523714992 187792295) Init world[grabbing_book_v]
7604
7605  (1523715002 523622402) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7606
7607  (1523715002 582173517) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7608
7609  (1523715019 69531121) [Dbg] [TiltGrabPlugin.cc:137] made first joint
```

```
7610
7611  (1523715023 691122785) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7612
7613  (1523715029 329480707) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
7614
7615  ********************************************************************************

7616
7617
7618
7619
7620
7621   50 :
7622
7623  Gazebo multi-robot simulator, version 7.9.0
7624
7625  Copyright (C) 2012 Open Source Robotics Foundation.
7626
7627  Released under the Apache 2 License.
7628
7629  http://gazebosim.org
7630
7631
7632
7633
7634
7635  (1523715192 278462716) [Msg] Waiting for master.
7636
7637  (1523715192 288740109) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7638
7639  (1523715192 288855826) [Msg] Publicized address: 10.0.2.15
7640
7641  (1523715192 660933948) Init world[grabbing_book_v]
7642
7643  (1523715203 149702314) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7644
7645  (1523715203 213097664) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7646
7647  (1523715219 801876730) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7648
7649  ********************************************************************************

7650
7651
7652
7653
7654
7655   51 :
7656
7657  Gazebo multi-robot simulator, version 7.9.0
7658
7659  Copyright (C) 2012 Open Source Robotics Foundation.
7660
7661  Released under the Apache 2 License.
7662
```

```
7663  http://gazebosim.org
7664
7665
7666
7667
7668
7669  (1523715392 652830732) [Msg] Waiting for master.
7670
7671  (1523715392 654978817) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7672
7673  (1523715392 655062665) [Msg] Publicized address: 10.0.2.15
7674
7675  (1523715393 5573963) Init world[grabbing_book_v]
7676
7677  (1523715403 183761013) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7678
7679  (1523715403 237018037) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7680
7681  (1523715419 423472672) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7682
7683  (1523715424 49942276) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7684
7685  (1523715429 706094595) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
7686
7687  ****************************************************************************************

7688
7689
7690
7691
7692
7693   52 :
7694
7695  Gazebo multi-robot simulator, version 7.9.0
7696
7697  Copyright (C) 2012 Open Source Robotics Foundation.
7698
7699  Released under the Apache 2 License.
7700
7701  http://gazebosim.org
7702
7703
7704
7705
7706
7707  (1523715593 91168604) [Msg] Waiting for master.
7708
7709  (1523715593 99013769) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7710
7711  (1523715593 99132339) [Msg] Publicized address: 10.0.2.15
7712
7713  (1523715593 489211263) Init world[grabbing_book_v]
7714
7715  (1523715603 742275201) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
```

```
7716
7717   (1523715603 792717904) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
7718
7719   (1523715620 279179245) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7720
7721   (1523715624 994914022) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7722
7723   (1523715627 36884126) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
7724
7725   *******************************************************************************

7726
7727
7728
7729
7730
7731    53 :
7732
7733   Gazebo multi-robot simulator, version 7.9.0
7734
7735   Copyright (C) 2012 Open Source Robotics Foundation.
7736
7737   Released under the Apache 2 License.
7738
7739   http://gazebosim.org
7740
7741
7742
7743
7744
7745   (1523715793 318100359) [Msg] Waiting for master.
7746
7747   (1523715793 318561993) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7748
7749   (1523715793 318638030) [Msg] Publicized address: 10.0.2.15
7750
7751   (1523715793 677623342) Init world[grabbing_book_v]
7752
7753   (1523715803 832925432) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
7754
7755   (1523715803 889700603) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
7756
7757   (1523715820 242621819) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7758
7759   (1523715824 994419089) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7760
7761   (1523715826 989505360) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
7762
7763   *******************************************************************************

7764
7765
7766
7767
```

```
7768
7769    54 :
7770
7771   Gazebo multi-robot simulator, version 7.9.0
7772
7773   Copyright (C) 2012 Open Source Robotics Foundation.
7774
7775   Released under the Apache 2 License.
7776
7777   http://gazebosim.org
7778
7779
7780
7781
7782
7783   (1523715993 634982493) [Msg] Waiting for master.
7784
7785   (1523715993 645137133) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7786
7787   (1523715993 645518068) [Msg] Publicized address: 10.0.2.15
7788
7789   (1523715994 1424443) Init world[grabbing_book_v]
7790
7791   (1523716004 271386417) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7792
7793   (1523716004 323935901) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7794
7795   (1523716020 639895741) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7796
7797   (1523716025 219319224) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7798
7799   (1523716030 896129417) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
7800
7801   *********************************************************************************

7802
7803
7804
7805
7806
7807    55 :
7808
7809   Gazebo multi-robot simulator, version 7.9.0
7810
7811   Copyright (C) 2012 Open Source Robotics Foundation.
7812
7813   Released under the Apache 2 License.
7814
7815   http://gazebosim.org
7816
7817
7818
7819
7820
7821   (1523716193 975928963) [Msg] Waiting for master.
```

```
7822
7823  (1523716193 977054911) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7824
7825  (1523716193 977124500) [Msg] Publicized address: 10.0.2.15
7826
7827  (1523716194 347293894) Init world[grabbing_book_v]
7828
7829  (1523716204 632666374) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7830
7831  (1523716204 691857669) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7832
7833  (1523716221 149479260) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7834
7835  ********************************************************************************

7836
7837
7838
7839
7840
7841   56 :
7842
7843  Gazebo multi-robot simulator, version 7.9.0
7844
7845  Copyright (C) 2012 Open Source Robotics Foundation.
7846
7847  Released under the Apache 2 License.
7848
7849  http://gazebosim.org
7850
7851
7852
7853
7854
7855  (1523716394 308927736) [Msg] Waiting for master.
7856
7857  (1523716394 318752419) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7858
7859  (1523716394 318850416) [Msg] Publicized address: 10.0.2.15
7860
7861  (1523716394 693902588) Init world[grabbing_book_v]
7862
7863  (1523716404 858824559) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7864
7865  (1523716404 910478257) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7866
7867  (1523716421 365678444) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7868
7869  ********************************************************************************

7870
7871
7872
```

```
7873
7874
7875   57 :
7876
7877  Gazebo multi-robot simulator, version 7.9.0
7878
7879  Copyright (C) 2012 Open Source Robotics Foundation.
7880
7881  Released under the Apache 2 License.
7882
7883  http://gazebosim.org
7884
7885
7886
7887
7888
7889  (1523716594 804445801) [Msg] Waiting for master.
7890
7891  (1523716594 836651267) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7892
7893  (1523716594 837612435) [Msg] Publicized address: 10.0.2.15
7894
7895  (1523716595 211227611) Init world[grabbing_book_v]
7896
7897  (1523716605 381790713) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7898
7899  (1523716605 426741200) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7900
7901  (1523716621 690742148) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7902
7903  (1523716626 295794278) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7904
7905  (1523716632 50850552) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
7906
7907  **********************************************************************************
7908
7909
7910
7911
7912
7913   58 :
7914
7915  Gazebo multi-robot simulator, version 7.9.0
7916
7917  Copyright (C) 2012 Open Source Robotics Foundation.
7918
7919  Released under the Apache 2 License.
7920
7921  http://gazebosim.org
7922
7923
7924
7925
7926
```

```
7927  (1523716795 281286885) [Msg] Waiting for master.
7928
7929  (1523716795 283404939) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7930
7931  (1523716795 283538860) [Msg] Publicized address: 10.0.2.15
7932
7933  (1523716795 654490434) Init world[grabbing_book_v]
7934
7935  (1523716805 845218773) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7936
7937  (1523716805 929096860) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7938
7939  (1523716822 467338534) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7940
7941  (1523716827 236566474) [Dbg] [TiltGrabPlugin.cc:147] made second joints
7942
7943  (1523716829 381985125) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
7944
7945  ********************************************************************************

7946
7947
7948
7949
7950
7951   59 :
7952
7953  Gazebo multi-robot simulator, version 7.9.0
7954
7955  Copyright (C) 2012 Open Source Robotics Foundation.
7956
7957  Released under the Apache 2 License.
7958
7959  http://gazebosim.org
7960
7961
7962
7963
7964
7965  (1523716995 607788679) [Msg] Waiting for master.
7966
7967  (1523716995 609242505) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
7968
7969  (1523716995 609316179) [Msg] Publicized address: 10.0.2.15
7970
7971  (1523716995 964037164) Init world[grabbing_book_v]
7972
7973  (1523717006 62624385) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
7974
7975  (1523717006 126714347) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
7976
7977  (1523717022 491061254) [Dbg] [TiltGrabPlugin.cc:137] made first joint
7978
```

```
7979  ********************************************************************************

7980
7981
7982
7983
7984
7985   60 :
7986
7987  Gazebo multi-robot simulator, version 7.9.0
7988
7989  Copyright (C) 2012 Open Source Robotics Foundation.
7990
7991  Released under the Apache 2 License.
7992
7993  http://gazebosim.org
7994
7995
7996
7997
7998
7999  (1523717195 991244140) [Msg] Waiting for master.
8000
8001  (1523717195 991917459) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8002
8003  (1523717195 992008203) [Msg] Publicized address: 10.0.2.15
8004
8005  (1523717196 339189274) Init world[grabbing_book_v]
8006
8007  (1523717206 607165245) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
8008
8009  (1523717206 659262718) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
8010
8011  (1523717223 19987413) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8012
8013  (1523717227 848083603) [Dbg] [TiltGrabPlugin.cc:147] made second joints
8014
8015  (1523717233 704778817) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
8016
8017  ********************************************************************************

8018
8019
8020
8021
8022
8023   61 :
8024
8025  Gazebo multi-robot simulator, version 7.9.0
8026
8027  Copyright (C) 2012 Open Source Robotics Foundation.
8028
8029  Released under the Apache 2 License.
8030
8031  http://gazebosim.org
```

```
8032
8033
8034
8035
8036
8037   (1523717396 369832361) [Msg] Waiting for master.
8038
8039   (1523717396 370429222) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8040
8041   (1523717396 370498422) [Msg] Publicized address: 10.0.2.15
8042
8043   (1523717396 726598550) Init world[grabbing_book_v]
8044
8045   (1523717406 937369157) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
8046
8047   (1523717407 11491964) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
8048
8049   (1523717423 475291478) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8050
8051   ****************************************************************************************

8052
8053
8054
8055
8056
8057    62 :
8058
8059   Gazebo multi-robot simulator, version 7.9.0
8060
8061   Copyright (C) 2012 Open Source Robotics Foundation.
8062
8063   Released under the Apache 2 License.
8064
8065   http://gazebosim.org
8066
8067
8068
8069
8070
8071   (1523717596 764234694) [Msg] Waiting for master.
8072
8073   (1523717596 766522585) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8074
8075   (1523717596 766607188) [Msg] Publicized address: 10.0.2.15
8076
8077   (1523717597 125545918) Init world[grabbing_book_v]
8078
8079   (1523717607 471183486) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
8080
8081   (1523717607 546329841) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
8082
8083   (1523717623 852962328) [Dbg] [TiltGrabPlugin.cc:137] made first joint
```

```
8084
8085  ********************************************************************************

8086
8087
8088
8089
8090
8091   63 :

8092
8093  Gazebo multi-robot simulator, version 7.9.0

8094
8095  Copyright (C) 2012 Open Source Robotics Foundation.

8096
8097  Released under the Apache 2 License.

8098
8099  http://gazebosim.org

8100
8101
8102
8103
8104
8105  (1523717797 256242565) [Msg] Waiting for master.

8106
8107  (1523717797 256958531) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

8108
8109  (1523717797 257037152) [Msg] Publicized address: 10.0.2.15

8110
8111  (1523717797 607566117) Init world[grabbing_book_v]

8112
8113  (1523717807 801221881) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point

8114
8115  (1523717807 849892573) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point

8116
8117  (1523717824 142161755) [Dbg] [TiltGrabPlugin.cc:137] made first joint

8118
8119  (1523717828 957350016) [Dbg] [TiltGrabPlugin.cc:147] made second joints

8120
8121  (1523717831 78963667) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success

8122
8123  ********************************************************************************

8124
8125
8126
8127
8128
8129   64 :

8130
8131  Gazebo multi-robot simulator, version 7.9.0

8132
8133  Copyright (C) 2012 Open Source Robotics Foundation.

8134
8135  Released under the Apache 2 License.

8136
```

```
8137  http://gazebosim.org
8138
8139
8140
8141
8142
8143  (1523717997 475529314) [Msg] Waiting for master.
8144
8145  (1523717997 477211177) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8146
8147  (1523717997 477281571) [Msg] Publicized address: 10.0.2.15
8148
8149  (1523717997 827539763) Init world[grabbing_book_v]
8150
8151  (1523718008 117710473) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
8152
8153  (1523718008 160827600) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
8154
8155  (1523718024 562903969) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8156
8157  (1523718029 139134841) [Dbg] [TiltGrabPlugin.cc:147] made second joints
8158
8159  (1523718034 925451241) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
8160
8161  *****************************************************************************

8162
8163
8164
8165
8166
8167   65 :
8168
8169  Gazebo multi-robot simulator, version 7.9.0
8170
8171  Copyright (C) 2012 Open Source Robotics Foundation.
8172
8173  Released under the Apache 2 License.
8174
8175  http://gazebosim.org
8176
8177
8178
8179
8180
8181  (1523718197 920102494) [Msg] Waiting for master.
8182
8183  (1523718197 922004075) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8184
8185  (1523718197 922081569) [Msg] Publicized address: 10.0.2.15
8186
8187  (1523718198 280926352) Init world[grabbing_book_v]
8188
8189  (1523718208 529578700) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
```

```
8190
8191   (1523718208 575447701) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
8192
8193   (1523718224 918306678) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8194
8195   ********************************************************************************

8196
8197
8198
8199
8200
8201    66 :
8202
8203   Gazebo multi-robot simulator, version 7.9.0
8204
8205   Copyright (C) 2012 Open Source Robotics Foundation.
8206
8207   Released under the Apache 2 License.
8208
8209   http://gazebosim.org
8210
8211
8212
8213
8214
8215   (1523718398 241740513) [Msg] Waiting for master.
8216
8217   (1523718398 243341374) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8218
8219   (1523718398 243411378) [Msg] Publicized address: 10.0.2.15
8220
8221   (1523718398 592961718) Init world[grabbing_book_v]
8222
8223   (1523718408 809047094) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
8224
8225   (1523718408 878726189) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
8226
8227   (1523718425 867267543) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8228
8229   ********************************************************************************

8230
8231
8232
8233
8234
8235    67 :
8236
8237   Gazebo multi-robot simulator, version 7.9.0
8238
8239   Copyright (C) 2012 Open Source Robotics Foundation.
8240
8241   Released under the Apache 2 License.
```

```
http://gazebosim.org




(1523718598 681071764) [Msg] Waiting for master.

(1523718598 681590398) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523718598 681670395) [Msg] Publicized address: 10.0.2.15

(1523718599 41190048) Init world[grabbing_book_v]

(1523718609 284336320) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523718609 331830326) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523718626 446411160) [Dbg] [TiltGrabPlugin.cc:137] made first joint

***************************************************************************************




 68 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523718799 38370854) [Msg] Waiting for master.

(1523718799 39399665) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523718799 39482387) [Msg] Publicized address: 10.0.2.15

(1523718799 392964387) Init world[grabbing_book_v]

(1523718809 656321954) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

(1523718809 718401616) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point
```

```
8294
8295   (1523718826 681010715) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8296
8297   ********************************************************************************

8298
8299
8300
8301
8302
8303    69 :
8304
8305   Gazebo multi-robot simulator, version 7.9.0
8306
8307   Copyright (C) 2012 Open Source Robotics Foundation.
8308
8309   Released under the Apache 2 License.
8310
8311   http://gazebosim.org
8312
8313
8314
8315
8316
8317   (1523718999 344790164) [Msg] Waiting for master.
8318
8319   (1523718999 345361194) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8320
8321   (1523718999 345504174) [Msg] Publicized address: 10.0.2.15
8322
8323   (1523718999 693170354) Init world[grabbing_book_v]
8324
8325   (1523719009 937816946) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
8326
8327   (1523719009 982230862) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
8328
8329   (1523719027 114467144) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8330
8331   (1523719031 789333945) [Dbg] [TiltGrabPlugin.cc:147] made second joints
8332
8333   (1523719037 620260434) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
8334
8335   ********************************************************************************

8336
8337
8338
8339
8340
8341    70 :
8342
8343   Gazebo multi-robot simulator, version 7.9.0
8344
8345   Copyright (C) 2012 Open Source Robotics Foundation.
8346
```

```
8347  Released under the Apache 2 License.
8348
8349  http://gazebosim.org
8350
8351
8352
8353
8354
8355  (1523719199 686629940) [Msg] Waiting for master.
8356
8357  (1523719199 697280181) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8358
8359  (1523719199 697390230) [Msg] Publicized address: 10.0.2.15
8360
8361  (1523719200 73075943) Init world[grabbing_book_v]
8362
8363  (1523719210 188908350) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
8364
8365  (1523719210 244613947) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
8366
8367  (1523719227 362726509) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8368
8369  (1523719231 984459781) [Dbg] [TiltGrabPlugin.cc:147] made second joints
8370
8371  (1523719234 256724002) [Dbg] [TiltGrabPlugin.cc:156] Experiment Success
8372
8373  *******************************************************************************

8374
8375
8376
8377
8378
8379   71 :
8380
8381  Gazebo multi-robot simulator, version 7.9.0
8382
8383  Copyright (C) 2012 Open Source Robotics Foundation.
8384
8385  Released under the Apache 2 License.
8386
8387  http://gazebosim.org
8388
8389
8390
8391
8392
8393  (1523719400 68330999) [Msg] Waiting for master.
8394
8395  (1523719400 69417319) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8396
8397  (1523719400 69494665) [Msg] Publicized address: 10.0.2.15
8398
8399  (1523719400 425322515) Init world[grabbing_book_v]
8400
```

```
8401  (1523719410 674299177) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
8402
8403  (1523719410 717112785) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
8404
8405  (1523719427 850057318) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8406
8407  ********************************************************************************

8408
8409
8410
8411
8412
8413   72 :
8414
8415  Gazebo multi-robot simulator, version 7.9.0
8416
8417  Copyright (C) 2012 Open Source Robotics Foundation.
8418
8419  Released under the Apache 2 License.
8420
8421  http://gazebosim.org
8422
8423
8424
8425
8426
8427  (1523719600 414476821) [Msg] Waiting for master.
8428
8429  (1523719600 426055256) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8430
8431  (1523719600 426487880) [Msg] Publicized address: 10.0.2.15
8432
8433  (1523719600 788367392) Init world[grabbing_book_v]
8434
8435  (1523719611 49980131) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
8436
8437  (1523719611 99781627) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
8438
8439  (1523719628 199586561) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8440
8441  ********************************************************************************

8442
8443
8444
8445
8446
8447   73 :
8448
8449  Gazebo multi-robot simulator, version 7.9.0
8450
8451  Copyright (C) 2012 Open Source Robotics Foundation.
```

```
8452
8453   Released under the Apache 2 License.
8454
8455   http://gazebosim.org
8456
8457
8458
8459
8460
8461   (1523719800 798351800) [Msg] Waiting for master.
8462
8463   (1523719800 798906765) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8464
8465   (1523719800 799000166) [Msg] Publicized address: 10.0.2.15
8466
8467   (1523719801 154577859) Init world[grabbing_book_v]
8468
8469   (1523719811 378516298) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
8470
8471   (1523719811 423138246) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
8472
8473   (1523719828 505508971) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8474
8475   ********************************************************************************

8476
8477
8478
8479
8480
8481    74 :
8482
8483   Gazebo multi-robot simulator, version 7.9.0
8484
8485   Copyright (C) 2012 Open Source Robotics Foundation.
8486
8487   Released under the Apache 2 License.
8488
8489   http://gazebosim.org
8490
8491
8492
8493
8494
8495   (1523720001 98129426) [Msg] Waiting for master.
8496
8497   (1523720001 98684778) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8498
8499   (1523720001 98889707) [Msg] Publicized address: 10.0.2.15
8500
8501   (1523720001 468756255) Init world[grabbing_book_v]
8502
8503   (1523720011 957070106) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
8504
```

```
8505  (1523720012 7422489) [Dbg] [giskard_visualization_plugin.cpp:133] Created Marker
         : giskard_expressions/tool-point
8506
8507  (1523720029 119084138) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8508
8509  ********************************************************************************

8510
8511
8512
8513
8514
8515   75 :
8516
8517  Gazebo multi-robot simulator, version 7.9.0
8518
8519  Copyright (C) 2012 Open Source Robotics Foundation.
8520
8521  Released under the Apache 2 License.
8522
8523  http://gazebosim.org
8524
8525
8526
8527
8528
8529  (1523720201 622148194) [Msg] Waiting for master.
8530
8531  (1523720201 633356624) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8532
8533  (1523720201 633495668) [Msg] Publicized address: 10.0.2.15
8534
8535  (1523720202 27379537) Init world[grabbing_book_v]
8536
8537  (1523720212 361876626) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/target-object-point
8538
8539  (1523720212 436665973) [Dbg] [giskard_visualization_plugin.cpp:133] Created
         Marker: giskard_expressions/tool-point
8540
8541  (1523720229 688351972) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8542
8543  ********************************************************************************

8544
8545
8546
8547
8548
8549   76 :
8550
8551  Gazebo multi-robot simulator, version 7.9.0
8552
8553  Copyright (C) 2012 Open Source Robotics Foundation.
8554
8555  Released under the Apache 2 License.
8556
```

```
8557    http://gazebosim.org
8558
8559
8560
8561
8562
8563    (1523720401 984584304) [Msg] Waiting for master.
8564
8565    (1523720401 985468235) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8566
8567    (1523720401 985539296) [Msg] Publicized address: 10.0.2.15
8568
8569    (1523720402 338474056) Init world[grabbing_book_v]
8570
8571    (1523720412 515921423) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
8572
8573    (1523720412 587771134) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/target-object-point
8574
8575    (1523720429 895725410) [Dbg] [TiltGrabPlugin.cc:137] made first joint
8576
8577    **************************************************************************************

8578
8579
8580
8581
8582
8583     77 :
8584
8585    Gazebo multi-robot simulator, version 7.9.0
8586
8587    Copyright (C) 2012 Open Source Robotics Foundation.
8588
8589    Released under the Apache 2 License.
8590
8591    http://gazebosim.org
8592
8593
8594
8595
8596
8597    (1523720602 378039847) [Msg] Waiting for master.
8598
8599    (1523720602 379250830) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8600
8601    (1523720602 379319828) [Msg] Publicized address: 10.0.2.15
8602
8603    (1523720602 732388947) Init world[grabbing_book_v]
8604
8605    (1523720613 8589117) [Dbg] [giskard_visualization_plugin.cpp:133] Created Marker
            : giskard_expressions/target-object-point
8606
8607    (1523720613 56734434) [Dbg] [giskard_visualization_plugin.cpp:133] Created
            Marker: giskard_expressions/tool-point
8608
```

```
8609    ********************************************************************************
8610
8611
8612
8613
8614
8615     78 :
8616
8617    Gazebo multi-robot simulator, version 7.9.0
8618
8619    Copyright (C) 2012 Open Source Robotics Foundation.
8620
8621    Released under the Apache 2 License.
8622
8623    http://gazebosim.org
8624
8625
8626
8627
8628
8629    (1523720802 760156925) [Msg] Waiting for master.
8630
8631    (1523720802 760808239) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8632
8633    (1523720802 760904687) [Msg] Publicized address: 10.0.2.15
8634
8635    (1523720803 126367047) Init world[grabbing_book_v]
8636
8637    (1523720813 199101465) [Dbg] [giskard_visualization_plugin.cpp:133] Created
             Marker: giskard_expressions/tool-point
8638
8639    (1523720813 273523180) [Dbg] [giskard_visualization_plugin.cpp:133] Created
             Marker: giskard_expressions/target-object-point
8640
8641    ********************************************************************************
8642
8643
8644
8645
8646
8647     79 :
8648
8649    Gazebo multi-robot simulator, version 7.9.0
8650
8651    Copyright (C) 2012 Open Source Robotics Foundation.
8652
8653    Released under the Apache 2 License.
8654
8655    http://gazebosim.org
8656
8657
8658
8659
8660
8661    (1523721003 104115712) [Msg] Waiting for master.
```

```
8662
8663   (1523721003 104739048) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8664
8665   (1523721003 104807803) [Msg] Publicized address: 10.0.2.15
8666
8667   (1523721003 469902022) Init world[grabbing_book_v]
8668
8669   (1523721013 742910052) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
8670
8671   (1523721013 800501263) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
8672
8673   ************************************************************************************

8674
8675
8676
8677
8678
8679    80 :
8680
8681   Gazebo multi-robot simulator, version 7.9.0
8682
8683   Copyright (C) 2012 Open Source Robotics Foundation.
8684
8685   Released under the Apache 2 License.
8686
8687   http://gazebosim.org
8688
8689
8690
8691
8692
8693   (1523721203 477801227) [Msg] Waiting for master.
8694
8695   (1523721203 484520546) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8696
8697   (1523721203 484626143) [Msg] Publicized address: 10.0.2.15
8698
8699   (1523721203 852686668) Init world[grabbing_book_v]
8700
8701   (1523721214 193616312) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
8702
8703   (1523721214 265815870) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
8704
8705   ************************************************************************************

8706
8707
8708
8709
8710
8711    81 :
8712
```

```
8713  Gazebo multi-robot simulator, version 7.9.0
8714
8715  Copyright (C) 2012 Open Source Robotics Foundation.
8716
8717  Released under the Apache 2 License.
8718
8719  http://gazebosim.org
8720
8721
8722
8723
8724
8725  (1523721403 837741509) [Msg] Waiting for master.
8726
8727  (1523721403 838522690) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8728
8729  (1523721403 838596727) [Msg] Publicized address: 10.0.2.15
8730
8731  (1523721404 197615720) Init world[grabbing_book_v]
8732
8733  (1523721414 475892477) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
8734
8735  (1523721414 541567053) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
8736
8737  *********************************************************************************

8738
8739
8740
8741
8742
8743   82 :
8744
8745  Gazebo multi-robot simulator, version 7.9.0
8746
8747  Copyright (C) 2012 Open Source Robotics Foundation.
8748
8749  Released under the Apache 2 License.
8750
8751  http://gazebosim.org
8752
8753
8754
8755
8756
8757  (1523721604 252014592) [Msg] Waiting for master.
8758
8759  (1523721604 263482142) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8760
8761  (1523721604 263598422) [Msg] Publicized address: 10.0.2.15
8762
8763  (1523721604 617484909) Init world[grabbing_book_v]
8764
8765  (1523721614 884633281) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
```

```
8766
8767  (1523721614 930732457) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
8768
8769  ********************************************************************************

8770
8771
8772
8773
8774
8775   83 :
8776
8777  Gazebo multi-robot simulator, version 7.9.0
8778
8779  Copyright (C) 2012 Open Source Robotics Foundation.
8780
8781  Released under the Apache 2 License.
8782
8783  http://gazebosim.org
8784
8785
8786
8787
8788
8789  (1523721804 583044717) [Msg] Waiting for master.
8790
8791  (1523721804 594106461) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8792
8793  (1523721804 594214617) [Msg] Publicized address: 10.0.2.15
8794
8795  (1523721804 963466079) Init world[grabbing_book_v]
8796
8797  (1523721815 244801380) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
8798
8799  (1523721815 321293725) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
8800
8801  ********************************************************************************

8802
8803
8804
8805
8806
8807   84 :
8808
8809  Gazebo multi-robot simulator, version 7.9.0
8810
8811  Copyright (C) 2012 Open Source Robotics Foundation.
8812
8813  Released under the Apache 2 License.
8814
8815  http://gazebosim.org
8816
8817
```

```
8818
8819
8820
8821   (1523722005 44659349) [Msg] Waiting for master.
8822
8823   (1523722005 45871333) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8824
8825   (1523722005 45955559) [Msg] Publicized address: 10.0.2.15
8826
8827   (1523722005 406128591) Init world[grabbing_book_v]
8828
8829   (1523722015 579703726) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
8830
8831   (1523722015 640509743) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
8832
8833   ********************************************************************************

8834
8835
8836
8837
8838
8839    85 :
8840
8841   Gazebo multi-robot simulator, version 7.9.0
8842
8843   Copyright (C) 2012 Open Source Robotics Foundation.
8844
8845   Released under the Apache 2 License.
8846
8847   http://gazebosim.org
8848
8849
8850
8851
8852
8853   (1523722205 425126430) [Msg] Waiting for master.
8854
8855   (1523722205 425529614) [Msg] Connected to gazebo master @ http://127.0.0.1:11345
8856
8857   (1523722205 425681940) [Msg] Publicized address: 10.0.2.15
8858
8859   (1523722205 808322393) Init world[grabbing_book_v]
8860
8861   (1523722216 48112417) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/target-object-point
8862
8863   (1523722216 102111134) [Dbg] [giskard_visualization_plugin.cpp:133] Created
          Marker: giskard_expressions/tool-point
8864
8865   ********************************************************************************

8866
8867
8868
```

```
 86 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523722405 802458826) [Msg] Waiting for master.

(1523722405 803590740) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523722405 803726034) [Msg] Publicized address: 10.0.2.15

(1523722406 165757213)  Init world[grabbing_book_v]

(1523722416 361198592) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/tool-point

(1523722416 447784691) [Dbg] [giskard_visualization_plugin.cpp:133] Created
    Marker: giskard_expressions/target-object-point

*********************************************************************************




 87 :

Gazebo multi-robot simulator, version 7.9.0

Copyright (C) 2012 Open Source Robotics Foundation.

Released under the Apache 2 License.

http://gazebosim.org




(1523722606 169405337) [Msg] Waiting for master.

(1523722606 180138902) [Msg] Connected to gazebo master @ http://127.0.0.1:11345

(1523722606 180250692) [Msg] Publicized address: 10.0.2.15
```

```
8923   (1523722606 545734306) Init world[grabbing_book_v]
8924
8925   (1523722616 832908142) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/tool-point
8926
8927   (1523722616 894873909) [Dbg] [giskard_visualization_plugin.cpp:133] Created
           Marker: giskard_expressions/target-object-point
8928
8929   ********************************************************************************
```

263   bookoutput.txt

```
 1    grabbing_book :
 2
 3    book_on_shelf :
 4
 5    grabbing_book :
 6
 7    book_on_shelf :
 8
 9    grabbing_book :
10
11    book_on_shelf :
12
13    grabbing_book :
14
15    book_on_shelf :
16
17    grabbing_book :
18
19    book_on_shelf :
20
21    grabbing_book :
22
23    book_on_shelf :
24
25    grabbing_book :
26
27    book_on_shelf :
28
29    grabbing_book :
30
31    book_on_shelf :
32
33    grabbing_book :
34
35    book_on_shelf :
36
37    grabbing_book :
38
39    book_on_shelf :
40
41    grabbing_book :
42
43    book_on_shelf :
44
45    grabbing_book2 :
46
47    book_on_shelf2 :
48
49    grabbing_book2 :
50
51    book_on_shelf2 :
52
53    grabbing_book2 :
54
55    book_on_shelf2 :
```

```
 56
 57    grabbing_book2 :

 58
 59    book_on_shelf2 :

 60
 61    grabbing_book2 :

 62
 63    book_on_shelf2 :

 64
 65    grabbing_book2 :

 66
 67    book_on_shelf2 :

 68
 69    grabbing_book2 :

 70
 71    book_on_shelf2 :

 72
 73    grabbing_book2 :

 74
 75    book_on_shelf2 :

 76
 77    grabbing_book2 :

 78
 79    book_on_shelf2 :

 80
 81    grabbing_book2 :

 82
 83    book_on_shelf2 :

 84
 85    grabbing_book2 :

 86
 87    book_on_shelf2 :

 88
 89    grabbing_book3 :

 90
 91    book_on_shelf3 :

 92
 93    grabbing_book3 :

 94
 95    book_on_shelf3 :

 96
 97    grabbing_book3 :

 98
 99    book_on_shelf3 :

100
101    grabbing_book3 :

102
103    book_on_shelf3 :

104
105    grabbing_book3 :

106
107    book_on_shelf3 :

108
109    grabbing_book3 :

110
111    book_on_shelf3 :

112
```

```
113    grabbing_book3 :

114
115    book_on_shelf3 :

116
117    grabbing_book3 :

118
119    book_on_shelf3 :

120
121    grabbing_book3 :

122
123    book_on_shelf3 :

124
125    grabbing_book3 :

126
127    book_on_shelf3 :

128
129    grabbing_book3 :

130
131    book_on_shelf3 :

132
133    grabbing_book4 :

134
135    book_on_shelf4 :

136
137    grabbing_book4 :

138
139    book_on_shelf4 :

140
141    grabbing_book4 :

142
143    book_on_shelf4 :

144
145    grabbing_book4 :

146
147    book_on_shelf4 :

148
149    grabbing_book4 :

150
151    book_on_shelf4 :

152
153    grabbing_book4 :

154
155    book_on_shelf4 :

156
157    grabbing_book4 :

158
159    book_on_shelf4 :

160
161    grabbing_book4 :

162
163    book_on_shelf4 :

164
165    grabbing_book4 :

166
167    book_on_shelf4 :

168
169    grabbing_book4 :
```

```
170
171    book_on_shelf4 :

172
173    grabbing_book4 :

174
175    book_on_shelf4 :

176
177    grabbing_book5 :

178
179    book_on_shelf5 :

180
181    grabbing_book5 :

182
183    book_on_shelf5 :

184
185    grabbing_book5 :

186
187    book_on_shelf5 :

188
189    grabbing_book5 :

190
191    book_on_shelf5 :

192
193    grabbing_book5 :

194
195    book_on_shelf5 :

196
197    grabbing_book5 :

198
199    book_on_shelf5 :

200
201    grabbing_book5 :

202
203    book_on_shelf5 :

204
205    grabbing_book5 :

206
207    book_on_shelf5 :

208
209    grabbing_book5 :

210
211    book_on_shelf5 :

212
213    grabbing_book5 :

214
215    book_on_shelf5 :

216
217    grabbing_book5 :

218
219    book_on_shelf5 :

220
221    grabbing_book6 :

222
223    book_on_shelf6 :

224
225    grabbing_book6 :

226
```

```
227    book_on_shelf6 :

228
229    grabbing_book6 :

230
231    book_on_shelf6 :

232
233    grabbing_book6 :

234
235    book_on_shelf6 :

236
237    grabbing_book6 :

238
239    book_on_shelf6 :

240
241    grabbing_book6 :

242
243    book_on_shelf6 :

244
245    grabbing_book6 :

246
247    book_on_shelf6 :

248
249    grabbing_book6 :

250
251    book_on_shelf6 :

252
253    grabbing_book6 :

254
255    book_on_shelf6 :

256
257    grabbing_book6 :

258
259    book_on_shelf6 :

260
261    grabbing_book6 :

262
263    book_on_shelf6 :

264
265    grabbing_book7 :

266
267    book_on_shelf7 :

268
269    grabbing_book7 :

270
271    book_on_shelf7 :

272
273    grabbing_book7 :

274
275    book_on_shelf7 :

276
277    grabbing_book7 :

278
279    book_on_shelf7 :

280
281    grabbing_book7 :

282
283    book_on_shelf7 :
```

```
284
285    grabbing_book7 :

286
287    book_on_shelf7 :

288
289    grabbing_book7 :

290
291    book_on_shelf7 :

292
293    grabbing_book7 :

294
295    book_on_shelf7 :

296
297    grabbing_book7 :

298
299    book_on_shelf7 :

300
301    grabbing_book7 :

302
303    book_on_shelf7 :

304
305    grabbing_book7 :

306
307    book_on_shelf7 :

308
309    grabbing_book8 :

310
311    book_on_shelf8 :

312
313    grabbing_book8 :

314
315    book_on_shelf8 :

316
317    grabbing_book8 :

318
319    book_on_shelf8 :

320
321    grabbing_book8 :

322
323    book_on_shelf8 :

324
325    grabbing_book8 :

326
327    book_on_shelf8 :

328
329    grabbing_book8 :

330
331    book_on_shelf8 :

332
333    grabbing_book8 :

334
335    book_on_shelf8 :

336
337    grabbing_book8 :

338
339    book_on_shelf8 :

340
```

```
341    grabbing_book8 :

342
343    book_on_shelf8 :

344
345    grabbing_book8 :

346
347    book_on_shelf8 :

348
349    grabbing_book8 :

350
351    book_on_shelf8 :
```

```cpp
1   #include "skill_transfer/giskard_adapter.h"
2   #include "skill_transfer/conversions.h"
3   #include "skill_transfer/giskard_utils.h"
4   #include "skill_transfer/giskard_viz.h"
5
6   GiskardAdapter::GiskardAdapter(int nWSR) : nWSR_(nWSR)
7   {
8   }
9
10  void GiskardAdapter::createController(const std::string &constraints)
11  {
12    controller_started_ = false;
13    controller_ = generateController(constraints);
14  }
15
16  void GiskardAdapter::startController(const Eigen::VectorXd &inputs)
17  {
18    if (!controller_started_)
19    {
20      if (!controller_.start(inputs, nWSR_))
21      {
22        throw std::runtime_error("Failed␣to␣start␣controller");
23      }
24
25      controller_started_ = true;
26    }
27    else
28    {
29      ROS_WARN("GiskardAdapter:␣Attempt␣to␣start␣an␣active␣controller");
30    }
31  }
32
33  void GiskardAdapter::updateController(const Eigen::VectorXd &inputs)
34  {
35    if (!controller_.update(inputs, nWSR_))
36    {
37      throw std::runtime_error("Failed␣to␣update␣controller");
38    }
39  }
40
41  geometry_msgs::Twist GiskardAdapter::getDesiredFrameTwistMsg(
42      const Eigen::VectorXd &inputs,
43      const std::string &frame_name)
44  {
45    const Eigen::VectorXd desired_velocity =
46        getJacobian(controller_, frame_name, inputs).data * controller_.
47            get_command();
48
49    return eigenVectorToMsgTwist(desired_velocity);
50  }
51
52  sensor_msgs::JointState GiskardAdapter::getDesiredJointVelocityMsg()
53  {
54    return eigenVectorToMsgJointState(controller_.get_command());
55  }
```

689

```cpp
55
56  geometry_msgs::Twist GiskardAdapter::getMeasuredFrameTwistMsg(
57      const Eigen::VectorXd &inputs,
58      const Eigen::VectorXd &velocities,
59      const std::string &frame_name)
60  {
61    return eigenVectorToMsgTwist(getJacobian(controller_, frame_name, inputs).data
62          * velocities);
63  }
64
65  double GiskardAdapter::getDistance()
66  {
67    const KDL::Expression<KDL::Vector>::Ptr distance_exp =
68        controller_.get_scope().find_vector_expression("distance");
69    auto distance_vector = distance_exp->value();
70    double distance = distance_vector.Norm();
71
72    return distance;
73  }
74
75  std::vector<visualization_msgs::Marker> GiskardAdapter::getVisualizationMsgs()
76  {
77    return std::vector<visualization_msgs::Marker>{
78        createPointMarker(controller_, "tool-point", "base_footprint"),
79        createPointMarker(controller_, "target-object-point", "base_footprint"),
80        createPointDirectionMarker(controller_, "tool-point", "distance", "
81            base_footprint")};
82  }
```

```cpp
1   #include <ros/ros.h>
2   #include <actionlib/server/simple_action_server.h>
3   #include <skill_transfer/MoveArmAction.h>
4   #include <geometry_msgs/Twist.h>
5   #include <gazebo_msgs/LinkStates.h>
6   #include <visualization_msgs/Marker.h>
7   #include <giskard_core/giskard_core.hpp>
8   #include "skill_transfer/conversions.h"
9   #include "skill_transfer/giskard_adapter.h"
10  #include <vector>
11  #include <string>
12  #include <algorithm>
13
14  class ConstraintController
15  {
16  public:
17    ConstraintController(std::string name) : as_(nh_, name, false),
18                                             action_name_(name),
19                                             giskard_adapter_(100)
20    {
21      //register the goal and feeback callbacks
22      as_.registerGoalCallback(boost::bind(&ConstraintController::onGoal, this));
23      as_.registerPreemptCallback(boost::bind(&ConstraintController::onPreempt,
24          this));
25
26      //subscribe to the data topic of interest
27      sub_ = nh_.subscribe("/gazebo/link_states", 1, &ConstraintController::
28          onLinkStatesMsg, this);
29      // Topic for simulation and executive node, since they only
30      // care about the end effector velocity and not about joint velocities
31      pub_l_ee_     = nh_.advertise<geometry_msgs::Twist>("/l_ee_twist", 1);
32      pub_set_l_ee_ = nh_.advertise<geometry_msgs::Twist>("/set_l_ee_twist", 1);
33      pub_r_ee_     = nh_.advertise<geometry_msgs::Twist>("/r_ee_twist", 1);
34      pub_set_r_ee_ = nh_.advertise<geometry_msgs::Twist>("/set_r_ee_twist", 1);
35      pub_r_ee_2_   = nh_.advertise<geometry_msgs::Twist>("/r_ee_2_twist", 1);
36      pub_set_r_ee_2_ = nh_.advertise<geometry_msgs::Twist>("/set_r_ee_2_twist",
37          1);
38      // Desired motion state visualization for RViz
39      pub_viz_ = nh_.advertise<visualization_msgs::Marker>("/giskard/
40          visualization_marker", 10);
41
42      as_.start();
43    }
44
45    ~ConstraintController()
46    {
47    }
48
49    void onGoal()
50    {
51      // Accept goal and get new constraints
52      const auto goal = as_.acceptNewGoal();
53      constraints_ = goal->constraints;
54
55      ROS_INFO("%s: Received a new goal", action_name_.c_str());
```

```
52
53        giskard_adapter_.createController(constraints_);
54    }
55
56    void onPreempt()
57    {
58        ROS_INFO("%s:␣Preempted", action_name_.c_str());
59        // set the action state to preempted
60        as_.setPreempted();
61    }
62
63    void onLinkStatesMsg(const gazebo_msgs::LinkStatesConstPtr &msg)
64    {
65        // Link state map
66        auto link_pose_map = toMap<std::string, geometry_msgs::Pose>(msg->name, msg
              ->pose);
67        auto link_twist_map = toMap<std::string, geometry_msgs::Twist>(msg->name,
              msg->twist);
68
69        const auto left_ee_pose = link_pose_map.find("left_ee::link")->second;
70        const auto left_ee_twist = link_twist_map.find("left_ee::link")->second;
71        const auto right_ee_pose = link_pose_map.find("right_ee::link")->second;
72        const auto right_ee_twist = link_twist_map.find("right_ee::link")->second;
73        const auto right_ee_2_pose = link_pose_map.find("right_ee_2::link")->second;
74        const auto right_ee_2_twist = link_twist_map.find("right_ee_2::link")->
              second;
75
76        // When action is not active send zero twist,
77        // otherwise do all the calculations
78        if (as_.isActive())
79        {
80            // Prepare controller inputs
81            Eigen::VectorXd inputs(18);
82            inputs.segment(0, 6) = msgPoseToEigenVector(left_ee_pose);
83            inputs.segment(6, 6) = msgPoseToEigenVector(right_ee_pose);
84            inputs.segment(12, 6) = msgPoseToEigenVector(right_ee_2_pose);
85
86            // Start the controller if it's a new one
87            if (!giskard_adapter_.controller_started_)
88            {
89                giskard_adapter_.startController(inputs);
90            }
91
92            // Get new calculations from the controller
93            giskard_adapter_.updateController(inputs);
94
95            const auto l_ee_twist_desired_msg = giskard_adapter_.
                  getDesiredFrameTwistMsg(inputs, "left_ee");
96            const auto r_ee_twist_desired_msg = giskard_adapter_.
                  getDesiredFrameTwistMsg(inputs, "right_ee");
97            const auto r_ee_2_twist_desired_msg = giskard_adapter_.
                  getDesiredFrameTwistMsg(inputs, "right_ee_2");
98
99            pub_set_l_ee_.publish(l_ee_twist_desired_msg);
100           pub_l_ee_.publish(left_ee_twist);
101           pub_set_r_ee_.publish(r_ee_twist_desired_msg);
102           pub_r_ee_.publish(right_ee_twist);
```

```cpp
103          pub_set_r_ee_2_.publish(r_ee_2_twist_desired_msg);
104          pub_r_ee_2_.publish(right_ee_2_twist);
105
106          feedback_.distance = giskard_adapter_.getDistance();
107          as_.publishFeedback(feedback_);
108
109          // Visualization
110          const auto viz_msgs = giskard_adapter_.getVisualizationMsgs();
111
112          for (const auto &m : viz_msgs)
113          {
114            pub_viz_.publish(m);
115          }
116        }
117        else
118        {
119          const geometry_msgs::Twist cmd;
120          pub_set_l_ee_.publish(cmd);
121          pub_set_r_ee_.publish(cmd);
122          pub_set_r_ee_2_.publish(cmd);
123        }
124
125        // ROS_INFO_STREAM("Twist: " << cmd.twist);
126      }
127
128  protected:
129    ros::NodeHandle nh_;
130    actionlib::SimpleActionServer<skill_transfer::MoveArmAction> as_;
131    std::string action_name_;
132    ros::Subscriber sub_;
133    ros::Publisher pub_l_ee_;
134    ros::Publisher pub_set_l_ee_;
135    ros::Publisher pub_r_ee_;
136    ros::Publisher pub_set_r_ee_;
137    ros::Publisher pub_r_ee_2_;
138    ros::Publisher pub_set_r_ee_2_;
139    ros::Publisher pub_viz_;
140    std::string constraints_;
141    skill_transfer::MoveArmFeedback feedback_;
142    GiskardAdapter giskard_adapter_;
143  };
144
145  int main(int argc, char **argv)
146  {
147    ros::init(argc, argv, "constraint_controller");
148
149    ConstraintController controller("move_arm");
150    ros::spin();
151
152    return 0;
153  }
```

266 src/twist$_{l}$og.cpp

```cpp
1  #include "skill_transfer/twist_log.h"
2  #include <algorithm>
3  #include <cmath>
4
5  TwistLog::TwistLog(unsigned int size) : size_(size)
6  {
7  }
8
9  void TwistLog::push(geometry_msgs::Twist twist)
10 {
11   // Keep the log size fixed by removing the oldest entry
12   if (log_.size() >= size_)
13     log_.pop_front();
14
15   // Save twist to log
16   log_.push_back(twist);
17 }
18
19 void TwistLog::clear()
20 {
21   log_.clear();
22 }
23
24 bool TwistLog::allFilledAndBelowThreshold(double threshold)
25 {
26   // Log has to be filled up
27   if (log_.size() < size_)
28     return false;
29
30   return std::all_of(log_.begin(), log_.end(),
31                      [threshold](const geometry_msgs::Twist &t) {
32                        return (std::abs(t.linear.x) < threshold) &&
33                               (std::abs(t.linear.y) < threshold) &&
34                               (std::abs(t.linear.z) < threshold) &&
35                               (std::abs(t.angular.x) < threshold) &&
36                               (std::abs(t.angular.y) < threshold) &&
37                               (std::abs(t.angular.z) < threshold);
38                      });
39 }
```

```cpp
1  #include <ros/ros.h>
2  #include <yaml-cpp/yaml.h>
3  #include <vector>
4  #include <utility>
5  #include <string>
6  #include <boost/filesystem.hpp>
7  #include <boost/filesystem/fstream.hpp>
8  #include <tf2_ros/static_transform_broadcaster.h>
9
10 #include <skill_transfer/StopCondition.h>
11 #include <skill_transfer/GetTaskSpec.h>
12 #include <skill_transfer/GetMotionSpec.h>
13 #include <skill_transfer/DetectTargetObjectInfo.h>
14 #include <skill_transfer/DetectToolInfo.h>
15
16 class KnowledgeManager
17 {
18 private:
19   // Possible internal states of the node
20   enum State
21   {
22     Created,
23     Initialized,
24     Waiting,
25     ProcessingKnowledge,
26     Ready
27   };
28   // State
29   State state_ = State::Created;
30   // ROS handles
31   ros::NodeHandle node_handle_;
32   ros::ServiceClient target_object_info_service_client_;
33   ros::ServiceClient tool_info_service_client_;
34   ros::ServiceServer task_spec_service_server_;
35   ros::ServiceServer motion_spec_service_server_;
36   // File paths
37   std::string task_file_path_;
38   std::string setup_file_path_;
39   std::string motion_template_file_path_;
40   // File directories
41   std::string motion_directory_path_;
42   std::string info_cache_directory_path_;
43   // YAML files
44   YAML::Node setup_;
45   YAML::Node task_;
46   YAML::Node motion_template_;
47   // TF2
48   tf2_ros::StaticTransformBroadcaster tf_broadcaster_;
49
50 public:
51   KnowledgeManager() : node_handle_("~")
52   {
53     // Load values from ROSParam
54
55     if (!node_handle_.getParam("task_file_path", task_file_path_))
```

```
56        {
57          throw std::runtime_error("Could␣not␣find␣parameter␣'task_file_path'␣in␣
                namespace␣'" +
58                                   node_handle_.getNamespace() + "'.");
59        }
60
61        if (!node_handle_.getParam("setup_file_path", setup_file_path_))
62        {
63          throw std::runtime_error("Could␣not␣find␣parameter␣'setup_file_path'␣in␣
                namespace␣'" +
64                                   node_handle_.getNamespace() + "'.");
65        }
66
67        if (!node_handle_.getParam("motion_template_file_path",
              motion_template_file_path_))
68        {
69          throw std::runtime_error("Could␣not␣find␣parameter␣'
                motion_template_file_path'␣in␣namespace␣'" +
70                                   node_handle_.getNamespace() + "'.");
71        }
72
73        if (!node_handle_.getParam("motion_directory_path", motion_directory_path_))
74        {
75          throw std::runtime_error("Could␣not␣find␣parameter␣'motion_directory_path'
                ␣in␣namespace␣'" +
76                                   node_handle_.getNamespace() + "'.");
77        }
78
79        if (!node_handle_.getParam("info_cache_directory_path",
              info_cache_directory_path_))
80        {
81          throw std::runtime_error("Could␣not␣find␣parameter␣'
                info_cache_directory_path'␣in␣namespace␣'" +
82                                   node_handle_.getNamespace() + "'.");
83        }
84
85        // Load files
86        try
87        {
88          setup_ = YAML::LoadFile(setup_file_path_);
89        }
90        catch (const std::exception &e)
91        {
92          ROS_ERROR("Could␣not␣load␣setup␣file");
93          throw;
94        }
95
96        try
97        {
98          task_ = YAML::LoadFile(task_file_path_);
99        }
100       catch (const std::exception &e)
101       {
102         ROS_ERROR("Could␣not␣load␣task␣file");
103         throw;
104       }
105
```

```
106      try
107      {
108        motion_template_ = YAML::LoadFile(motion_template_file_path_);
109      }
110      catch (const std::exception &e)
111      {
112        ROS_ERROR("Could␣not␣load␣motion␣template␣file");
113        throw;
114      }
115
116      // Initialize servers and clients
117      target_object_info_service_client_ =
118          node_handle_.serviceClient<skill_transfer::DetectTargetObjectInfo>("/
              feature_detector/detect_target_object_info");
119
120      tool_info_service_client_ =
121          node_handle_.serviceClient<skill_transfer::DetectToolInfo>("/
              feature_detector/detect_tool_info");
122
123      state_ = State::Initialized;
124    }
125
126    void start()
127    {
128      ROS_ASSERT(state_ == State::Initialized);
129
130      state_ = State::Waiting;
131
132      target_object_info_service_client_.waitForExistence();
133      tool_info_service_client_.waitForExistence();
134
135      state_ = State::ProcessingKnowledge;
136
137      // Broadcast grasps on TF
138      broadcastGrasps();
139
140      // Requesting info from detector
141
142      // Check if cache exist
143      const std::string &target_object_ply_name = setup_["point-clouds"]["target-
            object"].as<std::string>();
144      const std::string &tool_ply_name = setup_["point-clouds"]["tool"].as<std::
            string>();
145
146      if (cachedInfoExists(target_object_ply_name, tool_ply_name))
147      {
148        loadCachedInfo(target_object_ply_name, tool_ply_name);
149      }
150      else
151      {
152        // Target object info
153        if (task_["required-object-info"]["target-object"].as<bool>())
154        {
155          callDetectTargetObjectInfo();
156        }
157
158        // Tool info
```

```cpp
159            if (task_["required-object-info"]["tool"].as<bool>())
160            {
161              callDetectToolInfo();
162            }
163
164            saveCachedInfo(target_object_ply_name, tool_ply_name);
165          }
166
167          // Starting services
168          task_spec_service_server_ =
169              node_handle_.advertiseService("get_task_spec",
170                                            &KnowledgeManager::serveGetTaskSpec,
171                                            this);
172          motion_spec_service_server_ =
173              node_handle_.advertiseService("get_motion_spec",
174                                            &KnowledgeManager::serveGetMotionSpec,
175                                            this);
176
177          state_ = State::Ready;
178        }
179
180        bool serveGetMotionSpec(skill_transfer::GetMotionSpec::Request &req,
181                                skill_transfer::GetMotionSpec::Response &res)
182        {
183          ROS_ASSERT(state_ == State::Ready);
184
185          std::size_t index = req.index; // implicit type conversion
186          res.stop_condition = getMotionStopCondition(index);
187          res.spec = getMotionSpec(index);
188
189          // ROS_INFO_STREAM(res.spec);
190
191          return true;
192        }
193
194        bool serveGetTaskSpec(skill_transfer::GetTaskSpec::Request &req,
195                              skill_transfer::GetTaskSpec::Response &res)
196        {
197          ROS_ASSERT(state_ == State::Ready);
198
199          res.motion_phase_count = getMotionCount(); // implicit type conversion
200
201          return true;
202        }
203
204      private:
205        /**
206         * Makes a service call to feature_detector and saves returned values.
207         */
208        void callDetectTargetObjectInfo()
209        {
210          skill_transfer::DetectTargetObjectInfo srv;
211
212          srv.request.point_cloud_file_name =
213              setup_["point-clouds"]["target-object"].as<std::string>();
214
215          if (!target_object_info_service_client_.call(srv))
```

```
216        {
217            throw std::runtime_error("Failed␣to␣call␣service␣detect_target_object_info
                    ");
218        }
219
220        YAML::Node point_node;
221        point_node["vector3"].push_back(srv.response.edge_point.x);
222        point_node["vector3"].push_back(srv.response.edge_point.y);
223        point_node["vector3"].push_back(srv.response.edge_point.z);
224
225        setup_["object-info"]["edge-point"] = point_node;
226
227        YAML::Node vector_node;
228        vector_node["vector3"].push_back(srv.response.alignment_vector.x);
229        vector_node["vector3"].push_back(srv.response.alignment_vector.y);
230        vector_node["vector3"].push_back(srv.response.alignment_vector.z);
231
232        setup_["object-info"]["alignment-vector"] = vector_node;
233    }
234
235    void callDetectToolInfo()
236    {
237        skill_transfer::DetectToolInfo srv;
238
239        srv.request.point_cloud_file_name =
240            setup_["point-clouds"]["tool"].as<std::string>();
241
242        srv.request.task_name = task_["required-object-info"]["task"].as<std::string
                >();
243
244        srv.request.tool_mass = setup_["tool-mass"].as<double>();
245
246        srv.request.edge_point.x = setup_["object-info"]["edge-point"]["vector3"
                ][0].as<double>();
247        srv.request.edge_point.y = setup_["object-info"]["edge-point"]["vector3"
                ][1].as<double>();
248        srv.request.edge_point.z = setup_["object-info"]["edge-point"]["vector3"
                ][2].as<double>();
249
250        srv.request.alignment_vector.x = setup_["object-info"]["alignment-vector"]["
                vector3"][0].as<double>();
251        srv.request.alignment_vector.y = setup_["object-info"]["alignment-vector"]["
                vector3"][1].as<double>();
252        srv.request.alignment_vector.z = setup_["object-info"]["alignment-vector"]["
                vector3"][2].as<double>();
253
254        if (!tool_info_service_client_.call(srv))
255        {
256            throw std::runtime_error("Failed␣to␣call␣service␣detect_target_object_info
                    ");
257        }
258
259        YAML::Node grasp_node;
260        grasp_node["vector3"].push_back(srv.response.grasp_center.x);
261        grasp_node["vector3"].push_back(srv.response.grasp_center.y);
262        grasp_node["vector3"].push_back(srv.response.grasp_center.z);
263
```

```cpp
264        setup_["object-info"]["grasp-center"] = grasp_node;
265
266        YAML::Node center_node;
267        center_node["vector3"].push_back(srv.response.action_center.x);
268        center_node["vector3"].push_back(srv.response.action_center.y);
269        center_node["vector3"].push_back(srv.response.action_center.z);
270
271        setup_["object-info"]["action-center"] = center_node;
272
273        YAML::Node tip_node;
274        tip_node["vector3"].push_back(srv.response.tool_tip.x);
275        tip_node["vector3"].push_back(srv.response.tool_tip.y);
276        tip_node["vector3"].push_back(srv.response.tool_tip.z);
277
278        setup_["object-info"]["tool-tip"] = tip_node;
279
280        YAML::Node tip_vector_node;
281        tip_vector_node["vector3"].push_back(srv.response.tool_tip_vector.x);
282        tip_vector_node["vector3"].push_back(srv.response.tool_tip_vector.y);
283        tip_vector_node["vector3"].push_back(srv.response.tool_tip_vector.z);
284
285        setup_["object-info"]["tool-tip-vector"] = tip_vector_node;
286
287        YAML::Node orientation_node;
288        orientation_node["quaternion"].push_back(srv.response.tool_quaternion.x);
289        orientation_node["quaternion"].push_back(srv.response.tool_quaternion.y);
290        orientation_node["quaternion"].push_back(srv.response.tool_quaternion.z);
291        orientation_node["quaternion"].push_back(srv.response.tool_quaternion.w);
292
293        setup_["object-info"]["tool-quaternion"] = orientation_node;
294
295        YAML::Node heel_node;
296        heel_node["vector3"].push_back(srv.response.tool_heel.x);
297        heel_node["vector3"].push_back(srv.response.tool_heel.y);
298        heel_node["vector3"].push_back(srv.response.tool_heel.z);
299
300        setup_["object-info"]["tool-heel"] = heel_node;
301      }
302
303      std::size_t getMotionCount() const
304      {
305        return task_["motion-phases"].size();
306      }
307
308      /**
309      * Reads motion YAML file, combines it with
310      * motion template YAML file and
311      * fills in the gaps, i. e. grasps, object features.
312      * Returns the spec as a string.
313      *
314      * @return string Complete motion phase spec.
315      */
316      std::string getMotionSpec(std::size_t index) const
317      {
318        ROS_ASSERT(index >= 0 && index < task_["motion-phases"].size());
319
320        YAML::Node phase = task_["motion-phases"][index];
```

```
321
322        // Read the motion phase file
323        boost::filesystem::path dir_path(motion_directory_path_);
324        std::string file_path = phase["file"].as<std::string>();
325        const boost::filesystem::path path = dir_path / file_path;
326
327        if (!boost::filesystem::exists(path))
328        {
329          throw std::runtime_error("File not found: " + path.string());
330        }
331
332        const YAML::Node phase_spec = YAML::LoadFile(path.string());
333        YAML::Node motion_spec = YAML::Clone(motion_template_);
334
335        // Merge the template and the motion spec
336        const YAML::Node motion_spec_scope = motion_spec["scope"];
337        const YAML::Node scope = phase_spec["scope"];
338        const YAML::Node constraints = phase_spec["soft-constraints"];
339
340        // Fill in grasps
341        // They have to be put in front of the scope, so we
342        // make a new scope and re-add things
343        YAML::Node new_scope;
344
345        YAML::Node tool_grasp_node;
346        tool_grasp_node["tool-grasp"] = setup_["tool-grasp"];
347        YAML::Node target_object_grasp_node;
348        target_object_grasp_node["target-object-grasp"] = setup_["target-object-
                grasp"];
349        YAML::Node target_object_grasp_2_node;
350        target_object_grasp_2_node["target-object-grasp-2"] = setup_["target-object-
                grasp-2"];
351        YAML::Node object_width_node;
352        YAML::Node object_width_2_node;
353        double width;
354        width = setup_["object-width"].as<double>();
355        object_width_node["object-width"] = (width / 2) + 0.04;
356        object_width_2_node["object-width-2"] = -((width / 2) + 0.04);
357        new_scope.push_back(tool_grasp_node);
358        new_scope.push_back(target_object_grasp_node);
359        new_scope.push_back(target_object_grasp_2_node);
360        new_scope.push_back(object_width_node);
361        new_scope.push_back(object_width_2_node);
362
363        // Fill in object features
364        const YAML::Node &all_features_node = setup_["object-info"];
365
366        for (YAML::const_iterator it = all_features_node.begin(); it !=
                all_features_node.end(); ++it)
367        {
368          YAML::Node fn;
369          fn[it->first] = it->second;
370
371          new_scope.push_back(fn);
372        }
373
374        // Fill in template scope
```

```
375     for (YAML::const_iterator it = motion_spec_scope.begin(); it !=
            motion_spec_scope.end(); ++it)
376     {
377       new_scope.push_back(*it);
378     }
379
380     // Fill in the phase scope
381     for (YAML::const_iterator it = scope.begin(); it != scope.end(); ++it)
382     {
383       new_scope.push_back(*it);
384     }
385
386     // Replace scope
387     motion_spec["scope"] = new_scope;
388     // Insert constraints
389     motion_spec["soft-constraints"] = constraints;
390
391     // Convert spec to string
392     YAML::Emitter out;
393     out << motion_spec;
394     std::string spec{out.c_str()};
395
396     return spec;
397   }
398
399   skill_transfer::StopCondition getMotionStopCondition(std::size_t index) const
400   {
401     ROS_ASSERT(index >= 0 && index < task_["motion-phases"].size());
402
403     const YAML::Node &node = task_["motion-phases"][index]["stop"];
404     skill_transfer::StopCondition msg;
405
406     try
407     {
408       msg.measured_velocity_min = node["measured-velocity-min-threshold"].as<
            double>();
409       msg.desired_velocity_min = node["desired-velocity-min-threshold"].as<
            double>();
410       msg.contact = node["contact"].as<bool>();
411       msg.activation_distance = node["activation-distance"].as<double>();
412     }
413     catch (std::exception &e)
414     {
415       ROS_ERROR("Failed to parse stop condition");
416       throw;
417     }
418
419     return msg;
420   }
421
422   void broadcastGrasps()
423   {
424     // Broadcast grasps on TF
425     {
426       const auto &tool_grasp_frame = setup_["target-object-grasp"]["frame"];
427       double qx, qy, qz, qw, x, y, z;
428
```

```
429            for (const auto &n : tool_grasp_frame)
430            {
431              if (n["quaternion"])
432              {
433                const auto &q = n["quaternion"];
434
435                qx = q[0].as<double>();
436                qy = q[1].as<double>();
437                qz = q[2].as<double>();
438                qw = q[3].as<double>();
439              }
440
441              if (n["vector3"])
442              {
443                const auto &v = n["vector3"];
444
445                x = v[0].as<double>();
446                y = v[1].as<double>();
447                z = v[2].as<double>();
448              }
449            }
450
451          geometry_msgs::TransformStamped transform_stamped;
452
453          transform_stamped.header.frame_id = "r_gripper_tool_frame";
454          transform_stamped.child_frame_id = "target_object_frame";
455          transform_stamped.header.stamp = ros::Time::now();
456
457          transform_stamped.transform.translation.x = x;
458          transform_stamped.transform.translation.y = y;
459          transform_stamped.transform.translation.z = z;
460          transform_stamped.transform.rotation.x = qx;
461          transform_stamped.transform.rotation.y = qy;
462          transform_stamped.transform.rotation.z = qz;
463          transform_stamped.transform.rotation.w = qw;
464
465          tf_broadcaster_.sendTransform(transform_stamped);
466        }
467        {
468          const auto &tool_grasp_frame = setup_["target-object-grasp-2"]["frame"];
469          double qx, qy, qz, qw, x, y, z;
470
471          for (const auto &n : tool_grasp_frame)
472          {
473            if (n["quaternion"])
474            {
475              const auto &q = n["quaternion"];
476
477              qx = q[0].as<double>();
478              qy = q[1].as<double>();
479              qz = q[2].as<double>();
480              qw = q[3].as<double>();
481            }
482
483            if (n["vector3"])
484            {
485              const auto &v = n["vector3"];
```

```cpp
486
487                 x = v[0].as<double>();
488                 y = v[1].as<double>();
489                 z = v[2].as<double>();
490             }
491         }
492
493         geometry_msgs::TransformStamped transform_stamped;
494
495         transform_stamped.header.frame_id = "r_gripper_tool_frame";
496         transform_stamped.child_frame_id = "target-object-grasp-2";
497         transform_stamped.header.stamp = ros::Time::now();
498
499         transform_stamped.transform.translation.x = x;
500         transform_stamped.transform.translation.y = y;
501         transform_stamped.transform.translation.z = z;
502         transform_stamped.transform.rotation.x = qx;
503         transform_stamped.transform.rotation.y = qy;
504         transform_stamped.transform.rotation.z = qz;
505         transform_stamped.transform.rotation.w = qw;
506
507         tf_broadcaster_.sendTransform(transform_stamped);
508     }
509     {
510         const auto &tool_grasp_frame = setup_["tool-grasp"]["frame"];
511         double qx, qy, qz, qw, x, y, z;
512
513         for (const auto &n : tool_grasp_frame)
514         {
515           if (n["quaternion"])
516           {
517             const auto &q = n["quaternion"];
518
519             qx = q[0].as<double>();
520             qy = q[1].as<double>();
521             qz = q[2].as<double>();
522             qw = q[3].as<double>();
523           }
524
525           if (n["vector3"])
526           {
527             const auto &v = n["vector3"];
528
529             x = v[0].as<double>();
530             y = v[1].as<double>();
531             z = v[2].as<double>();
532           }
533         }
534
535         geometry_msgs::TransformStamped transform_stamped;
536
537         transform_stamped.header.frame_id = "l_gripper_tool_frame";
538         transform_stamped.child_frame_id = "tool_frame";
539         transform_stamped.header.stamp = ros::Time::now();
540
541         transform_stamped.transform.translation.x = x;
542         transform_stamped.transform.translation.y = y;
```

```
543          transform_stamped.transform.translation.z = z;
544          transform_stamped.transform.rotation.x = qx;
545          transform_stamped.transform.rotation.y = qy;
546          transform_stamped.transform.rotation.z = qz;
547          transform_stamped.transform.rotation.w = qw;
548
549          tf_broadcaster_.sendTransform(transform_stamped);
550        }
551      }
552
553      bool cachedInfoExists(const std::string &target_object_ply_name,
554                            const std::string &tool_ply_name)
555      {
556        const boost::filesystem::path target_object_ply_path{target_object_ply_name
                };
557        const boost::filesystem::path tool_ply_path{tool_ply_name};
558
559        std::string cache_file_name = target_object_ply_path.stem().string() +
560                                      "_" + tool_ply_path.stem().string();
561
562        boost::filesystem::path dir_path(info_cache_directory_path_);
563        const boost::filesystem::path path = dir_path / (cache_file_name + ".yaml");
564
565        if (!boost::filesystem::exists(path))
566        {
567          return false;
568        }
569
570        return true;
571      }
572
573      void loadCachedInfo(const std::string &target_object_ply_name,
574                          const std::string &tool_ply_name)
575      {
576        const boost::filesystem::path target_object_ply_path{target_object_ply_name
                };
577        const boost::filesystem::path tool_ply_path{tool_ply_name};
578
579        std::string cache_file_name = target_object_ply_path.stem().string() +
580                                      "_" + tool_ply_path.stem().string();
581
582        boost::filesystem::path dir_path(info_cache_directory_path_);
583        const boost::filesystem::path path = dir_path / (cache_file_name + ".yaml");
584
585        if (!boost::filesystem::exists(path))
586        {
587          throw std::runtime_error("File not found: " + path.string());
588        }
589
590        const YAML::Node info_node = YAML::LoadFile(path.string());
591        setup_["object-info"] = info_node;
592
593        ROS_INFO_STREAM("SETUP: \n"
594                        << setup_["object-info"]);
595      }
596
597      void saveCachedInfo(const std::string &target_object_ply_name,
```

```cpp
598                          const std::string &tool_ply_name)
599    {
600        const YAML::Node &all_features_node = setup_["object-info"];
601
602        const boost::filesystem::path target_object_ply_path{target_object_ply_name
                };
603        const boost::filesystem::path tool_ply_path{tool_ply_name};
604
605        std::string cache_file_name = target_object_ply_path.stem().string() +
606                                        "_" + tool_ply_path.stem().string();
607
608        boost::filesystem::path dir_path(info_cache_directory_path_);
609        const boost::filesystem::path path = dir_path / (cache_file_name + ".yaml");
610
611        YAML::Emitter emitter;
612        emitter << all_features_node;
613
614        std::ofstream fout(path.c_str());
615        fout << emitter.c_str();
616    }
617 };
618
619 int main(int argc, char **argv)
620 {
621    ros::init(argc, argv, "knowledge_manager");
622    KnowledgeManager manager;
623    manager.start();
624    ros::spin();
625
626    return 0;
627 }
```

```
 1  #include <ros/ros.h>
 2  #include <tf2_ros/transform_listener.h>
 3  #include <tf/transform_datatypes.h>
 4  #include <geometry_msgs/Point.h>
 5  #include <boost/format.hpp>
 6  #include <fstream>
 7  #include <map>
 8
 9  #include <skill_transfer/DetectTargetObjectInfo.h>
10  #include <skill_transfer/DetectToolInfo.h>
11
12  class FeatureDetector
13  {
14  private:
15    // ROS handles
16    ros::NodeHandle node_handle_;
17    ros::ServiceServer tool_info_service_server_;
18    ros::ServiceServer target_object_info_service_server_;
19    // File directories
20    std::string point_cloud_directory_path_;
21    std::string trained_data_directory_path_;
22    // TF
23    tf2_ros::Buffer tfBuffer;
24    tf2_ros::TransformListener tfListener;
25    std::map<std::string, std::string> name2frame_;
26    // Additional parameters
27    bool show_results_ = false;
28
29  public:
30    FeatureDetector() : node_handle_("~"),
31                        tfListener(tfBuffer)
32    {
33      // Initialize name -> frame map
34      name2frame_["tool"] = "tool_frame";
35      name2frame_["target-object"] = "target_object_frame";
36
37      if (!node_handle_.getParam("point_cloud_directory_path",
38          point_cloud_directory_path_))
38      {
39        throw std::runtime_error("Could not find parameter '
             point_cloud_directory_path' in namespace '" +
40                                  node_handle_.getNamespace() + "'.");
41      }
42
43      if (!node_handle_.getParam("trained_data_directory_path",
             trained_data_directory_path_))
44      {
45        throw std::runtime_error("Could not find parameter '
             trained_data_directory_path' in namespace '" +
46                                  node_handle_.getNamespace() + "'.");
47      }
48
49      node_handle_.getParam("show_results", show_results_);
50
51      // Start services
```

```
52     tool_info_service_server_ = node_handle_.advertiseService("detect_tool_info"
           ,
53                                                      &FeatureDetector::
                                                           serveDetectToolInfo
                                                           ,
54                                                      this);
55     target_object_info_service_server_ = node_handle_.advertiseService("
           detect_target_object_info",
56                                                                &
                                                                   FeatureDetector
                                                                   ::
                                                                   serveDetectTargetObjectInfo
                                                                   ,
57                                                                this);
58  }
59
60  bool serveDetectTargetObjectInfo(skill_transfer::DetectTargetObjectInfo::
         Request &req,
61                                   skill_transfer::DetectTargetObjectInfo::
                                       Response &res)
62  {
63     // Find reference point
64     const geometry_msgs::TransformStamped transform_stamped = findTransform("
           target-object", "tool");
65     const geometry_msgs::Vector3 reference_point = transform_stamped.transform.
           translation;
66
67     const std::string &point_cloud_file_name = req.point_cloud_file_name;
68     const std::string point_cloud_path = point_cloud_directory_path_ +
           point_cloud_file_name;
69
70     std::string display_options = "";
71
72     display_options = show_results_ ? "1 1" : "";
73
74     const auto command =
75         boost::format("run_get_target_obj_info.sh /usr/local/MATLAB/
             MATLAB_Runtime/v93 %1% \"[%2% %3% %4%]\" %5% > /tmp/
             target_object_info.txt") %
76         point_cloud_path % reference_point.x % reference_point.y %
             reference_point.z % display_options;
77
78     ROS_INFO_STREAM("Command: " << command);
79
80     std::system(command.str().c_str());
81
82     std::ifstream file("/tmp/target_object_info.txt");
83
84     for (std::string line; std::getline(file, line);)
85     {
86       if (line.empty())
87         continue;
88
89       if (line.find("target_obj_contact_points") == 0)
90       {
91         std::getline(file, line);
92         std::istringstream line_iss(line);
```

```cpp
 93
 94            // read point
 95            line_iss >> res.edge_point.x;
 96            line_iss >> res.edge_point.y;
 97            line_iss >> res.edge_point.z;
 98          }
 99
100          if (line.find("target_obj_align_vecs") == 0)
101          {
102            std::getline(file, line);
103            std::istringstream line_iss(line);
104
105            // read point
106            line_iss >> res.alignment_vector.x;
107            line_iss >> res.alignment_vector.y;
108            line_iss >> res.alignment_vector.z;
109          }
110        }
111
112        ROS_INFO_STREAM("Target Object Info: \n"
113                        << res);
114
115        return true;
116      }
117
118      bool serveDetectToolInfo(skill_transfer::DetectToolInfo::Request &req,
119                               skill_transfer::DetectToolInfo::Response &res)
120      {
121        const std::string &point_cloud_file_name = req.point_cloud_file_name;
122        const std::string point_cloud_path = point_cloud_directory_path_ +
123            point_cloud_file_name;
124        const std::string trained_data_file_name = req.task_name + ".mat";
125        const std::string trained_data_path = trained_data_directory_path_ +
126            trained_data_file_name;
127        std::string display_options = show_results_ ? "1 1" : "";
128
129        // Rotate alignment vector
130        // const geometry_msgs::TransformStamped target_2_tool_transform_msg =
131        //     findTransform("target-object", "tool");
132        // tf::Transform target_2_tool_transform;
133        // tf::Vector3 aligvector;
134        // tf::transformMsgToTF(target_2_tool_transform_msg.transform,
135        //     target_2_tool_transform);
136        // tf::vector3MsgToTF(req.alignment_vector, aligvector);
137        // tf::Vector3 transformed_vector = target_2_tool_transform(aligvector);
138
139        const auto command =
140            boost::format("run_get_tool_info.sh /usr/local/MATLAB/MATLAB_Runtime/v93
141                 %1% %2% \"[%3%;%4%;%5%]\" \"[%6% %7% %8%]\" %9% %10% %11% > /tmp/
142                 tool_info.txt") %
143            point_cloud_path %
            req.tool_mass %
            req.alignment_vector.x %
            req.alignment_vector.y %
            req.alignment_vector.z %
```

```
144              req.edge_point.x %
145              req.edge_point.y %
146              req.edge_point.z %
147              req.task_name %
148              trained_data_path %
149              display_options;
150
151          ROS_INFO_STREAM("Command:␣" << command);
152
153          std::system(command.str().c_str());
154
155          std::ifstream file("/tmp/tool_info.txt");
156
157          for (std::string line; std::getline(file, line);)
158          {
159            ROS_INFO_STREAM(line);
160
161            if (line.empty())
162              continue;
163
164            if (line.find("affordance_score") == 0)
165            {
166              std::getline(file, line);
167              std::istringstream line_iss(line);
168
169              // read number
170              line_iss >> res.affordance_score;
171            }
172
173            if (line.find("grasp_center") == 0)
174            {
175              std::getline(file, line);
176              std::istringstream line_iss(line);
177
178              // read point
179              line_iss >> res.grasp_center.x;
180              line_iss >> res.grasp_center.y;
181              line_iss >> res.grasp_center.z;
182            }
183
184            if (line.find("action_center") == 0)
185            {
186              std::getline(file, line);
187              std::istringstream line_iss(line);
188
189              // read point
190              line_iss >> res.action_center.x;
191              line_iss >> res.action_center.y;
192              line_iss >> res.action_center.z;
193            }
194
195            if (line.find("tool_tip_vector") == 0)
196            {
197              std::getline(file, line);
198              std::istringstream line_iss(line);
199
200              // read point
```

```cpp
201             line_iss >> res.tool_tip_vector.x;
202             line_iss >> res.tool_tip_vector.y;
203             line_iss >> res.tool_tip_vector.z;
204         }
205
206         if (line.find("tool_tip") == 0)
207         {
208             std::getline(file, line);
209             std::istringstream line_iss(line);
210
211             // read point
212             line_iss >> res.tool_tip.x;
213             line_iss >> res.tool_tip.y;
214             line_iss >> res.tool_tip.z;
215         }
216
217         if (line.find("tool_quaternion") == 0)
218         {
219             std::getline(file, line);
220             std::istringstream line_iss(line);
221
222             // read point
223             line_iss >> res.tool_quaternion.w;
224             line_iss >> res.tool_quaternion.x;
225             line_iss >> res.tool_quaternion.y;
226             line_iss >> res.tool_quaternion.z;
227         }
228
229         if (line.find("tool_heel") == 0)
230         {
231             std::getline(file, line);
232             std::istringstream line_iss(line);
233
234             // read point
235             line_iss >> res.tool_heel.x;
236             line_iss >> res.tool_heel.y;
237             line_iss >> res.tool_heel.z;
238         }
239     }
240
241     // ROS_INFO_STREAM("Before: \n" << res.tool_quaternion << "\n");
242
243     // // Transform quaternion
244     // const geometry_msgs::TransformStamped tool_2_target_transform_msg =
            findTransform("tool", "target-object");
245     // tf::Transform tool_2_target_transform;
246     // tf::Quaternion tool_quaterniion;
247     // tf::transformMsgToTF(tool_2_target_transform_msg.transform,
            tool_2_target_transform);
248     // tf::quaternionMsgToTF(res.tool_quaternion, tool_quaterniion);
249
250     // tf::Quaternion transformed_quaternion = tool_2_target_transform *
            tool_quaterniion;
251
252     // tf::quaternionTFToMsg(transformed_quaternion, res.tool_quaternion);
253
254     ROS_INFO_STREAM("Tool␣Info:␣\n"
```

```
255                         << res);
256
257         return true;
258     }
259
260  private:
261     geometry_msgs::TransformStamped findTransform(std::string object, std::string
            reference)
262     {
263         std::string object_frame = name2frame_[object];
264         std::string reference_frame = name2frame_[reference];
265
266         geometry_msgs::TransformStamped transform_stamped;
267
268         try
269         {
270             transform_stamped = tfBuffer.lookupTransform(
271                 object_frame, reference_frame, ros::Time(0), ros::Duration(10.0));
272         }
273         catch (tf2::TransformException &ex)
274         {
275             ROS_ERROR("Reference point lookup failed");
276             throw;
277         }
278
279         return transform_stamped;
280     }
281  };
282
283  int main(int argc, char **argv)
284  {
285     ros::init(argc, argv, "feature_detector");
286
287     FeatureDetector detector;
288     ros::spin();
289
290     return 0;
291  }
```

```cpp
1   #include <ros/ros.h>
2   #include <actionlib/server/simple_action_server.h>
3   #include <skill_transfer/MoveArmAction.h>
4   #include <geometry_msgs/Twist.h>
5   #include <sensor_msgs/JointState.h>
6   #include <visualization_msgs/Marker.h>
7   #include <giskard_core/giskard_core.hpp>
8   #include "skill_transfer/conversions.h"
9   #include "skill_transfer/giskard_adapter.h"
10  #include <vector>
11  #include <string>
12  #include <algorithm>
13  #include "skill_transfer/watchdog.hpp"
14
15  class ConstraintController
16  {
17  public:
18    ConstraintController(std::string name) : as_(nh_, name, false),
19                                             action_name_(name),
20                                             giskard_adapter_(100)
21    {
22      joint_names_ = {
23          "torso_lift_joint",
24          "l_shoulder_pan_joint",
25          "l_shoulder_lift_joint",
26          "l_upper_arm_roll_joint",
27          "l_elbow_flex_joint",
28          "l_forearm_roll_joint",
29          "l_wrist_flex_joint",
30          "l_wrist_roll_joint",
31          "r_shoulder_pan_joint",
32          "r_shoulder_lift_joint",
33          "r_upper_arm_roll_joint",
34          "r_elbow_flex_joint",
35          "r_forearm_roll_joint",
36          "r_wrist_flex_joint",
37          "r_wrist_roll_joint"};
38
39      //register the goal and feeback callbacks
40      as_.registerGoalCallback(boost::bind(&ConstraintController::onGoal, this));
41      as_.registerPreemptCallback(boost::bind(&ConstraintController::onPreempt,
42          this));
43      //subscribe to the data topic of interest
44      sub_ = nh_.subscribe("/joint_states", 1, &ConstraintController::
45          onJointStatesMsg, this,
                            ros::TransportHints().tcpNoDelay());
46
47      // Topic for real PR2 commands (joint velocities)
48      pub_ = nh_.advertise<sensor_msgs::JointState>("/whole_body_controller/
49          velocity_controller/command", 1);
50      // Topic for simulation and executive node, since they only
51      // care about the end effector velocity and not about joint velocities
        pub_gripper_ = nh_.advertise<geometry_msgs::Twist>("/set_l_ee_twist", 1);
52      pub_gripper_measured_ = nh_.advertise<geometry_msgs::Twist>("/l_ee_twist",
```

```
                  1);
53        // Desired motion state visualization for RViz
54        pub_viz_ = nh_.advertise<visualization_msgs::Marker>("/giskard/
              visualization_marker", 1);
55
56        watchdog_.setPeriod(ros::Duration(0.1));
57
58        as_.start();
59      }
60
61      ~ConstraintController()
62      {
63      }
64
65      void onGoal()
66      {
67        // Accept goal and get new constraints
68        const auto goal = as_.acceptNewGoal();
69        constraints_ = goal->constraints;
70
71        ROS_INFO("%s:␣Received␣a␣new␣goal", action_name_.c_str());
72
73        giskard_adapter_.createController(constraints_);
74        watchdog_.kick(ros::Time::now());
75      }
76
77      void onPreempt()
78      {
79        ROS_INFO("%s:␣Preempted", action_name_.c_str());
80        // set the action state to preempted
81        as_.setPreempted();
82      }
83
84      void onJointStatesMsg(const sensor_msgs::JointStateConstPtr &msg)
85      {
86        if (watchdog_.barking(msg->header.stamp))
87        {
88          // ROS_INFO("BARKING");
89          return;
90        }
91
92        // Link state map
93        auto joint_positions_map = toMap<std::string, double>(msg->name, msg->
              position);
94        auto joint_velocities_map = toMap<std::string, double>(msg->name, msg->
              velocity);
95
96        auto joint_count = joint_names_.size();
97
98        // When action is not active send zero twist,
99        // otherwise do all the calculations
100       if (as_.isActive())
101       {
102         // Prepare controller inputs
103
104         Eigen::VectorXd inputs(joint_count);
105
```

```
106         for (int i = 0; i < joint_count; ++i)
107         {
108             inputs(i) = joint_positions_map.find(joint_names_[i])->second;
109         }
110
111         Eigen::VectorXd velocities(joint_count);
112
113         for (int i = 0; i < joint_count; ++i)
114         {
115             velocities(i) = joint_velocities_map.find(joint_names_[i])->second;
116         }
117
118         // Start the controller if it's a new one
119         if (!giskard_adapter_.controller_started_)
120         {
121             giskard_adapter_.startController(inputs);
122         }
123
124         // Get new calculations from the controller
125         giskard_adapter_.updateController(inputs);
126
127         const auto ee_twist_desired = giskard_adapter_.getDesiredFrameTwistMsg(
                inputs, "left_ee");
128         const auto ee_twist_measured = giskard_adapter_.getMeasuredFrameTwistMsg(
                inputs, velocities, "left_ee");
129         const auto cmd = giskard_adapter_.getDesiredJointVelocityMsg();
130
131         // ROS_INFO_STREAM("ee_twist_desired" << ee_twist_desired);
132
133         pub_.publish(cmd);
134         pub_gripper_.publish(ee_twist_desired);
135         pub_gripper_measured_.publish(ee_twist_measured);
136
137         feedback_.distance = giskard_adapter_.getDistance();
138         as_.publishFeedback(feedback_);
139
140         // Visualization
141         const auto viz_msgs = giskard_adapter_.getVisualizationMsgs();
142
143         for (const auto &m : viz_msgs)
144         {
145             pub_viz_.publish(m);
146         }
147     }
148     else
149     {
150         Eigen::VectorXd velocities(joint_count);
151
152         for (int i = 0; i < joint_count; ++i)
153         {
154             velocities(i) = 0.0;
155         }
156
157         auto cmd = eigenVectorToMsgJointState(velocities);
158
159         pub_.publish(cmd);
160     }
```

```cpp
161
162        watchdog_.kick(ros::Time::now());
163        // ROS_INFO_STREAM("Twist: " << cmd.twist);
164    }
165
166  protected:
167    ros::NodeHandle nh_;
168    actionlib::SimpleActionServer<skill_transfer::MoveArmAction> as_;
169    std::string action_name_;
170    ros::Subscriber sub_;
171    ros::Publisher pub_;
172    ros::Publisher pub_gripper_;
173    ros::Publisher pub_gripper_measured_;
174    ros::Publisher pub_viz_;
175    std::string constraints_;
176    skill_transfer::MoveArmFeedback feedback_;
177    GiskardAdapter giskard_adapter_;
178    std::vector<std::string> joint_names_;
179    giskard_ros::Watchdog<ros::Time, ros::Duration> watchdog_;
180  };
181
182  int main(int argc, char **argv)
183  {
184    ros::init(argc, argv, "constraint_controller");
185
186    ConstraintController controller("move_arm");
187    ros::spin();
188
189    return 0;
190  }
```

```
1  #include <ros/ros.h>
2  #include <actionlib/client/simple_action_client.h>
3  #include <actionlib/client/terminal_state.h>
4  #include <geometry_msgs/Twist.h>
5  #include <gazebo_msgs/ContactsState.h>
6
7  #include <skill_transfer/StopCondition.h>
8  #include <skill_transfer/GetTaskSpec.h>
9  #include <skill_transfer/GetMotionSpec.h>
10 #include <skill_transfer/MoveArmAction.h>
11
12 #include "skill_transfer/twist_log.h"
13
14 class TaskExecutive
15 {
16 private:
17   // Possible internal states of the node
18   enum State
19   {
20     Created,
21     Initialized,
22     Waiting,
23     ObtainingTaskSpec,
24     Ready,
25     ObtainingMotionSpec,
26     Running,
27     Stopped,
28     Finished
29   };
30   // State
31   State state_ = State::Created;
32   // ROS handles
33   ros::NodeHandle node_handle_;
34   ros::Subscriber ee_twist_subscriber_;
35   ros::Subscriber set_ee_twist_subscriber_;
36   ros::Subscriber r_ee_twist_subscriber_;
37   ros::Subscriber set_r_ee_twist_subscriber_;
38   ros::Subscriber r_ee_2_twist_subscriber_;
39   ros::Subscriber set_r_ee_2_twist_subscriber_;
40   ros::Subscriber tool_contact_subscriber_;
41   ros::ServiceClient task_spec_service_client_;
42   ros::ServiceClient motion_spec_service_client_;
43   actionlib::SimpleActionClient<skill_transfer::MoveArmAction>
44       constraint_action_server_;
45   // Motion control variables
46   int phase_count_;
47   int phase_index_;
48   TwistLog velocity_log_;
49   TwistLog command_log_;
50   double goal_distance_;
51   skill_transfer::StopCondition stop_condition_;
52   std::string spec_;
53
54 public:
55   TaskExecutive() : node_handle_("~"),
```

```
55                        constraint_action_server_("move_arm", true),
56                        velocity_log_(10),
57                        command_log_(10)
58    {
59      ee_twist_subscriber_ = node_handle_.subscribe("/l_ee_twist", 1,
60                                            &TaskExecutive::onEeTwistMsg,
61                                                this);
62      set_ee_twist_subscriber_ = node_handle_.subscribe("/set_l_ee_twist", 1,
63                                            &TaskExecutive::
                                                  onSetEeTwistMsg, this);
64      r_ee_twist_subscriber_ = node_handle_.subscribe("/r_ee_twist", 1,
65                                            &TaskExecutive::onEeTwistMsg,
66                                                this);
67      set_r_ee_twist_subscriber_ = node_handle_.subscribe("/set_r_ee_twist", 1,
                                            &TaskExecutive::
                                                  onSetEeTwistMsg, this);
68
69      r_ee_2_twist_subscriber_ = node_handle_.subscribe("/r_ee_2_twist", 1,
70                                            &TaskExecutive::onEeTwistMsg,
                                                this);
71      set_r_ee_2_twist_subscriber_ = node_handle_.subscribe("/set_r_ee_2_twist",
            1,
72                                            &TaskExecutive::
                                                  onSetEeTwistMsg, this);
73
74      tool_contact_subscriber_ = node_handle_.subscribe("/
            tool_contact_sensor_state", 1,
75                                            &TaskExecutive::
                                                  onToolContactSensorStateMsg
                                                  , this);
76
77      task_spec_service_client_ = node_handle_.serviceClient<skill_transfer::
            GetTaskSpec>("/knowledge_manager/get_task_spec");
78      motion_spec_service_client_ = node_handle_.serviceClient<skill_transfer::
            GetMotionSpec>("/knowledge_manager/get_motion_spec");
79
80      state_ = State::Initialized;
81    }
82
83    void start()
84    {
85      ROS_ASSERT(state_ == State::Initialized);
86
87      // Wait for the 3rd parties
88      state_ = State::Waiting;
89
90      task_spec_service_client_.waitForExistence();
91      motion_spec_service_client_.waitForExistence();
92      constraint_action_server_.waitForServer();
93
94      // Obtain the number of phases
95      state_ = State::ObtainingTaskSpec;
96
97      skill_transfer::GetTaskSpec srv;
98
99      if (!task_spec_service_client_.call(srv))
```

```
100        {
101            throw std::runtime_error("Failed to call service get_task_spec");
102        }
103
104        phase_count_ = srv.response.motion_phase_count;
105
106        state_ = State::Ready;
107
108        ROS_INFO("Press any key to begin the motion");
109
110        //std::getchar();
111
112        // Start the motion
113        startPhase(0);
114    }
115
116    void onEeTwistMsg(const geometry_msgs::TwistConstPtr &msg)
117    {
118        if (state_ != State::Running)
119        {
120            return;
121        }
122
123        // Save twist to log
124        velocity_log_.push(*msg);
125
126        checkMeasuredVelocityStop();
127    }
128
129    void onSetEeTwistMsg(const geometry_msgs::TwistConstPtr &msg)
130    {
131        // Do not track velocities until the motion starts
132        if (state_ != State::Running)
133        {
134            return;
135        }
136
137        // Save twist to log
138        command_log_.push(*msg);
139
140        checkDesiredVelocityStop();
141    }
142
143    void onToolContactSensorStateMsg(const gazebo_msgs::ContactsStatePtr
144                                     &msg)
145    {
146        // Do not track contact until the motion starts
147        if (state_ != State::Running)
148        {
149            return;
150        }
151
152        // Continue only when there's a contact
153        if (msg->states.size() == 0)
154            return;
155
156        checkContactStop();
```

```
157        }
158
159        void onFinish(const actionlib::SimpleClientGoalState &state,
160                      const skill_transfer::MoveArmResultConstPtr &result)
161        {
162          // This should never happen, as constraint_controller doesn't
163          // ever finish.
164          ROS_INFO("Finished␣in␣state␣[%s]", state.toString().c_str());
165          ros::shutdown();
166        }
167
168        void onFeedback(const skill_transfer::MoveArmFeedbackConstPtr &feedback)
169        {
170          goal_distance_ = feedback->distance;
171        }
172
173    private:
174        void startPhase(int index)
175        {
176          ROS_ASSERT(index >= 0 && index < phase_count_);
177          ROS_ASSERT(state_ == State::Ready);
178
179          state_ = State::ObtainingMotionSpec;
180
181          // Obtain the motion spec
182          skill_transfer::GetMotionSpec srv;
183
184          srv.request.index = index;
185
186          if (!motion_spec_service_client_.call(srv))
187          {
188            throw std::runtime_error("Failed␣to␣call␣service␣get_task_spec");
189          }
190
191          spec_ = srv.response.spec;
192          stop_condition_ = srv.response.stop_condition;
193
194          state_ = State::Stopped;
195
196          phase_index_ = index;
197
198          goal_distance_ = std::numeric_limits<double>::infinity();
199          velocity_log_.clear();
200          command_log_.clear();
201
202          // Create and send goal
203          skill_transfer::MoveArmGoal goal;
204          goal.constraints = spec_;
205          // ROS_INFO("Spec:");
206          // ROS_INFO_STREAM(spec_);
207
208          ROS_INFO("Sending␣new␣goal.");
209
210          constraint_action_server_
211              .sendGoal(goal,
212                        boost::bind(&TaskExecutive::onFinish, this, _1, _2),
213                        actionlib::SimpleActionClient<skill_transfer::MoveArmAction>::
```

```
                          SimpleActiveCallback(),
214                   boost::bind(&TaskExecutive::onFeedback, this, _1));
215
216     state_ = State::Running;
217   }
218
219   void finish()
220   {
221     constraint_action_server_.cancelGoal();
222
223     state_ = State::Finished;
224   }
225
226   void checkDesiredVelocityStop()
227   {
228     if (goal_distance_ > stop_condition_.activation_distance)
229     {
230       return;
231     }
232
233     if (!command_log_.allFilledAndBelowThreshold(stop_condition_.
            desired_velocity_min))
234     {
235       return;
236     }
237
238     ROS_INFO("Desired Velocity Stop");
239
240     completePhase();
241   }
242
243   void checkMeasuredVelocityStop()
244   {
245     if (goal_distance_ > stop_condition_.activation_distance)
246     {
247       return;
248     }
249
250     if (!velocity_log_.allFilledAndBelowThreshold(stop_condition_.
            measured_velocity_min))
251     {
252       return;
253     }
254
255     ROS_INFO("Measured Velocity Stop");
256
257     completePhase();
258   }
259
260   void checkContactStop()
261   {
262     if (!stop_condition_.contact)
263     {
264       return;
265     }
266
267     if (goal_distance_ > stop_condition_.activation_distance)
```

```
268        {
269            return;
270        }
271
272        ROS_INFO_STREAM("Contact Stop");
273
274        completePhase();
275    }
276
277    void completePhase()
278    {
279        state_  = State::Stopped;
280
281        int next_phase_index = phase_index_ + 1;
282
283        state_  = State::Ready;
284
285        if (phase_count_ > next_phase_index)
286        {
287            ROS_INFO("Next");
288            startPhase(next_phase_index);
289        }
290        else
291        {
292            ROS_INFO("Finish");
293            finish();
294        }
295    }
296 };
297
298 int main(int argc, char **argv)
299 {
300    ros::init(argc, argv, "task_executive");
301    TaskExecutive executive;
302    executive.start();
303    ros::spin();
304
305    return 0;
306 }
```

271 TestResults

```
 1  grabbing_book 10
 2  first - 10
 3  second - 6
 4  Success - 10
 5  freezer_box 10
 6  first - 10
 7  second - 9
 8  Success - 0
 9  freezer_box2 10
10  first - 10
11  second - 10
12  Success - 0
13
14  TestName - Attempts - FirstJoint - SecondJoint - Success
15
16  Freezer_box    - 11 - 11 - 9 - 9
17  Freezer_box2   - 11 - 11 - 4 - 0
18  Freezer_box3   - 11 - 11 - 3 - 0
19  Freezer_box4   - 11 - 11 - 7 - 0
20  Freezer_box5   - 11 - 11 - 6 - 0
21  Freezer_box6   - 11 - 9  - 6 - 0
22  Freezer_box7   - 11 - 11 - 5 - 5
23  Book_on_shelf  - 11 - 11 - 8 - 8
24  Book_on_shelf2 - 11 - 11 - 5 - 1
25  Book_on_shelf3 - 11 - 11 - 2 - 2
26  Book_on_shelf4 - 11 - 11 - 5 - 0
27  Book_on_shelf5 - 11 - 11 - 8 - 8
28  Book_on_shelf6 - 11 - 11 - 5 - 5
29  Book_on_shelf7 - 11 - 11 - 2 - 2
30  Book_on_shelf8 - 11 - 0  - 0 - 0
```

272 action/MoveArm.action

```
1  # The goal
2  string constraints
3  ---
4  # The result
5  float64 distance
6  ---
7  # The feedback
8  float64 distance
```

273   config/simulator.rviz

```
 1  Panels:
 2    - Class: rviz/Displays
 3      Help Height: 78
 4      Name: Displays
 5      Property Tree Widget:
 6        Expanded:
 7          - /Global Options1
 8          - /Status1
 9        Splitter Ratio: 0.5
10      Tree Height: 890
11    - Class: rviz/Selection
12      Name: Selection
13    - Class: rviz/Tool Properties
14      Expanded:
15        - /2D Pose Estimate1
16        - /2D Nav Goal1
17        - /Publish Point1
18      Name: Tool Properties
19      Splitter Ratio: 0.588679
20    - Class: rviz/Views
21      Expanded:
22        - /Current View1
23      Name: Views
24      Splitter Ratio: 0.5
25    - Class: rviz/Time
26      Experimental: false
27      Name: Time
28      SyncMode: 0
29      SyncSource: ""
30  Visualization Manager:
31    Class: ""
32    Displays:
33      - Alpha: 0.5
34        Cell Size: 1
35        Class: rviz/Grid
36        Color: 160; 160; 164
37        Enabled: true
38        Line Style:
39          Line Width: 0.03
40          Value: Lines
41        Name: Grid
42        Normal Cell Count: 0
43        Offset:
44          X: 0
45          Y: 0
46          Z: 0
47        Plane: XY
48        Plane Cell Count: 10
49        Reference Frame: <Fixed Frame>
50        Value: true
51      - Alpha: 1
52        Class: rviz/RobotModel
53        Collision Enabled: false
54        Enabled: true
55        Links:
```

```
56          All Links Enabled: true
57          Expand Joint Details: false
58          Expand Link Details: false
59          Expand Tree: false
60          Link Tree Style: Links in Alphabetic Order
61          base_bellow_link:
62            Alpha: 1
63            Show Axes: false
64            Show Trail: false
65            Value: true
66          base_footprint:
67            Alpha: 1
68            Show Axes: false
69            Show Trail: false
70            Value: true
71          base_laser_link:
72            Alpha: 1
73            Show Axes: false
74            Show Trail: false
75          base_link:
76            Alpha: 1
77            Show Axes: false
78            Show Trail: false
79            Value: true
80          bl_caster_l_wheel_link:
81            Alpha: 1
82            Show Axes: false
83            Show Trail: false
84            Value: true
85          bl_caster_r_wheel_link:
86            Alpha: 1
87            Show Axes: false
88            Show Trail: false
89            Value: true
90          bl_caster_rotation_link:
91            Alpha: 1
92            Show Axes: false
93            Show Trail: false
94            Value: true
95          br_caster_l_wheel_link:
96            Alpha: 1
97            Show Axes: false
98            Show Trail: false
99            Value: true
100         br_caster_r_wheel_link:
101           Alpha: 1
102           Show Axes: false
103           Show Trail: false
104           Value: true
105         br_caster_rotation_link:
106           Alpha: 1
107           Show Axes: false
108           Show Trail: false
109           Value: true
110         double_stereo_link:
111           Alpha: 1
112           Show Axes: false
```

```
113                    Show Trail: false
114                    Value: true
115              fl_caster_l_wheel_link:
116                    Alpha: 1
117                    Show Axes: false
118                    Show Trail: false
119                    Value: true
120              fl_caster_r_wheel_link:
121                    Alpha: 1
122                    Show Axes: false
123                    Show Trail: false
124                    Value: true
125              fl_caster_rotation_link:
126                    Alpha: 1
127                    Show Axes: false
128                    Show Trail: false
129                    Value: true
130              fr_caster_l_wheel_link:
131                    Alpha: 1
132                    Show Axes: false
133                    Show Trail: false
134                    Value: true
135              fr_caster_r_wheel_link:
136                    Alpha: 1
137                    Show Axes: false
138                    Show Trail: false
139                    Value: true
140              fr_caster_rotation_link:
141                    Alpha: 1
142                    Show Axes: false
143                    Show Trail: false
144                    Value: true
145              head_mount_kinect_ir_link:
146                    Alpha: 1
147                    Show Axes: false
148                    Show Trail: false
149                    Value: true
150              head_mount_kinect_ir_optical_frame:
151                    Alpha: 1
152                    Show Axes: false
153                    Show Trail: false
154              head_mount_kinect_rgb_link:
155                    Alpha: 1
156                    Show Axes: false
157                    Show Trail: false
158                    Value: true
159              head_mount_kinect_rgb_optical_frame:
160                    Alpha: 1
161                    Show Axes: false
162                    Show Trail: false
163              head_mount_link:
164                    Alpha: 1
165                    Show Axes: false
166                    Show Trail: false
167                    Value: true
168              head_mount_prosilica_link:
169                    Alpha: 1
```

```
170              Show Axes: false
171              Show Trail: false
172              Value: true
173          head_mount_prosilica_optical_frame:
174            Alpha: 1
175            Show Axes: false
176            Show Trail: false
177          head_pan_link:
178            Alpha: 1
179            Show Axes: false
180            Show Trail: false
181            Value: true
182          head_plate_frame:
183            Alpha: 1
184            Show Axes: false
185            Show Trail: false
186            Value: true
187          head_tilt_link:
188            Alpha: 1
189            Show Axes: false
190            Show Trail: false
191            Value: true
192          high_def_frame:
193            Alpha: 1
194            Show Axes: false
195            Show Trail: false
196          high_def_optical_frame:
197            Alpha: 1
198            Show Axes: false
199            Show Trail: false
200          imu_link:
201            Alpha: 1
202            Show Axes: false
203            Show Trail: false
204          l_elbow_flex_link:
205            Alpha: 1
206            Show Axes: false
207            Show Trail: false
208            Value: true
209          l_force_torque_adapter_link:
210            Alpha: 1
211            Show Axes: false
212            Show Trail: false
213          l_force_torque_link:
214            Alpha: 1
215            Show Axes: false
216            Show Trail: false
217            Value: true
218          l_forearm_cam_frame:
219            Alpha: 1
220            Show Axes: false
221            Show Trail: false
222          l_forearm_cam_optical_frame:
223            Alpha: 1
224            Show Axes: false
225            Show Trail: false
226          l_forearm_link:
```

```
227                    Alpha: 1
228                    Show Axes: false
229                    Show Trail: false
230                    Value: true
231                  l_forearm_roll_link:
232                    Alpha: 1
233                    Show Axes: false
234                    Show Trail: false
235                    Value: true
236                  l_gripper_l_finger_link:
237                    Alpha: 1
238                    Show Axes: false
239                    Show Trail: false
240                    Value: true
241                  l_gripper_l_finger_tip_frame:
242                    Alpha: 1
243                    Show Axes: false
244                    Show Trail: false
245                  l_gripper_l_finger_tip_link:
246                    Alpha: 1
247                    Show Axes: false
248                    Show Trail: false
249                    Value: true
250                  l_gripper_led_frame:
251                    Alpha: 1
252                    Show Axes: false
253                    Show Trail: false
254                  l_gripper_motor_accelerometer_link:
255                    Alpha: 1
256                    Show Axes: false
257                    Show Trail: false
258                    Value: true
259                  l_gripper_motor_screw_link:
260                    Alpha: 1
261                    Show Axes: false
262                    Show Trail: false
263                  l_gripper_motor_slider_link:
264                    Alpha: 1
265                    Show Axes: false
266                    Show Trail: false
267                  l_gripper_palm_link:
268                    Alpha: 1
269                    Show Axes: false
270                    Show Trail: false
271                    Value: true
272                  l_gripper_r_finger_link:
273                    Alpha: 1
274                    Show Axes: false
275                    Show Trail: false
276                    Value: true
277                  l_gripper_r_finger_tip_link:
278                    Alpha: 1
279                    Show Axes: false
280                    Show Trail: false
281                    Value: true
282                  l_gripper_tool_frame:
283                    Alpha: 1
```

```
284            Show Axes: false
285            Show Trail: false
286        l_shoulder_lift_link:
287          Alpha: 1
288          Show Axes: false
289          Show Trail: false
290          Value: true
291        l_shoulder_pan_link:
292          Alpha: 1
293          Show Axes: false
294          Show Trail: false
295          Value: true
296        l_torso_lift_side_plate_link:
297          Alpha: 1
298          Show Axes: false
299          Show Trail: false
300        l_upper_arm_link:
301          Alpha: 1
302          Show Axes: false
303          Show Trail: false
304          Value: true
305        l_upper_arm_roll_link:
306          Alpha: 1
307          Show Axes: false
308          Show Trail: false
309          Value: true
310        l_wrist_flex_link:
311          Alpha: 1
312          Show Axes: false
313          Show Trail: false
314          Value: true
315        l_wrist_roll_link:
316          Alpha: 1
317          Show Axes: false
318          Show Trail: false
319          Value: true
320        laser_tilt_link:
321          Alpha: 1
322          Show Axes: false
323          Show Trail: false
324        laser_tilt_mount_link:
325          Alpha: 1
326          Show Axes: false
327          Show Trail: false
328          Value: true
329        narrow_stereo_l_stereo_camera_frame:
330          Alpha: 1
331          Show Axes: false
332          Show Trail: false
333        narrow_stereo_l_stereo_camera_optical_frame:
334          Alpha: 1
335          Show Axes: false
336          Show Trail: false
337        narrow_stereo_link:
338          Alpha: 1
339          Show Axes: false
340          Show Trail: false
```

```
341            narrow_stereo_optical_frame:
342              Alpha: 1
343              Show Axes: false
344              Show Trail: false
345            narrow_stereo_r_stereo_camera_frame:
346              Alpha: 1
347              Show Axes: false
348              Show Trail: false
349            narrow_stereo_r_stereo_camera_optical_frame:
350              Alpha: 1
351              Show Axes: false
352              Show Trail: false
353            projector_wg6802418_child_frame:
354              Alpha: 1
355              Show Axes: false
356              Show Trail: false
357            projector_wg6802418_frame:
358              Alpha: 1
359              Show Axes: false
360              Show Trail: false
361            r_elbow_flex_link:
362              Alpha: 1
363              Show Axes: false
364              Show Trail: false
365              Value: true
366            r_forearm_cam_frame:
367              Alpha: 1
368              Show Axes: false
369              Show Trail: false
370            r_forearm_cam_optical_frame:
371              Alpha: 1
372              Show Axes: false
373              Show Trail: false
374            r_forearm_link:
375              Alpha: 1
376              Show Axes: false
377              Show Trail: false
378              Value: true
379            r_forearm_roll_link:
380              Alpha: 1
381              Show Axes: false
382              Show Trail: false
383              Value: true
384            r_gripper_l_finger_link:
385              Alpha: 1
386              Show Axes: false
387              Show Trail: false
388              Value: true
389            r_gripper_l_finger_tip_frame:
390              Alpha: 1
391              Show Axes: false
392              Show Trail: false
393            r_gripper_l_finger_tip_link:
394              Alpha: 1
395              Show Axes: false
396              Show Trail: false
397              Value: true
```

```
398            r_gripper_led_frame:
399              Alpha: 1
400              Show Axes: false
401              Show Trail: false
402            r_gripper_motor_accelerometer_link:
403              Alpha: 1
404              Show Axes: false
405              Show Trail: false
406              Value: true
407            r_gripper_motor_screw_link:
408              Alpha: 1
409              Show Axes: false
410              Show Trail: false
411            r_gripper_motor_slider_link:
412              Alpha: 1
413              Show Axes: false
414              Show Trail: false
415            r_gripper_palm_link:
416              Alpha: 1
417              Show Axes: false
418              Show Trail: false
419              Value: true
420            r_gripper_r_finger_link:
421              Alpha: 1
422              Show Axes: false
423              Show Trail: false
424              Value: true
425            r_gripper_r_finger_tip_link:
426              Alpha: 1
427              Show Axes: false
428              Show Trail: false
429              Value: true
430            r_gripper_tool_frame:
431              Alpha: 1
432              Show Axes: false
433              Show Trail: false
434            r_shoulder_lift_link:
435              Alpha: 1
436              Show Axes: false
437              Show Trail: false
438              Value: true
439            r_shoulder_pan_link:
440              Alpha: 1
441              Show Axes: false
442              Show Trail: false
443              Value: true
444            r_torso_lift_side_plate_link:
445              Alpha: 1
446              Show Axes: false
447              Show Trail: false
448            r_upper_arm_link:
449              Alpha: 1
450              Show Axes: false
451              Show Trail: false
452              Value: true
453            r_upper_arm_roll_link:
454              Alpha: 1
```

```
          Show Axes: false
          Show Trail: false
          Value: true
        r_wrist_flex_link:
          Alpha: 1
          Show Axes: false
          Show Trail: false
          Value: true
        r_wrist_roll_link:
          Alpha: 1
          Show Axes: false
          Show Trail: false
          Value: true
        sensor_mount_link:
          Alpha: 1
          Show Axes: false
          Show Trail: false
          Value: true
        torso_lift_link:
          Alpha: 1
          Show Axes: false
          Show Trail: false
          Value: true
        torso_lift_motor_screw_link:
          Alpha: 1
          Show Axes: false
          Show Trail: false
        wide_stereo_l_stereo_camera_frame:
          Alpha: 1
          Show Axes: false
          Show Trail: false
        wide_stereo_l_stereo_camera_optical_frame:
          Alpha: 1
          Show Axes: false
          Show Trail: false
        wide_stereo_link:
          Alpha: 1
          Show Axes: false
          Show Trail: false
        wide_stereo_optical_frame:
          Alpha: 1
          Show Axes: false
          Show Trail: false
        wide_stereo_r_stereo_camera_frame:
          Alpha: 1
          Show Axes: false
          Show Trail: false
        wide_stereo_r_stereo_camera_optical_frame:
          Alpha: 1
          Show Axes: false
          Show Trail: false
      Name: RobotModel
      Robot Description: robot_description
      TF Prefix: ""
      Update Interval: 0
      Value: true
      Visual Enabled: true
```

```
512    Enabled: true
513    Global Options:
514      Background Color: 48; 48; 48
515      Fixed Frame: map
516      Frame Rate: 30
517    Name: root
518    Tools:
519      - Class: rviz/Interact
520        Hide Inactive Objects: true
521      - Class: rviz/MoveCamera
522      - Class: rviz/Select
523      - Class: rviz/FocusCamera
524      - Class: rviz/Measure
525      - Class: rviz/SetInitialPose
526        Topic: /initialpose
527      - Class: rviz/SetGoal
528        Topic: /move_base_simple/goal
529      - Class: rviz/PublishPoint
530        Single click: true
531        Topic: /clicked_point
532    Value: true
533    Views:
534      Current:
535        Class: rviz/Orbit
536        Distance: 2.45918
537        Enable Stereo Rendering:
538          Stereo Eye Separation: 0.06
539          Stereo Focal Distance: 1
540          Swap Stereo Eyes: false
541          Value: false
542        Focal Point:
543          X: 0.5601
544          Y: -0.301017
545          Z: 1.21782
546        Name: Current View
547        Near Clip Distance: 0.01
548        Pitch: 0.439797
549        Target Frame: <Fixed Frame>
550        Value: Orbit (rviz)
551        Yaw: 6.24358
552      Saved: ~
553  Window Geometry:
554    Displays:
555      collapsed: false
556    Height: 1176
557    Hide Left Dock: false
558    Hide Right Dock: true
559    QMainWindow State: 000000
         ff00000000fd0000000400000000000016b00000409fc0200000008fb0000001200530065006c006500630074006f006e
```
```
560    Selection:
561      collapsed: false
562    Time:
563      collapsed: false
564    Tool Properties:
565      collapsed: false
566    Views:
```

```
567        collapsed: true
568    Width: 1855
569    X: 65
570    Y: 24
```

274   Readme.md

```
1   ### IROS 2018
2   # Skill Transfer
3
4   ROS package that realises transfer of manipulation skills from known objects and
        situations to new, unseen objects and their setups.
5
6   ## Requirements
7
8   This package is **Developed and Tested on ROS Kinetic**.
9   At it's core, the system makes use of Giskard library for robot control: https
        ://github.com/SemRoCo/giskard_core
10
11  ## Architecture
12
13  The package consists of multiple ROS nodes that work collectively for achieving
        the desired effects. They communicate in roughly following manner:
14
15  ```
16  [FeatureDetector] <--> [KnowledgeManager] <--> [TaskExecutive] --> [
        ConstraintController] --> <Actuators >
17  ```
18
19  *KnowledgeManager* manages all specs needed for the task.
20
21  *TaskExecutive* is the main node that supervises the whole process and sends
        requests to all other nodes.
22
23  *FeatureDetector* finds desired object features (edge-point, ...)
24
25  *ConstraintController* uses Giskard internally, translates motion description
        files into desired joint velocities.
26
27  ### The Process
28
29  The whole process begins with *KnowledgeManager* reading task and setup YAML
        files. It decides what visual features are missing
30  from the description and asks *FeatureDetector* for them. Once the specs are
        ready *TaskExecutive* asks for them and the moiton sequence begins.
31  *KnowledgeManager* provides individual motion specs to the *TaskExecutive*
        previously combining them with appropriate motion template.
32  Such prepared motion phase file is then sent to *ConstraintController* for
        execution. While that happens *TaskExecutive* observes
33  the state of the robot and decides when to finish one phase and begin the next
        one according to the task specification file.
34  When all motion phases are done the task is considered as finished.
35
36  ### Configuration files
37
38  There are configuration files that describe different levels of the system:
        motions, tasks, setups. All files are YAML.
39
40  *robot template* specifies the kinematic chain of a robot.
41
42  *motion phase* specifies motion in terms of constraints that should be satified.
43
```

```
44  *tasks* contains a sequence of motion phases and appropriate stop conditions as
        well as required visual features that should be resolved. Those elements
        toghether form a full task description.
45
46  *setups* specifies objects that take part in the task, callibrated grasp
        transformations and handcoded visual features.
47
48  ### Supported tasks
49
50  1. Scraping butter off a tool into a container - not supported in with this
        version
51  2. Scooping a substance (e.g. grains) from a container - not supported in with
        this version
52  3. Cutting an object on a flat object/surface - not supported in with this
        version
53  4. Tilting and grabbing an object, eg a book from a bookshelf
54
55  ## Installation
56  * Install ROS, then:
57    ```
58    mkdir -p ~/catkin_ws/src
59    cd ~/catkin_ws
60    catkin init
61    cd src
62    wstool init
63    wstool merge https://raw.githubusercontent.com/Weetabixx/skill_transfer/master
        /rosinstall/catkin.rosinstall
64    wstool merge https://raw.githubusercontent.com/SemRoCo/giskard_core/master/
        rosinstall/catkin.rosinstall
65    wstool merge https://raw.githubusercontent.com/SemRoCo/giskard_pr2/master/
        rosinstall/catkin_indigo.rosinstall
66    wstool update
67    rosdep install --ignore-src --from-paths .
68    cd ..
69    catkin build
70    source ~/catkin_ws/devel/setup.bash
71    ```
72  * Install Matlab executable from here:
73    https://github.com/pauloabelha/enzymes/blob/master/Bremen/edge_detector/
        for_redistribution/edge_detector_installer.install
74    ```
75    sudo edge_detector/edge_detector.install
76    ```
77    Add edge_detector application directory to your *PATH*, so you can run it with
         only following command:
78    ```
79    run_edge_detector.sh
80    ```
81
82  ## Running
83
84  Worlds with `_v` prefix are for free end effectors simulation only, `_p` for PR2
         simulation.
85
86  Experiment launch file can be run for freely flying end effectors simulation (
        argument `robot:=free_ees`) or simulated or real PR2 (`robot:=pr2`).
87
```

```
88    ### Running with Gazebo simulator
89
90    1. Launch the Gazebo world and keep it running
91       ```
92       roslaunch skill_transfer simulation.launch world:=grabbing_book
93       ```
94
95    2. In a new terminal, launch the experiment
96       ```
97       roslaunch skill_transfer experiment.launch task:=tiltgrabbing robot:=free_ees
          setup:=book_on_shelf
98       ```
99
100   ### Running with Gazebo and iai_naive_kinematics PR2 simulator
101
102   1. Launch PR2 simulator, keep it running
103      ```
104      roslaunch skill_transfer pr2.launch
105      ```
106   2. Launch the Gazebo world, keep it running
107      ```
108      roslaunch skill_transfer simulation.launch world:=big_bowl_spatula_p
109      ```
110
111   3. In a new terminal, launch the experiment.
112      ```
113      roslaunch skill_transfer experiment.launch task:=scraping robot:=pr2 setup:=
          big_bowl_spatula
114      ```
115
116   ### Running with real robot
117
118   1. Prepare the robot.
119
120   2. Launch the experiment.
121      ```
122      roslaunch skill_transfer experiment.launch task:=scraping robot:=pr2 setup:=
          big_bowl_spatula
123      ```
```

```yaml
scope:
  # definition of some nice short-cuts
  - unit-x: {vector3: [1, 0, 0]}
  - unit-y: {vector3: [0, 1, 0]}
  - unit-z: {vector3: [0, 0, 1]}
  - identity-rot: {axis-angle: [unit-x, 0]}
  - zero-vec: {vector3: [0, 0, 0]}

  # defintion of EE FK
  - left_ee:
      frame-mul:
        - frame: [identity-rot, {vector3: [{input-var: 0}, 0, 0]}]
        - frame: [identity-rot, {vector3: [0, {input-var: 1}, 0]}]
        - frame: [identity-rot, {vector3: [0, 0, {input-var: 2}]}]
        - frame: [{axis-angle: [unit-z, {input-var: 3}]}, zero-vec]
        - frame: [{axis-angle: [unit-y, {input-var: 4}]}, zero-vec]
        - frame: [{axis-angle: [unit-x, {input-var: 5}]}, zero-vec]

  - right_ee:
      frame-mul:
        - frame: [identity-rot, {vector3: [{input-var: 6}, 0, 0]}]
        - frame: [identity-rot, {vector3: [0, {input-var: 7}, 0]}]
        - frame: [identity-rot, {vector3: [0, 0, {input-var: 8}]}]
        - frame: [{axis-angle: [unit-z, {input-var: 9}]}, zero-vec]
        - frame: [{axis-angle: [unit-y, {input-var: 10}]}, zero-vec]
        - frame: [{axis-angle: [unit-x, {input-var: 11}]}, zero-vec]

  - right_ee_2:
      frame-mul:
        - frame: [identity-rot, {vector3: [{input-var: 12}, 0, 0]}]
        - frame: [identity-rot, {vector3: [0, {input-var: 13}, 0]}]
        - frame: [identity-rot, {vector3: [0, 0, {input-var: 14}]}]
        - frame: [{axis-angle: [unit-z, {input-var: 15}]}, zero-vec]
        - frame: [{axis-angle: [unit-y, {input-var: 16}]}, zero-vec]
        - frame: [{axis-angle: [unit-x, {input-var: 17}]}, zero-vec]

  # control params
  - rot_p_gain: 3.0
  - rot_thresh: 0.1
  - weight_rot_control: 1
  - l_trans_vel_min: -0.3
  - l_trans_vel_max: 0.3
  - l_rot_vel_min: -0.5
  - l_rot_vel_max: 0.5
  - r_trans_vel_min: -0.3
  - r_trans_vel_max: 0.3
  - r_rot_vel_min: -0.5
  - r_rot_vel_max: 0.5
  - r_2_trans_vel_min: -0.3
  - r_2_trans_vel_max: 0.3
  - r_2_rot_vel_min: -0.5
  - r_2_rot_vel_max: 0.5

controllable-constraints:
  # left arm joints
```

```
56    - controllable-constraint: [l_trans_vel_min, l_trans_vel_max, controllable-
          weight, 0, l_gripper_pos_x]
57    - controllable-constraint: [l_trans_vel_min, l_trans_vel_max, controllable-
          weight, 1, l_gripper_pos_y]
58    - controllable-constraint: [l_trans_vel_min, l_trans_vel_max, controllable-
          weight, 2, l_gripper_pos_z]
59    - controllable-constraint: [l_rot_vel_min, l_rot_vel_max, controllable-weight,
          3, l_gripper_rot_x]
60    - controllable-constraint: [l_rot_vel_min, l_rot_vel_max, controllable-weight,
          4, l_gripper_rot_y]
61    - controllable-constraint: [l_rot_vel_min, l_rot_vel_max, controllable-weight,
          5, l_gripper_rot_z]
62    # right arm joints
63    - controllable-constraint: [r_trans_vel_min, r_trans_vel_max, controllable-
          weight, 6, r_gripper_pos_x]
64    - controllable-constraint: [r_trans_vel_min, r_trans_vel_max, controllable-
          weight, 7, r_gripper_pos_y]
65    - controllable-constraint: [r_trans_vel_min, r_trans_vel_max, controllable-
          weight, 8, r_gripper_pos_z]
66    - controllable-constraint: [r_rot_vel_min, r_rot_vel_max, controllable-weight,
          9, r_gripper_rot_x]
67    - controllable-constraint: [r_rot_vel_min, r_rot_vel_max, controllable-weight,
          10, r_gripper_rot_y]
68    - controllable-constraint: [r_rot_vel_min, r_rot_vel_max, controllable-weight,
          11, r_gripper_rot_z]
69
70    # second right arm joints
71    - controllable-constraint: [r_2_trans_vel_min, r_2_trans_vel_max, controllable
          -weight, 12, r_2_gripper_pos_x]
72    - controllable-constraint: [r_2_trans_vel_min, r_2_trans_vel_max, controllable
          -weight, 13, r_2_gripper_pos_y]
73    - controllable-constraint: [r_2_trans_vel_min, r_2_trans_vel_max, controllable
          -weight, 14, r_2_gripper_pos_z]
74    - controllable-constraint: [r_2_rot_vel_min, r_2_rot_vel_max, controllable-
          weight, 15, r_2_gripper_rot_x]
75    - controllable-constraint: [r_2_rot_vel_min, r_2_rot_vel_max, controllable-
          weight, 16, r_2_gripper_rot_y]
76    - controllable-constraint: [r_2_rot_vel_min, r_2_rot_vel_max, controllable-
          weight, 17, r_2_gripper_rot_z]
77
78  hard-constraints: [] # no hard constraints used in this motion
79
80  # Motion description should be appended below
```

```
1   scope:
2     # definition of some nice short-cuts
3     - unit-x: {vector3: [1, 0, 0]}
4     - unit-y: {vector3: [0, 1, 0]}
5     - unit-z: {vector3: [0, 0, 1]}
6
7     # definition of joint input variables
8     - torso_lift_joint: {input-var: 0}
9     - l_shoulder_pan_joint: {input-var: 1}
10    - l_shoulder_lift_joint: {input-var: 2}
11    - l_upper_arm_roll_joint: {input-var: 3}
12    - l_elbow_flex_joint: {input-var: 4}
13    - l_forearm_roll_joint: {input-var: 5}
14    - l_wrist_flex_joint: {input-var: 6}
15    - l_wrist_roll_joint: {input-var: 7}
16    - r_shoulder_pan_joint: {input-var: 8}
17    - r_shoulder_lift_joint: {input-var: 9}
18    - r_upper_arm_roll_joint: {input-var: 10}
19    - r_elbow_flex_joint: {input-var: 11}
20    - r_forearm_roll_joint: {input-var: 12}
21    - r_wrist_flex_joint: {input-var: 13}
22    - r_wrist_roll_joint: {input-var: 14}
23
24    # definition of joint transforms
25    - torso_lift:
26        frame: [{axis-angle: [unit-x, 0]}, {vector3: [-0.05, 0, {double-add:
               [0.739675, torso_lift_joint]}]}]
27    - l_shoulder_pan:
28        frame: [{axis-angle: [unit-z, l_shoulder_pan_joint]}, {vector3: [0.0,
               0.188, 0.0]}]
29    - l_shoulder_lift:
30        frame: [{axis-angle: [unit-y, l_shoulder_lift_joint]}, {vector3: [0.1, 0,
               0]}]
31    - l_upper_arm_roll:
32        frame: [{axis-angle: [unit-x, l_upper_arm_roll_joint]}, {vector3: [0, 0,
               0]}]
33    - l_elbow_flex:
34        frame: [{axis-angle: [unit-y, l_elbow_flex_joint]}, {vector3: [0.4, 0,
               0]}]
35    - l_forearm_roll:
36        frame: [{axis-angle: [unit-x, l_forearm_roll_joint]}, {vector3: [0, 0,
               0]}]
37    - l_wrist_flex:
38        frame: [{axis-angle: [unit-y, l_wrist_flex_joint]}, {vector3: [0.321, 0,
               0]}]
39    - l_wrist_roll:
40        frame: [{axis-angle: [unit-x, l_wrist_roll_joint]}, {vector3: [0, 0, 0]}]
41    - l_gripper_offset:
42        frame: [{axis-angle: [unit-x, 0]}, {vector3: [0.2156, 0, 0]}]
43    - r_shoulder_pan:
44        frame: [{axis-angle: [unit-z, r_shoulder_pan_joint]}, {vector3: [0,
               -0.188, 0]}]
45    - r_shoulder_lift:
46        frame: [{axis-angle: [unit-y, r_shoulder_lift_joint]}, {vector3: [0.1, 0,
               0]}]
```

```
47    - r_upper_arm_roll:
48        frame: [{axis-angle: [unit-x, r_upper_arm_roll_joint]}, {vector3: [0, 0,
              0]}]
49    - r_elbow_flex:
50        frame: [{axis-angle: [unit-y, r_elbow_flex_joint]}, {vector3: [0.4, 0,
              0]}]
51    - r_forearm_roll:
52        frame: [{axis-angle: [unit-x, r_forearm_roll_joint]}, {vector3: [0, 0,
              0]}]
53    - r_wrist_flex:
54        frame: [{axis-angle: [unit-y, r_wrist_flex_joint]}, {vector3: [0.321, 0,
              0]}]
55    - r_wrist_roll:
56        frame: [{axis-angle: [unit-x, r_wrist_roll_joint]}, {vector3: [0, 0, 0]}]
57    - r_gripper_offset:
58        frame: [{axis-angle: [unit-x, 0]}, {vector3: [0.18, 0, 0]}]
59
60    # definition of elbow FK
61    - left_elbow:
62        frame-mul:
63        - torso_lift
64        - l_shoulder_pan
65        - l_shoulder_lift
66        - l_upper_arm_roll
67        - l_elbow_flex
68    - right_elbow:
69        frame-mul:
70        - torso_lift
71        - r_shoulder_pan
72        - r_shoulder_lift
73        - r_upper_arm_roll
74        - r_elbow_flex
75
76    # defintion of EE FK
77    - left_ee:
78        frame-mul:
79        - left_elbow
80        - l_forearm_roll
81        - l_wrist_flex
82        - l_wrist_roll
83        - l_gripper_offset
84    - right_ee:
85        frame-mul:
86        - right_elbow
87        - r_forearm_roll
88        - r_wrist_flex
89        - r_wrist_roll
90        - r_gripper_offset
91
92    # control params
93    - pos_p_gain: 3.0
94    - rot_p_gain: 3.0
95    - pos_thresh: 0.05
96    - rot_thresh: 0.1
97    - weight_arm_joints: 0.001
98    - weight_torso_joint: 0.01
99    - weight_pos_control: 1
```

```
100     - weight_rot_control: 1
101     - weight_elbow_control: 0
102     - l_neg_vel_limit_arm_joints: -0.6
103     - l_pos_vel_limit_arm_joints: 0.6
104     - r_neg_vel_limit_arm_joints: 0
105     - r_pos_vel_limit_arm_joints: 0
106     - neg_vel_limit_torso_joint: -0.02
107     - pos_vel_limit_torso_joint: 0.02
108
109   controllable-constraints:
110     # torso joint
111     - controllable-constraint: [neg_vel_limit_torso_joint,
            pos_vel_limit_torso_joint, weight_torso_joint, 0, torso_lift_joint]
112     # left arm joints
113     - controllable-constraint: [l_neg_vel_limit_arm_joints,
            l_pos_vel_limit_arm_joints, weight_arm_joints, 1, l_shoulder_pan_joint]
114     - controllable-constraint: [l_neg_vel_limit_arm_joints,
            l_pos_vel_limit_arm_joints, weight_arm_joints, 2, l_shoulder_lift_joint]
115     - controllable-constraint: [l_neg_vel_limit_arm_joints,
            l_pos_vel_limit_arm_joints, weight_arm_joints, 3, l_upper_arm_roll_joint]
116     - controllable-constraint: [l_neg_vel_limit_arm_joints,
            l_pos_vel_limit_arm_joints, weight_arm_joints, 4, l_elbow_flex_joint]
117     - controllable-constraint: [l_neg_vel_limit_arm_joints,
            l_pos_vel_limit_arm_joints, weight_arm_joints, 5, l_forearm_roll_joint]
118     - controllable-constraint: [l_neg_vel_limit_arm_joints,
            l_pos_vel_limit_arm_joints, weight_arm_joints, 6, l_wrist_flex_joint]
119     - controllable-constraint: [l_neg_vel_limit_arm_joints,
            l_pos_vel_limit_arm_joints, weight_arm_joints, 7, l_wrist_roll_joint]
120     # right arm joints
121     - controllable-constraint: [r_neg_vel_limit_arm_joints,
            r_pos_vel_limit_arm_joints, weight_arm_joints, 8, r_shoulder_pan_joint]
122     - controllable-constraint: [r_neg_vel_limit_arm_joints,
            r_pos_vel_limit_arm_joints, weight_arm_joints, 9, r_shoulder_lift_joint]
123     - controllable-constraint: [r_neg_vel_limit_arm_joints,
            r_pos_vel_limit_arm_joints, weight_arm_joints, 10, r_upper_arm_roll_joint]
124     - controllable-constraint: [r_neg_vel_limit_arm_joints,
            r_pos_vel_limit_arm_joints, weight_arm_joints, 11, r_elbow_flex_joint]
125     - controllable-constraint: [r_neg_vel_limit_arm_joints,
            r_pos_vel_limit_arm_joints, weight_arm_joints, 12, r_forearm_roll_joint]
126     - controllable-constraint: [r_neg_vel_limit_arm_joints,
            r_pos_vel_limit_arm_joints, weight_arm_joints, 13, r_wrist_flex_joint]
127     - controllable-constraint: [r_neg_vel_limit_arm_joints,
            r_pos_vel_limit_arm_joints, weight_arm_joints, 14, r_wrist_roll_joint]
128
129   hard-constraints:
130     - hard-constraint:
131         - {double-sub: [0.0115, torso_lift_joint]}
132         - {double-sub: [0.325, torso_lift_joint]}
133         - torso_lift_joint
134     - hard-constraint:
135         - {double-sub: [-0.5646, l_shoulder_pan_joint]}
136         - {double-sub: [2.1353, l_shoulder_pan_joint]}
137         - l_shoulder_pan_joint
138     - hard-constraint:
139         - {double-sub: [-0.3536, l_shoulder_lift_joint]}
140         - {double-sub: [1.2963, l_shoulder_lift_joint]}
141         -  l_shoulder_lift_joint
```

```
142     - hard-constraint:
143         - {double-sub: [-0.65, l_upper_arm_roll_joint]}
144         - {double-sub: [3.75, l_upper_arm_roll_joint]}
145         - l_upper_arm_roll_joint
146     - hard-constraint:
147         - {double-sub: [-2.1213, l_elbow_flex_joint]}
148         - {double-sub: [-0.15, l_elbow_flex_joint]}
149         - l_elbow_flex_joint
150     - hard-constraint:
151         - {double-sub: [-2.0, l_wrist_flex_joint]}
152         - {double-sub: [-0.1, l_wrist_flex_joint]}
153         - l_wrist_flex_joint
154     - hard-constraint:
155         - {double-sub: [-2.1353, r_shoulder_pan_joint]}
156         - {double-sub: [0.5646, r_shoulder_pan_joint]}
157         - r_shoulder_pan_joint
158     - hard-constraint:
159         - {double-sub: [-0.3536, r_shoulder_lift_joint]}
160         - {double-sub: [1.2963, r_shoulder_lift_joint]}
161         -  r_shoulder_lift_joint
162     - hard-constraint:
163         - {double-sub: [-3.75, r_upper_arm_roll_joint]}
164         - {double-sub: [0.65, r_upper_arm_roll_joint]}
165         - r_upper_arm_roll_joint
166     - hard-constraint:
167         - {double-sub: [-2.1213, r_elbow_flex_joint]}
168         - {double-sub: [-0.15, r_elbow_flex_joint]}
169         - r_elbow_flex_joint
170     - hard-constraint:
171         - {double-sub: [-2.0, r_wrist_flex_joint]}
172         - {double-sub: [-0.1, r_wrist_flex_joint]}
173         - r_wrist_flex_joint
174
175  # Motion description should be appended below
```