ROS Lab 7

Vipul Dinesh, 220929024, MTE-A-09

1. Using the given tutorials, convert the SLDPRT parts to SLDASM, then use SW2URDF plugin to convert the given CAD to a URDF file (Note: This urdf file points to meshes/STL files for geometry)

- https://www.youtube.com/playlist?list=PLeEzO_sX5H6RgynT5Z5G1KxuytSeXoJ71
- https://github.com/ageofrobotics/urdf_tutorial

2. Create `robot_arm_urdf` package
- `cd ~/ros2_ws/src`
- `ros2 pkg create --build-type ament_python robot_arm_urdf --dependencies rclpy`

3. Make urdf and launch sub-folders in `robot_arm_urdf` package folder
- `mkdir ~/ros2_ws/src/robot_arm_urdf/urdf`
- `mkdir ~/ros2_ws/src/robot_arm_urdf/launch`

4. Create a urdf file called `robot_arm_urdf.urdf` in the urdf directory just created and fill content as follows

`robot_arm_urdf.urdf`

```xml
<?xml version="1.0"?>
<robot
 name="robot_arm_urdf">
 <link name="world"/>
 <joint name="base_joint" type="fixed">
   <parent link="world"/>
   <child link="base_link"/>
   <origin rpy="0 0 0" xyz="0.0 0.0 0.0"/>
 </joint>
 <link
   name="base_link">
   <inertial>
     <origin
       xyz="4.1633E-17 0 0.073876"
       rpy="0 0 0" />
     <mass
       value="17.147" />
     <inertia
       ixx="0.192"
       ixy="-4.9423E-10"
       ixz="1.2752E-17"
       iyy="0.192"
```

```xml
            iyz="2.6417E-18"
            izz="0.29544" />
        </inertial>
        <visual>
          <origin
            xyz="0 0 0"
            rpy="0 0 0" />
          <geometry>
            <mesh
              filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/base_link.STL" />
          </geometry>
          <material
            name="">
            <color
              rgba="0.79216 0.81961 0.93333 1" />
          </material>
        </visual>
        <collision>
          <origin
            xyz="0 0 0"
            rpy="0 0 0" />
          <geometry>
            <mesh
              filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/base_link.STL" />
          </geometry>
        </collision>
      </link>
      <link
        name="link_1">
        <inertial>
          <origin
            xyz="-2.5757E-14 0.11047 -7.8988E-11"
            rpy="0 0 0" />
          <mass
            value="3.0905" />
          <inertia
            ixx="0.026302"
            ixy="-2.5267E-15"
            ixz="-1.4177E-12"
```

```xml
              iyy="0.019632"
              iyz="-7.4535E-12"
              izz="0.025388" />
      </inertial>
      <visual>
        <origin
          xyz="0 0 0"
          rpy="0 0 0" />
        <geometry>
          <mesh

filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_1.ST
L" />
        </geometry>
        <material
          name="">
          <color
            rgba="1 1 1 1" />
        </material>
      </visual>
      <collision>
        <origin
          xyz="0 0 0"
          rpy="0 0 0" />
        <geometry>
          <mesh

filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_1.ST
L" />
        </geometry>
      </collision>
    </link>
    <joint
      name="joint_1"
      type="revolute">
      <origin
        xyz="0 0 0.2"
        rpy="1.5708 0 1.5708" />
      <parent
        link="base_link" />
      <child
        link="link_1" />
      <axis
```

```xml
            xyz="0 1 0" />
        <limit
          lower="0"
          upper="3.142"
          effort="300"
          velocity="3" />
      </joint>
      <link
        name="link_2">
        <inertial>
          <origin
            xyz="-1.1102E-16 0.16752 -2.498E-16"
            rpy="0 0 0" />
          <mass
            value="5.5867" />
          <inertia
            ixx="0.12632"
            ixy="8.4877E-17"
            ixz="7.8685E-19"
            iyy="0.011401"
            iyz="1.4432E-16"
            izz="0.12911" />
        </inertial>
        <visual>
          <origin
            xyz="0 0 0"
            rpy="0 0 0" />
          <geometry>
            <mesh
filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_2.STL" />
          </geometry>
          <material
            name="">
            <color
              rgba="0.79216 0.81961 0.93333 1" />
          </material>
        </visual>
        <collision>
          <origin
            xyz="0 0 0"
            rpy="0 0 0" />
```

```xml
        <geometry>
          <mesh
filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_2.ST
L" />
        </geometry>
      </collision>
    </link>
    <joint
      name="joint_2"
      type="revolute">
      <origin
        xyz="0 0.205 0"
        rpy="0 0 0" />
      <parent
        link="link_1" />
      <child
        link="link_2" />
      <axis
        xyz="0 0 1" />
      <limit
        lower="-1.57"
        upper="1.57"
        effort="200"
        velocity="3" />
    </joint>
    <link
      name="link_3">
      <inertial>
        <origin
          xyz="-0.17893 0 -1.249E-16"
          rpy="0 0 0" />
        <mass
          value="2.8262" />
        <inertia
          ixx="0.0074041"
          ixy="-1.7927E-17"
          ixz="4.2672E-17"
          iyy="0.028552"
          iyz="-3.4736E-10"
          izz="0.025128" />
      </inertial>
      <visual>
```

```xml
        <origin
          xyz="0 0 0"
          rpy="0 0 0" />
        <geometry>
          <mesh
            filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_3.STL" />
        </geometry>
        <material
          name="">
          <color
            rgba="0.79216 0.81961 0.93333 1" />
        </material>
      </visual>
      <collision>
        <origin
          xyz="0 0 0"
          rpy="0 0 0" />
        <geometry>
          <mesh
            filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_3.STL" />
        </geometry>
      </collision>
    </link>
    <joint
      name="joint_3"
      type="revolute">
      <origin
        xyz="0 0.4 0"
        rpy="0 0 0" />
      <parent
        link="link_2" />
      <child
        link="link_3" />
      <axis
        xyz="0 0 1" />
      <limit
        lower="0"
        upper="3.142"
        effort="200"
```

```xml
          velocity="3" />
      </joint>
      <link
        name="link_4">
        <inertial>
          <origin
            xyz="-0.051672 -2.2204E-16 -1.1102E-16"
            rpy="0 0 0" />
          <mass
            value="1.8097" />
          <inertia
            ixx="0.0023112"
            ixy="-9.6437E-18"
            ixz="-9.9829E-19"
            iyy="0.0096102"
            iyz="1.3194E-19"
            izz="0.0093908" />
        </inertial>
        <visual>
          <origin
            xyz="0 0 0"
            rpy="0 0 0" />
          <geometry>
            <mesh
              filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_4.STL" />
          </geometry>
          <material
            name="">
            <color
              rgba="0.79216 0.81961 0.93333 1" />
          </material>
        </visual>
        <collision>
          <origin
            xyz="0 0 0"
            rpy="0 0 0" />
          <geometry>
            <mesh
              filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_4.STL" />
```

```xml
        </geometry>
      </collision>
    </link>
    <joint
      name="joint_4"
      type="revolute">
      <origin
        xyz="-0.35 0 0"
        rpy="0 0 1.5708" />
      <parent
        link="link_3" />
      <child
        link="link_4" />
      <axis
        xyz="0 0 1" />
      <limit
        lower="0"
        upper="-3.142"
        effort="200"
        velocity="3" />
    </joint>
    <link
      name="link_5">
      <inertial>
        <origin
          xyz="-0.018544 0 -2.7756E-17"
          rpy="0 0 0" />
        <mass
          value="0.19053" />
        <inertia
          ixx="0.00030197"
          ixy="1.6611E-20"
          ixz="3.6309E-21"
          iyy="0.00022817"
          iyz="-1.9664E-11"
          izz="0.00011843" />
      </inertial>
      <visual>
        <origin
          xyz="0 0 0"
          rpy="0 0 0" />
        <geometry>
          <mesh
```

```xml
          filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_5.STL" />
            </geometry>
            <material
              name="">
              <color
                rgba="0.79216 0.81961 0.93333 1" />
            </material>
          </visual>
          <collision>
            <origin
              xyz="0 0 0"
              rpy="0 0 0" />
            <geometry>
              <mesh
          filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_5.STL" />
            </geometry>
          </collision>
        </link>
        <joint
          name="joint_5"
          type="revolute">
          <origin
            xyz="-0.188 0 0"
            rpy="0 0 0" />
          <parent
            link="link_4" />
          <child
            link="link_5" />
          <axis
            xyz="1 0 0" />
          <limit
            lower="0"
            upper="3.142"
            effort="200"
            velocity="3" />
        </joint>
        <link
          name="link_6">
          <inertial>
```

```xml
      <origin
        xyz="-0.60237 0.4 -0.016013"
        rpy="0 0 0" />
      <mass
        value="0.11653" />
      <inertia
        ixx="3.9246E-05"
        ixy="-9.4878E-20"
        ixz="1.0258E-05"
        iyy="7.1189E-05"
        iyz="-3.4206E-20"
        izz="8.4875E-05" />
    </inertial>
    <visual>
      <origin
        xyz="0 0 0"
        rpy="0 0 0" />
      <geometry>
        <mesh
          filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_6.STL" />
      </geometry>
      <material
        name="">
        <color
          rgba="0.79216 0.81961 0.93333 1" />
      </material>
    </visual>
    <collision>
      <origin
        xyz="0 0 0"
        rpy="0 0 0" />
      <geometry>
        <mesh
          filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_6.STL" />
      </geometry>
    </collision>
  </link>
  <joint
    name="joint_6"
```

```xml
          type="prismatic">
          <origin
            xyz="0.54 -0.4 0"
            rpy="0 0 0" />
          <parent
            link="link_5" />
          <child
            link="link_6" />
          <axis
            xyz="0 0 -1" />
          <limit
            lower="0"
            upper="0.03"
            effort="100"
            velocity="3" />
      </joint>
      <link
        name="link_7">
        <inertial>
          <origin
            xyz="-0.60237 0.4 -0.016013"
            rpy="0 0 0" />
          <mass
            value="0.11653" />
          <inertia
            ixx="3.9246E-05"
            ixy="-4.7946E-20"
            ixz="1.0258E-05"
            iyy="7.1189E-05"
            iyz="-3.946E-20"
            izz="8.4875E-05" />
        </inertial>
        <visual>
          <origin
            xyz="0 0 0"
            rpy="0 0 0" />
          <geometry>
            <mesh
filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_7.STL" />
          </geometry>
          <material
```

```xml
              name="">
                <color
                  rgba="0.79216 0.81961 0.93333 1" />
              </material>
          </visual>
          <collision>
            <origin
              xyz="0 0 0"
              rpy="0 0 0" />
            <geometry>
              <mesh
filename="/home/vipul/ros2_ws/src/robot_arm_urdf/meshes/link_7.ST
L" />
            </geometry>
          </collision>
        </link>
        <joint
          name="joint_7"
          type="prismatic">
          <origin
            xyz="0.54 0.4 0"
            rpy="3.1416 0 0" />
          <parent
            link="link_5" />
          <child
            link="link_7" />
          <axis
            xyz="0 0 1" />
          <limit
            lower="-0.03"
            upper="0"
            effort="100"
            velocity="3" />
        </joint>
        <transmission name="link_1_trans">
          <type>transmission_interface/SimpleTransmission</type>
          <joint name="joint_1">

<hardwareInterface>hardware_interface/PositionJointInterface</har
dwareInterface>
          </joint>
          <actuator name="link_1_motor">
```

```xml
          <mechanicalReduction>1.0</mechanicalReduction>

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </actuator>
      </transmission>
      <transmission name="link_2_trans">
        <type>transmission_interface/SimpleTransmission</type>
        <joint name="joint_2">

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </joint>
        <actuator name="link_2_motor">
          <mechanicalReduction>1.0</mechanicalReduction>

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </actuator>
      </transmission>
      <transmission name="link_3_trans">
        <type>transmission_interface/SimpleTransmission</type>
        <joint name="joint_3">

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </joint>
        <actuator name="link_3_motor">
          <mechanicalReduction>1.0</mechanicalReduction>

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </actuator>
      </transmission>
      <transmission name="link_4_trans">
        <type>transmission_interface/SimpleTransmission</type>
        <joint name="joint_4">

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </joint>
        <actuator name="link_4_motor">
          <mechanicalReduction>1.0</mechanicalReduction>
```

```xml
<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </actuator>
      </transmission>
      <transmission name="link_5_trans">
        <type>transmission_interface/SimpleTransmission</type>
        <joint name="joint_5">

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </joint>
        <actuator name="link_5_motor">
          <mechanicalReduction>1.0</mechanicalReduction>

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </actuator>
      </transmission>
      <transmission name="link_6_trans">
        <type>transmission_interface/SimpleTransmission</type>
        <joint name="joint_6">

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </joint>
        <actuator name="link_6_motor">
          <mechanicalReduction>1.0</mechanicalReduction>

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </actuator>
      </transmission>
      <transmission name="link_7_trans">
        <type>transmission_interface/SimpleTransmission</type>
        <joint name="joint_7">

<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </joint>
        <actuator name="link_7_motor">
          <mechanicalReduction>1.0</mechanicalReduction>
```

```xml
<hardwareInterface>hardware_interface/PositionJointInterface</hardwareInterface>
        </actuator>
      </transmission>
      <gazebo>
        <plugin name="control"
filename="libgazebo_ros_control.so">
          <robotNamespace>/</robotNamespace>
        </plugin>
      </gazebo>
      <gazebo reference="link1">
        <selfCollide>true</selfCollide>
      </gazebo>
      <gazebo reference="link2">
        <selfCollide>true</selfCollide>
      </gazebo>
      <gazebo reference="link3">
        <selfCollide>true</selfCollide>
      </gazebo>
      <gazebo reference="link4">
        <selfCollide>true</selfCollide>
      </gazebo>
      <gazebo reference="link5">
        <selfCollide>true</selfCollide>
      </gazebo>
      <gazebo reference="link6">
        <selfCollide>true</selfCollide>
      </gazebo>
      <gazebo reference="link7">
        <selfCollide>true</selfCollide>
      </gazebo>
    </robot>
```

5. In the launch folder, create a launch file for gazebo so that it uses the `robot_arm_urdf.urdf` file. Name it as `gazebo.launch.py` and fill the content as follows

`gazebo.launch.py`

```python
import os
from launch import LaunchDescription
from launch.actions import ExecuteProcess
from launch_ros.actions import Node


def generate_launch_description():
```

```python
        urdf_file =
'/home/vipul/ros2_ws/src/robot_arm_urdf/urdf/robot_arm_urdf.urdf'

        return LaunchDescription(
            [
                ExecuteProcess(
                    cmd=["gazebo", "-s",
"libgazebo_ros_factory.so"],
                    output="screen",
                ),
                Node(
                    package="gazebo_ros",
                    executable="spawn_entity.py",
                    arguments=["-entity", "manipulator", "-b", "-
file", urdf_file],
                    output="screen",
                ),
                Node(
                    package="robot_state_publisher",
                    executable="robot_state_publisher",
                    arguments=[urdf_file],
                    output="screen",
                ),
            ]
        )
```

6. Make changes in `setup.py`

setup.py

```python
from setuptools import find_packages, setup
from glob import glob
import os

package_name = 'robot_arm_urdf'

setup(
    name=package_name,
    version='0.0.0',
    packages=find_packages(exclude=['test']),
    data_files=[
        ('share/ament_index/resource_index/packages',
            ['resource/' + package_name]),
        ('share/' + package_name, ['package.xml']),
        (os.path.join('share', package_name), glob('urdf/*')),
        (os.path.join('share', package_name), glob('launch/*')),
    ],
```

```
        install_requires=['setuptools'],
        zip_safe=True,
        maintainer='vipul',
        maintainer_email='vipul@todo.todo',
        description='TODO: Package description',
        license='TODO: License declaration',
        tests_require=['pytest'],
        entry_points={
            'console_scripts': [
            ],
        },
    )
```

7. Rebuild the package and source it again
- `cd ~/ros2_ws/`
- `colcon build --packages-select robot_arm_urdf`
- `source ~/ros2_ws/install/setup.zsh`

8. Launch gazebo using the launch file
- `ros2 launch robot_arm_urdf gazebo.launch.py`