





GAZEBO

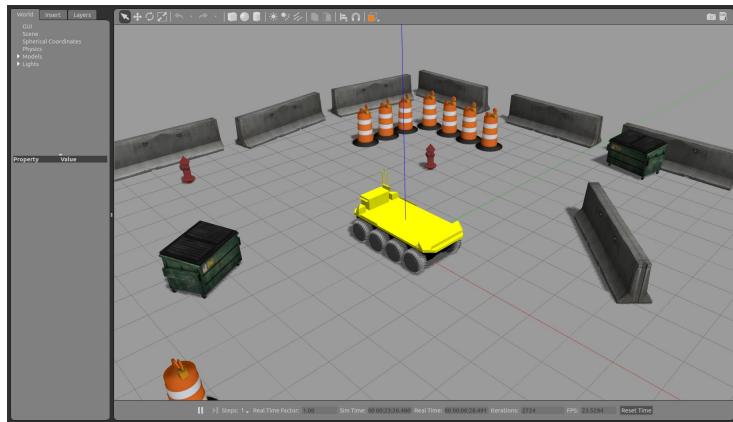
REF: <http://gazebosim.org/>

What is Gazebo?

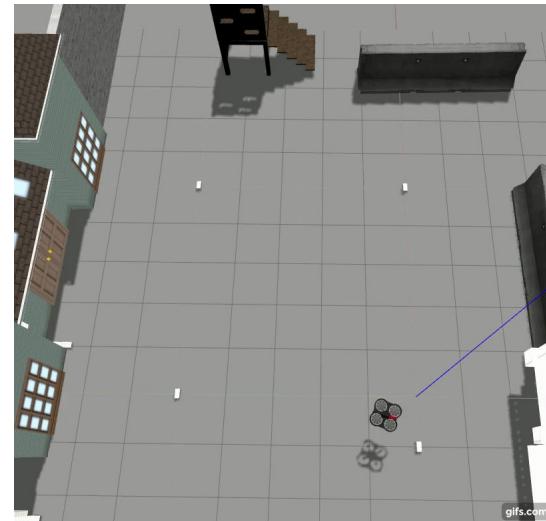
อะไรคือ Gazebo

What is Gazebo?

- Gazebo เป็นระบบ robot simulation ในรูปแบบของ physics engine โดยໄວ້ໃຊ້ສໍາຮັບການທົດສອບ software , ກາຣອກແບບຫຸ້ນຍິນຕີ ແລະກາຣ train AI ດ້ວຍກາຣໃຊ້ realistic scenarios



REF: <https://www.clearpathrobotics.com/assets/quides/kinetic/moose/MooseSimulation.html>



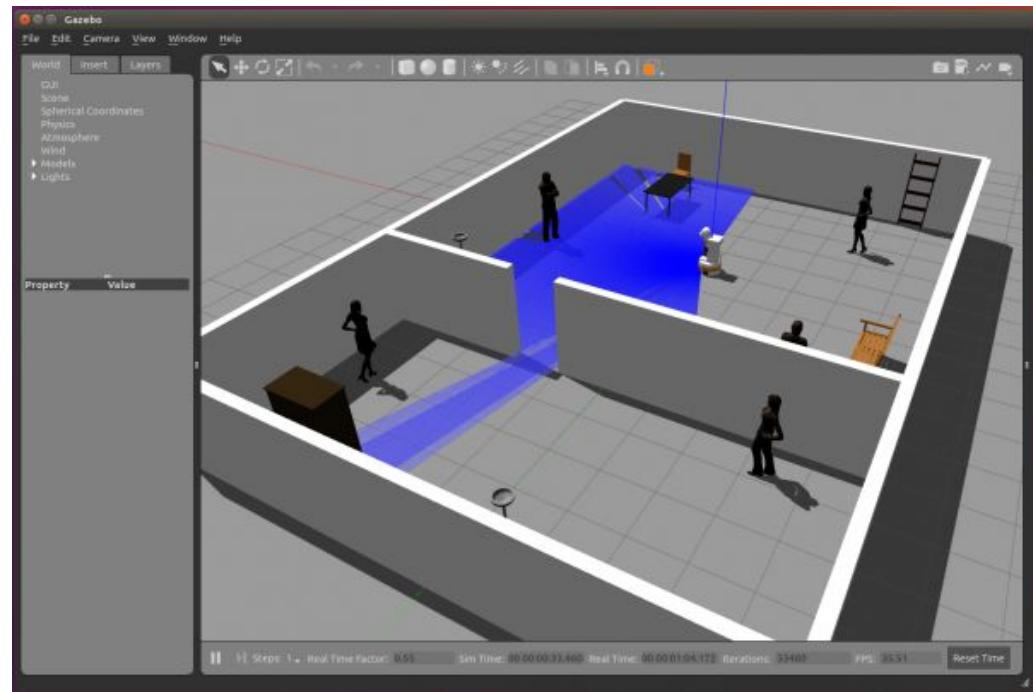
REF: <https://github.com/topics/autonomous-navigation>

Why Gazebo?

ทำไมต้องใช้ Gazebo

Why Gazebo?

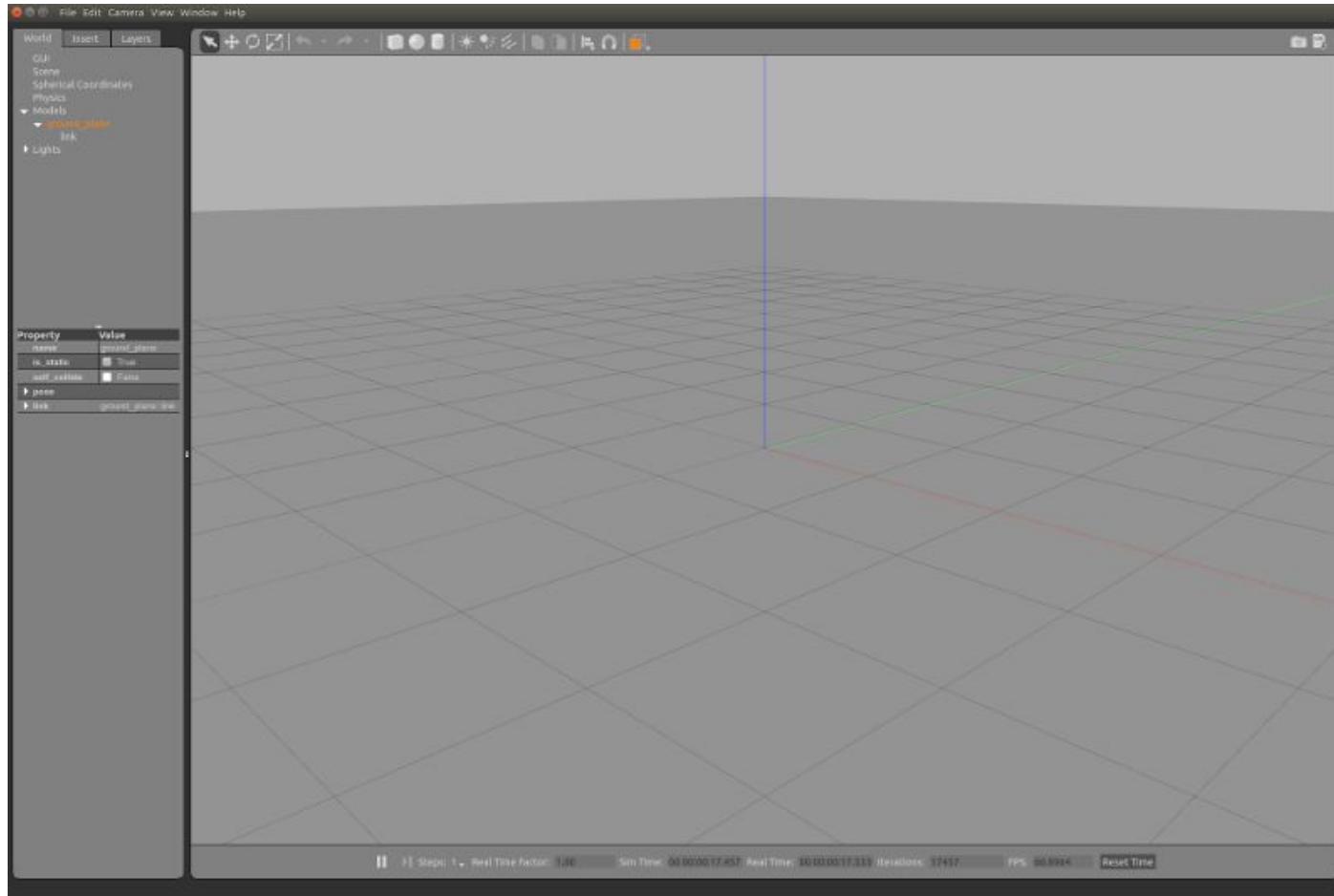
- Robust physics engine
 - เป็นระบบจำลองฟิสิกส์ที่ Robust
- High-quality graphics
 - มีกราฟฟิคที่คุณภาพสูง
- Convenient programmatic
 - เหมาะสมกับการเขียน program
- Graphical interfaces
 - มี interface ที่เป็นกราฟฟิค
- FREE
 - สามารถใช้งานได้ฟรี



Installation

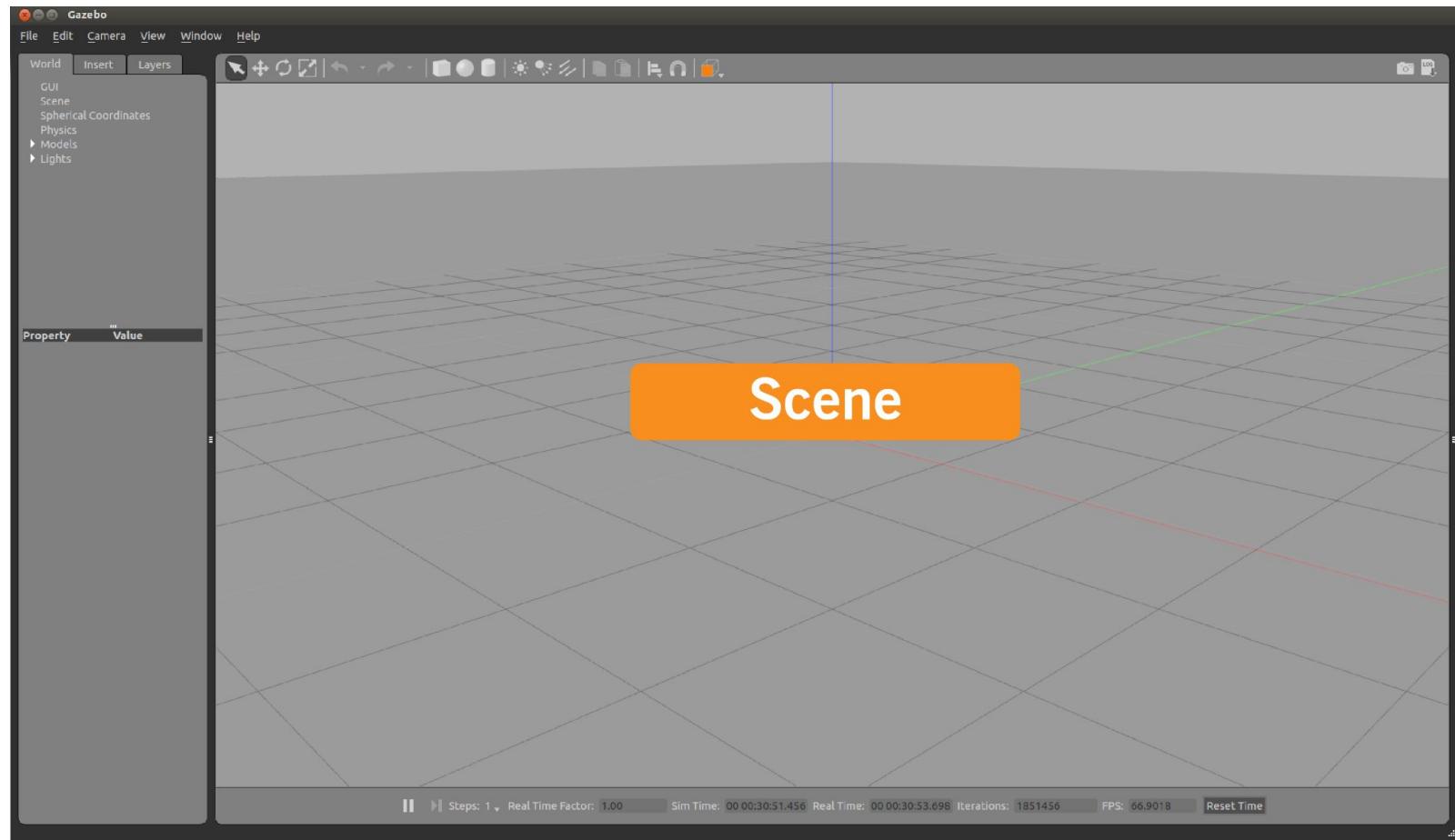
```
$ sudo apt install ros-noetic-gazebo-ros
```

```
$ roslaunch gazebo_ros empty_world.launch
```

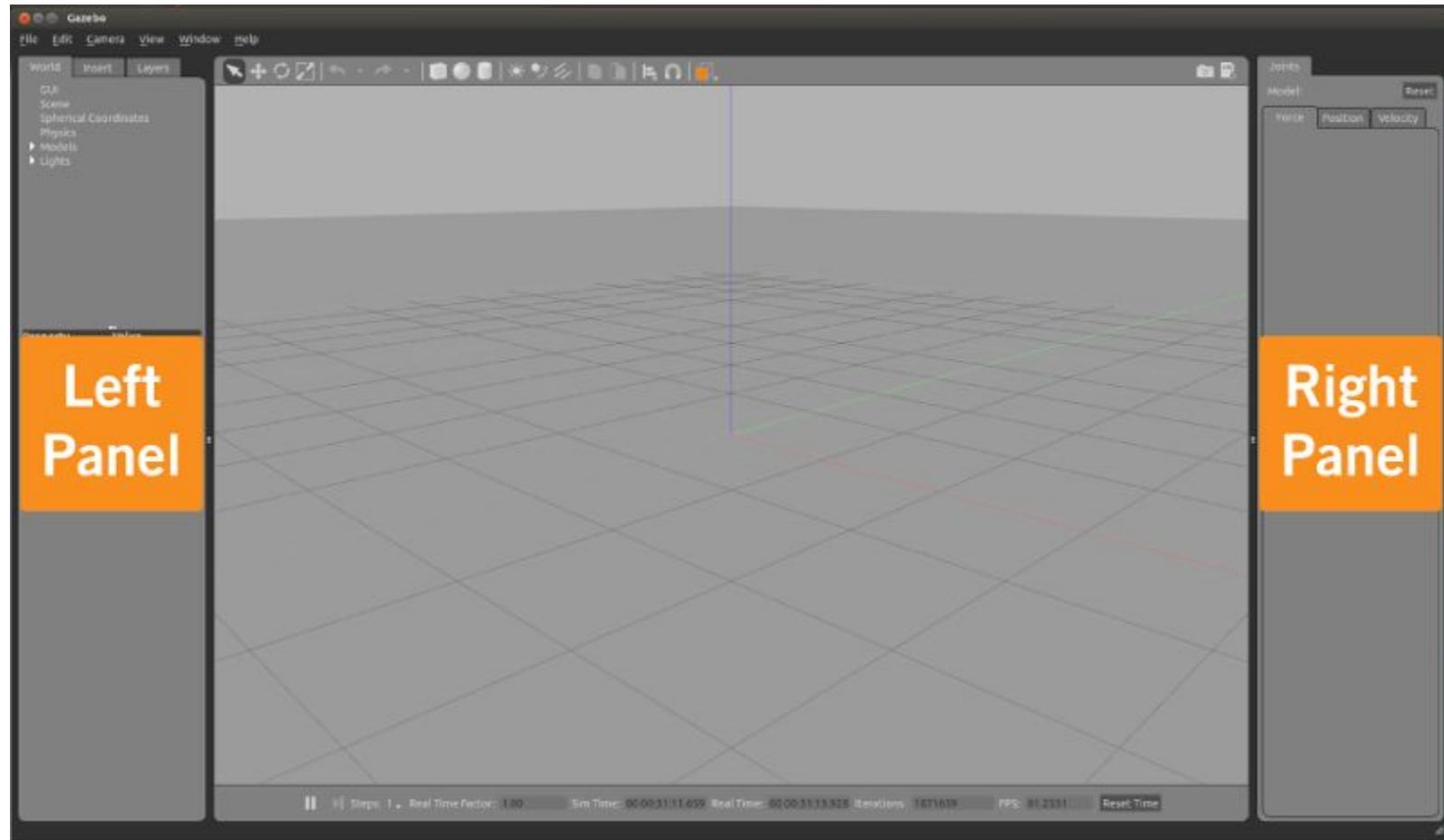


REF: http://gazebosim.org/tutorials?cat=guided_b&tut=guided_b2

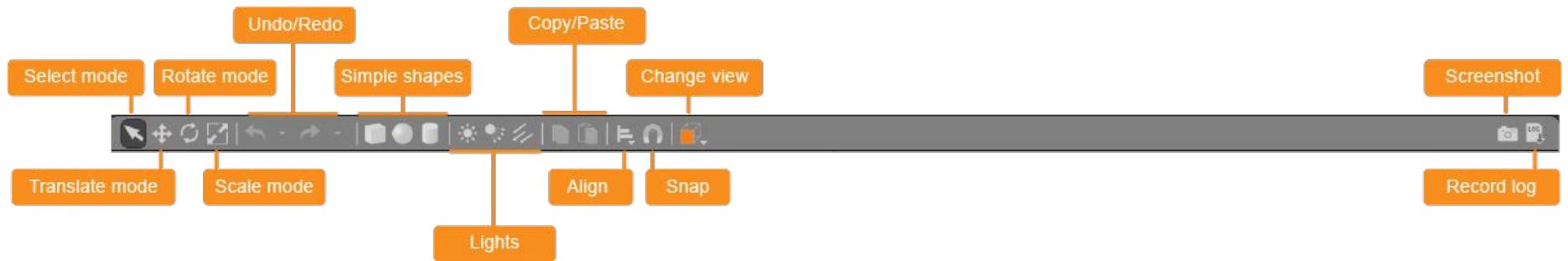
GUI



REF: http://gazebosim.org/tutorials?cat=guided_b&tut=guided_b2



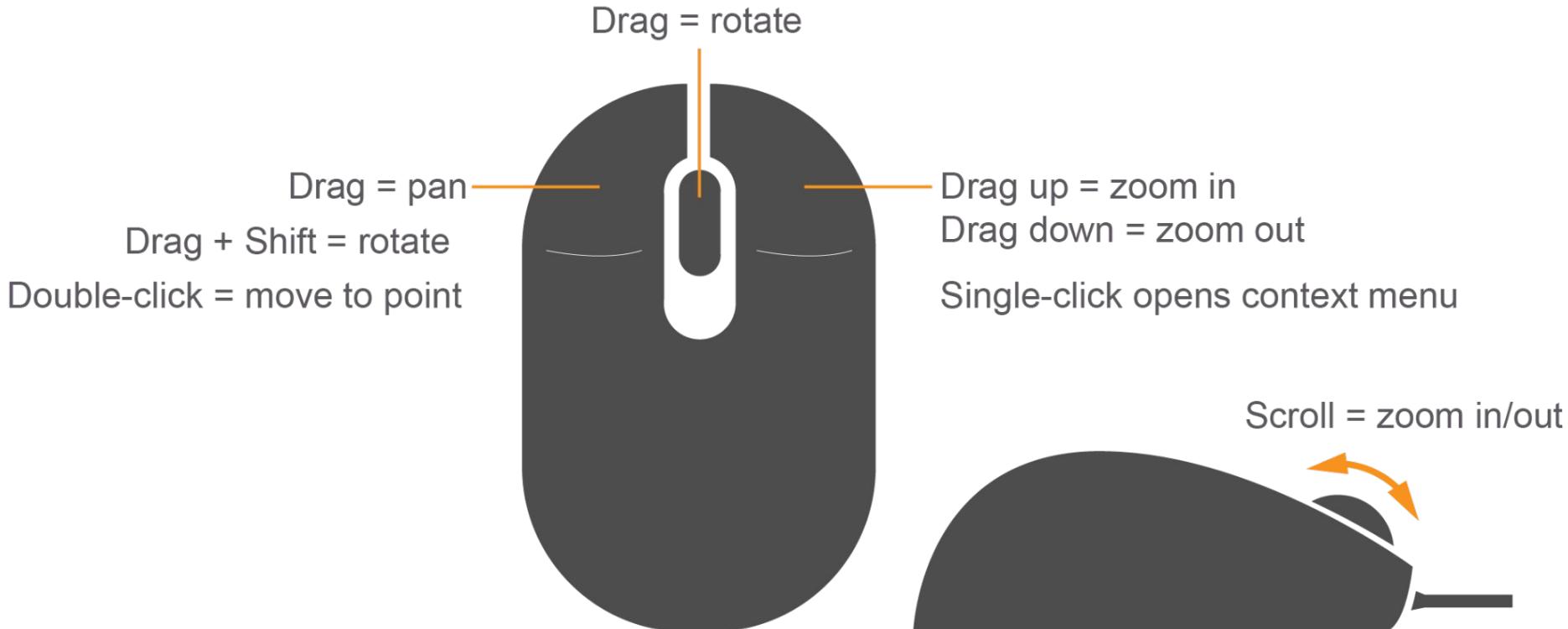
REF: http://gazebosim.org/tutorials?cat=guided_b&tut=guided_b2



REF: http://gazebosim.org/tutorials?cat=guided_b&tut=guided_b2

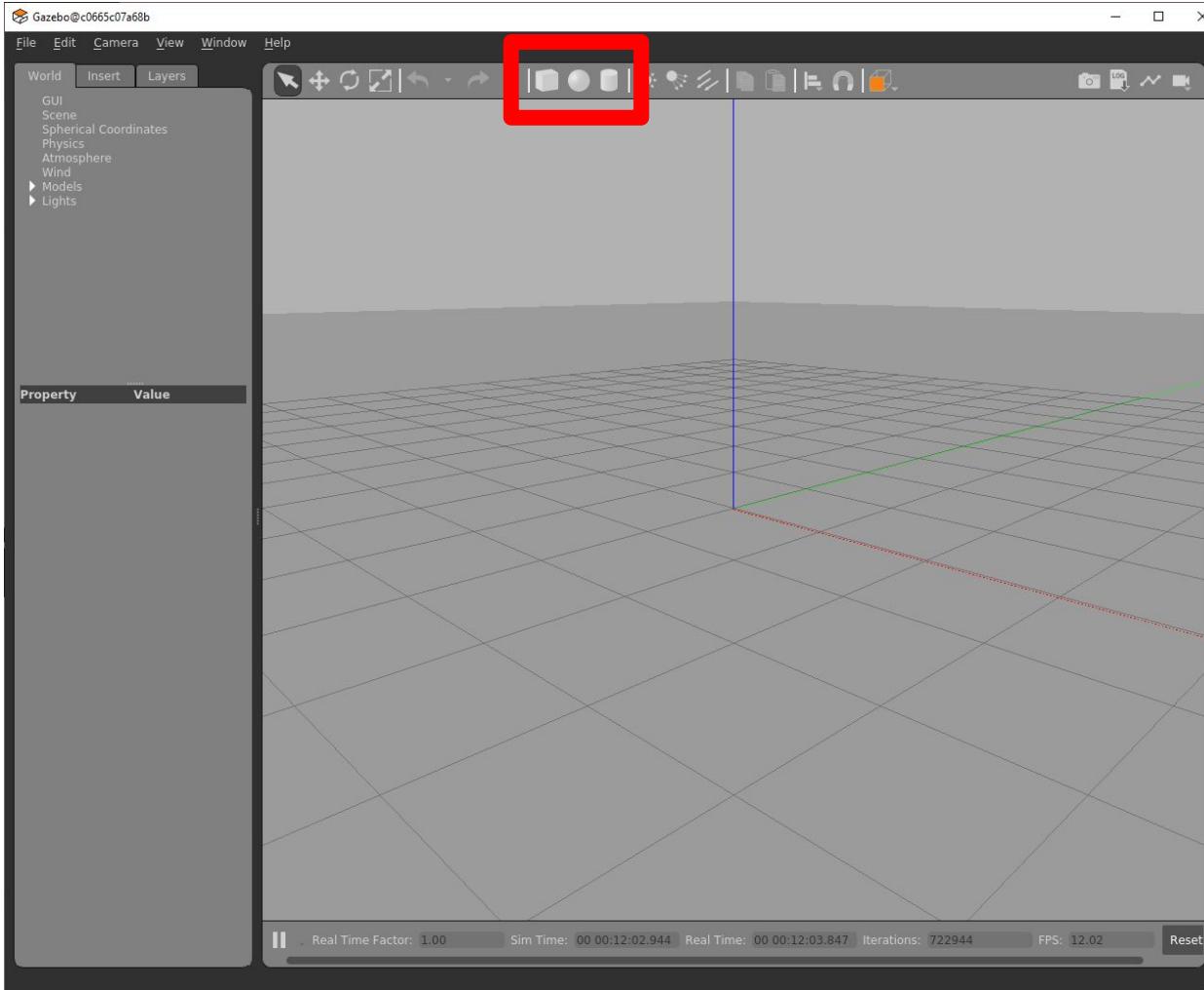


REF: http://gazebosim.org/tutorials?cat=guided_b&tut=guided_b2

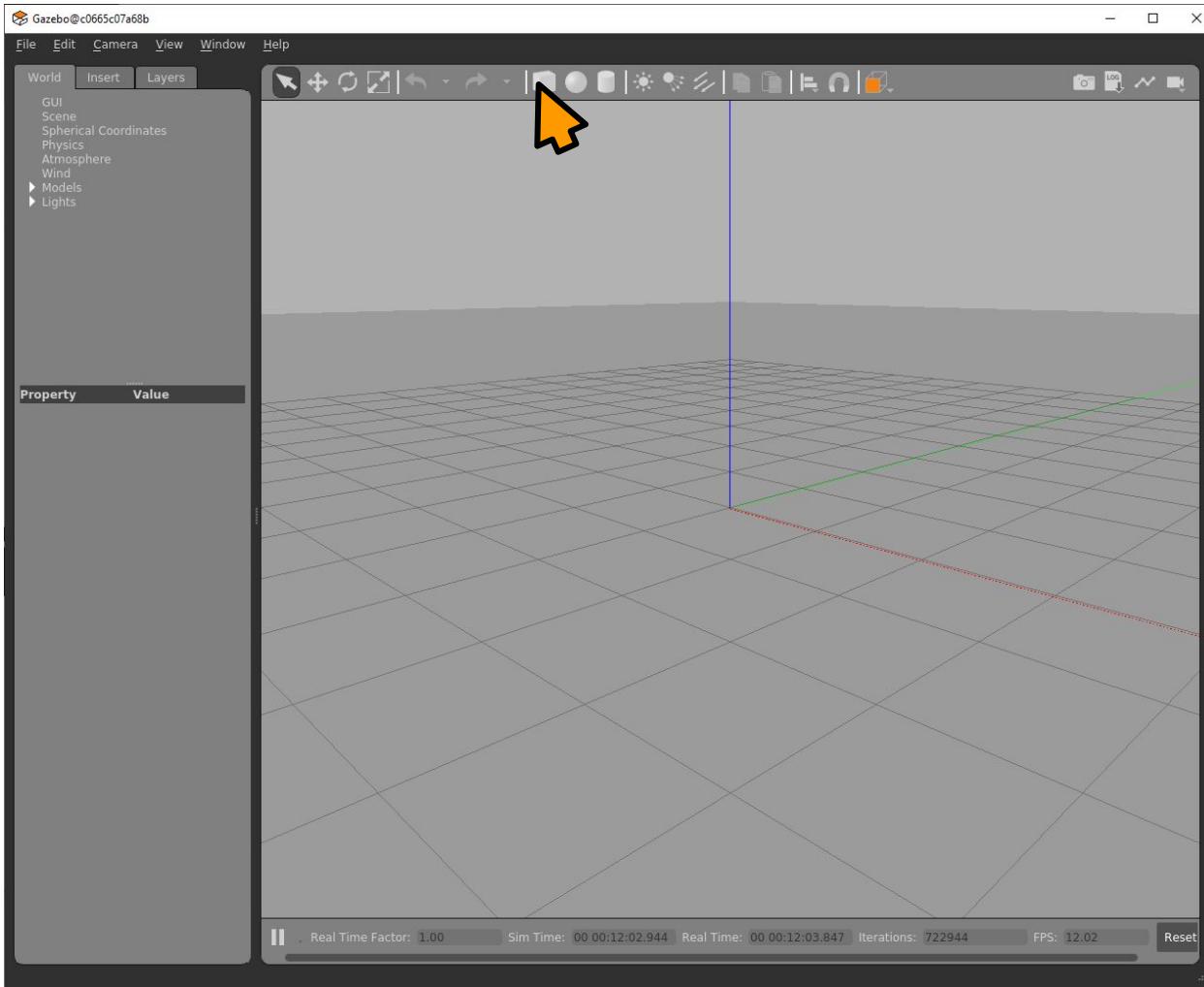


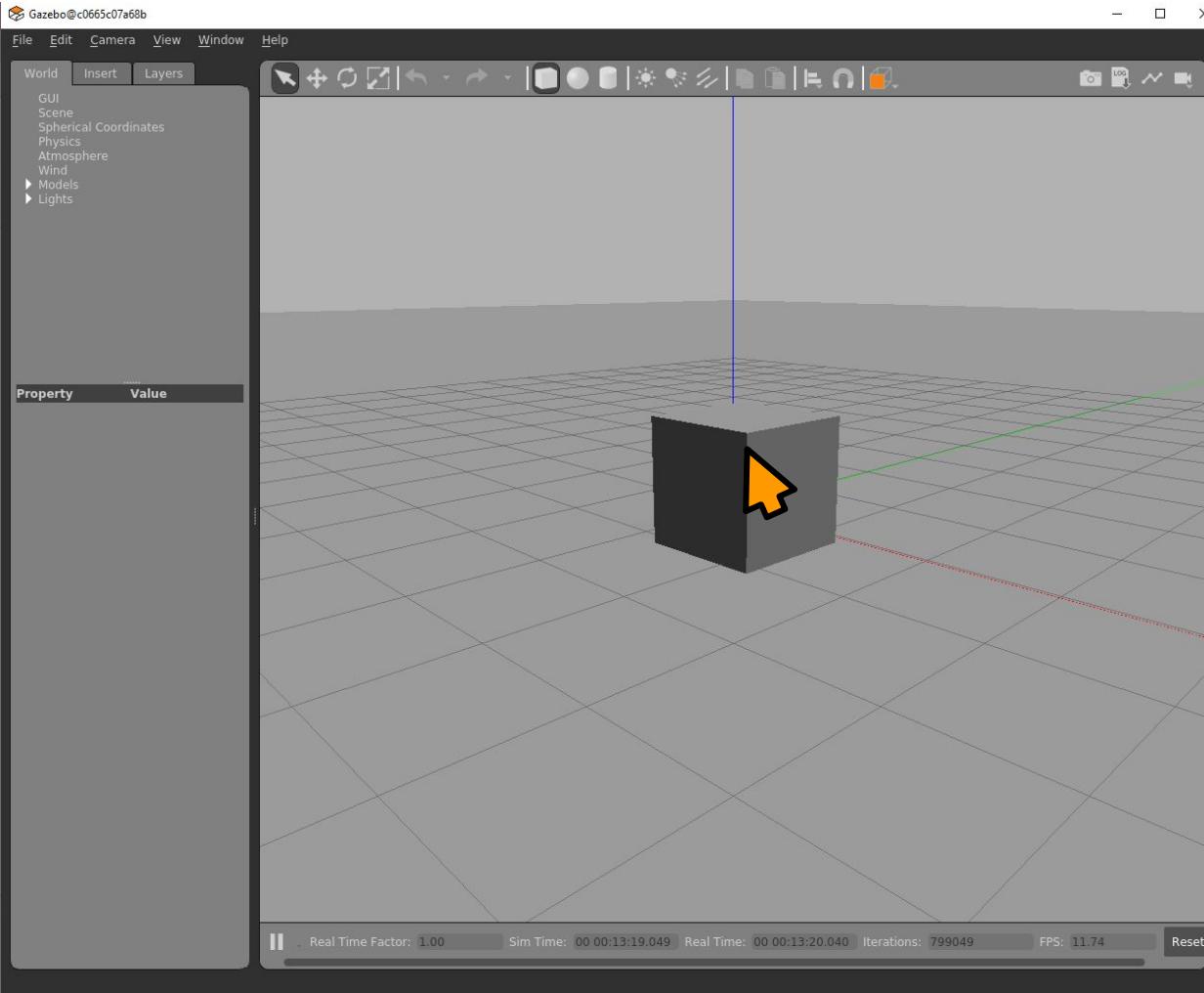
REF: http://gazebosim.org/tutorials?cat=guided_b&tut=guided_b2

Spawn object to Gazebo

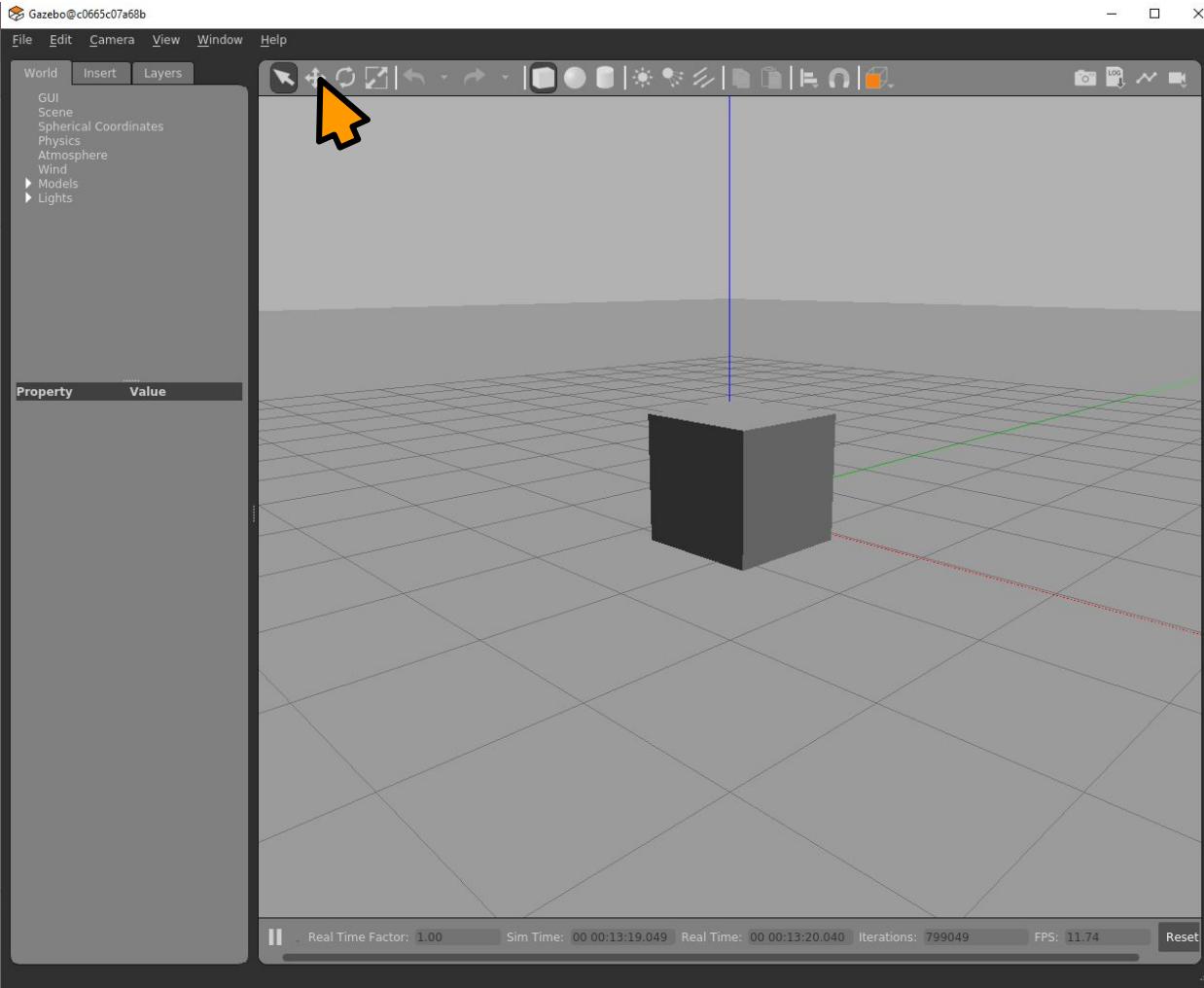


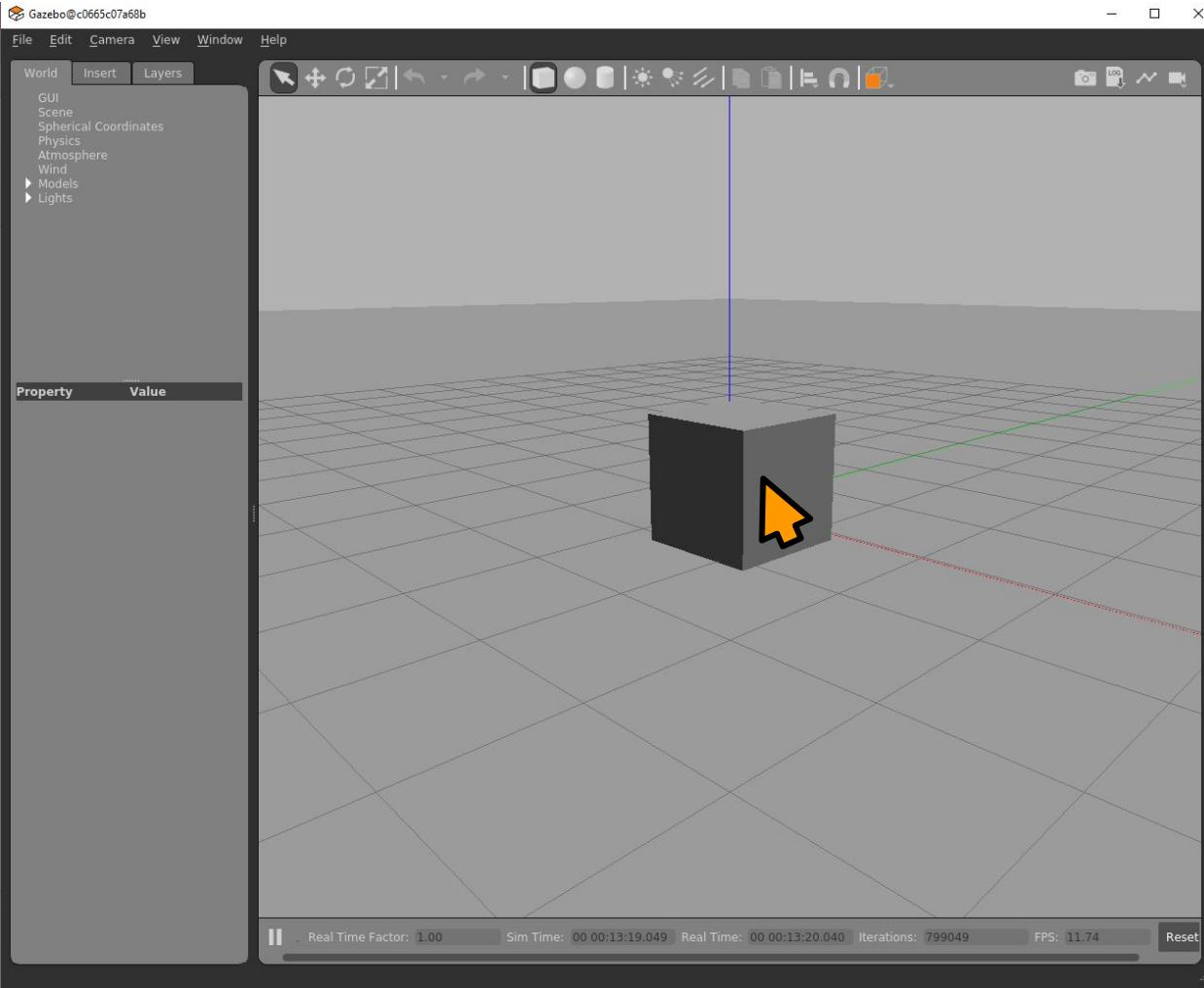


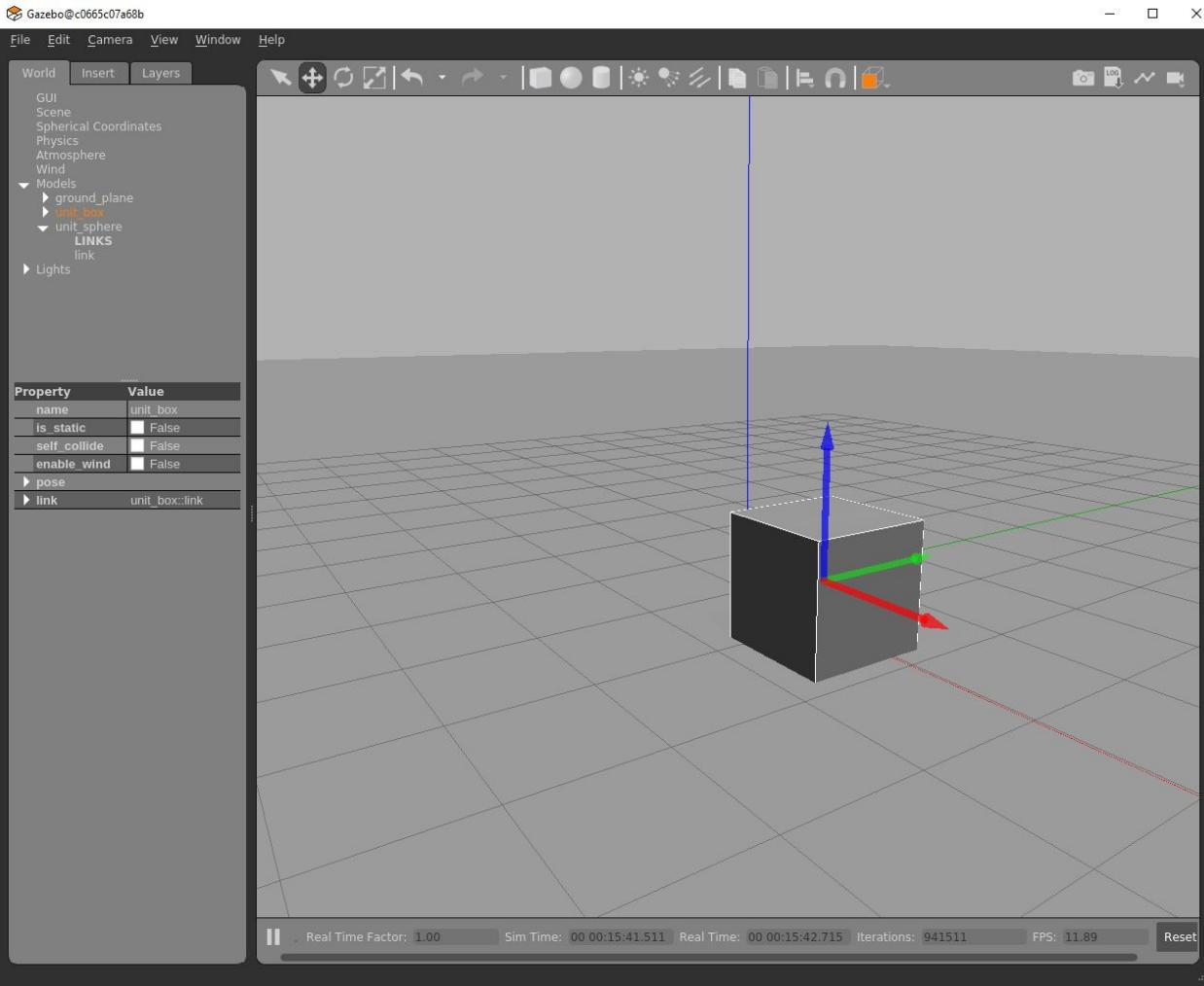




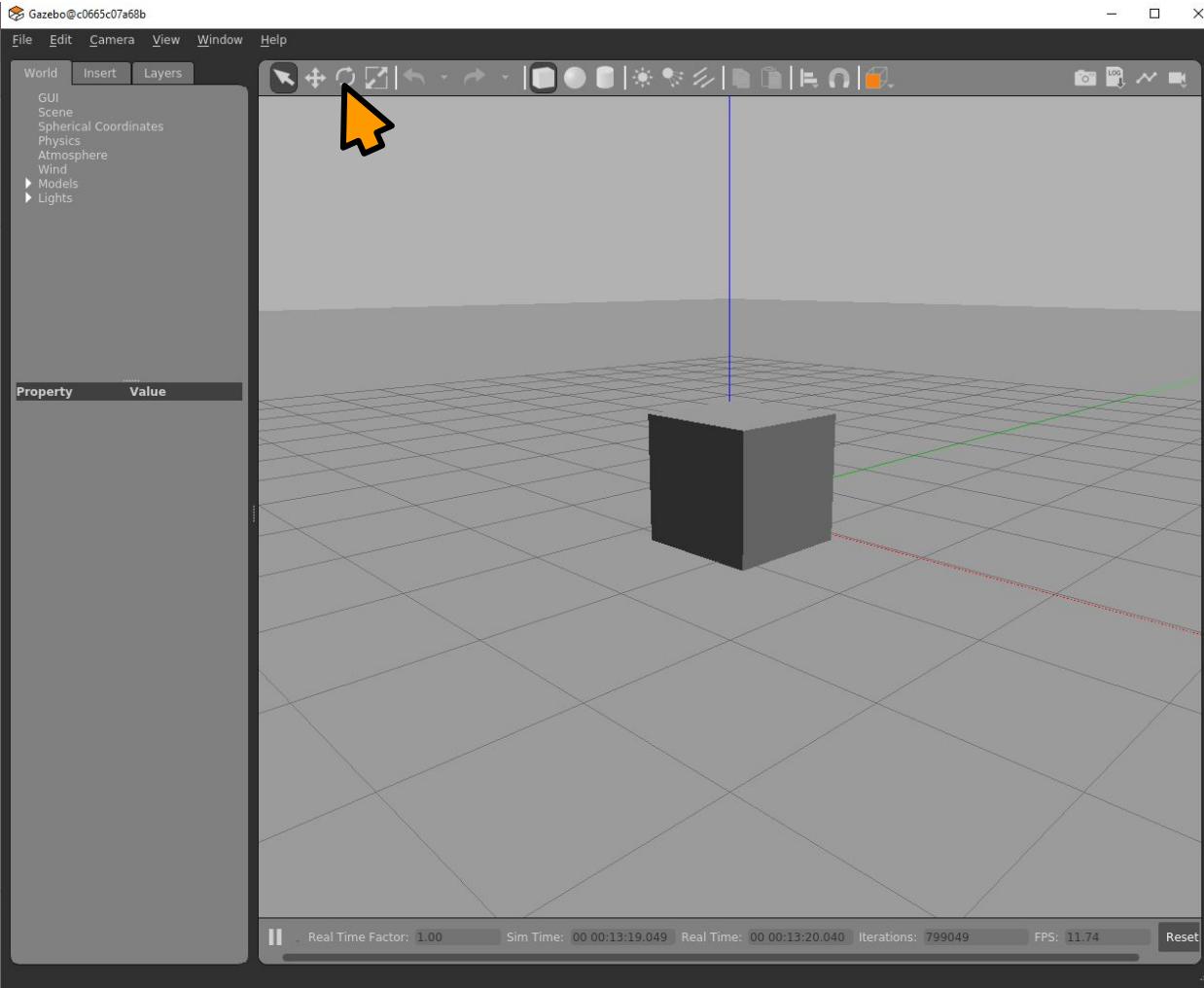
ข้อมูล object

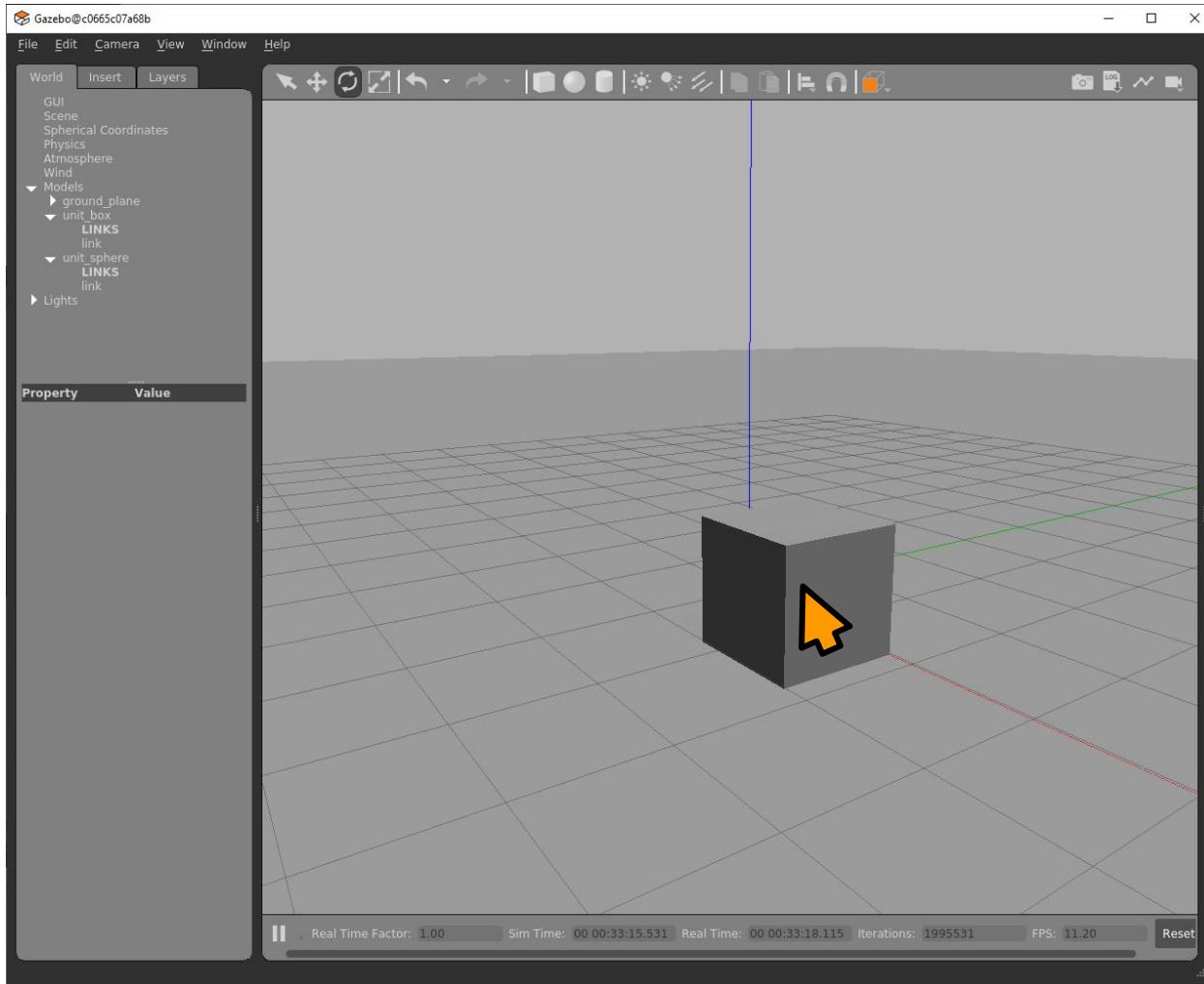


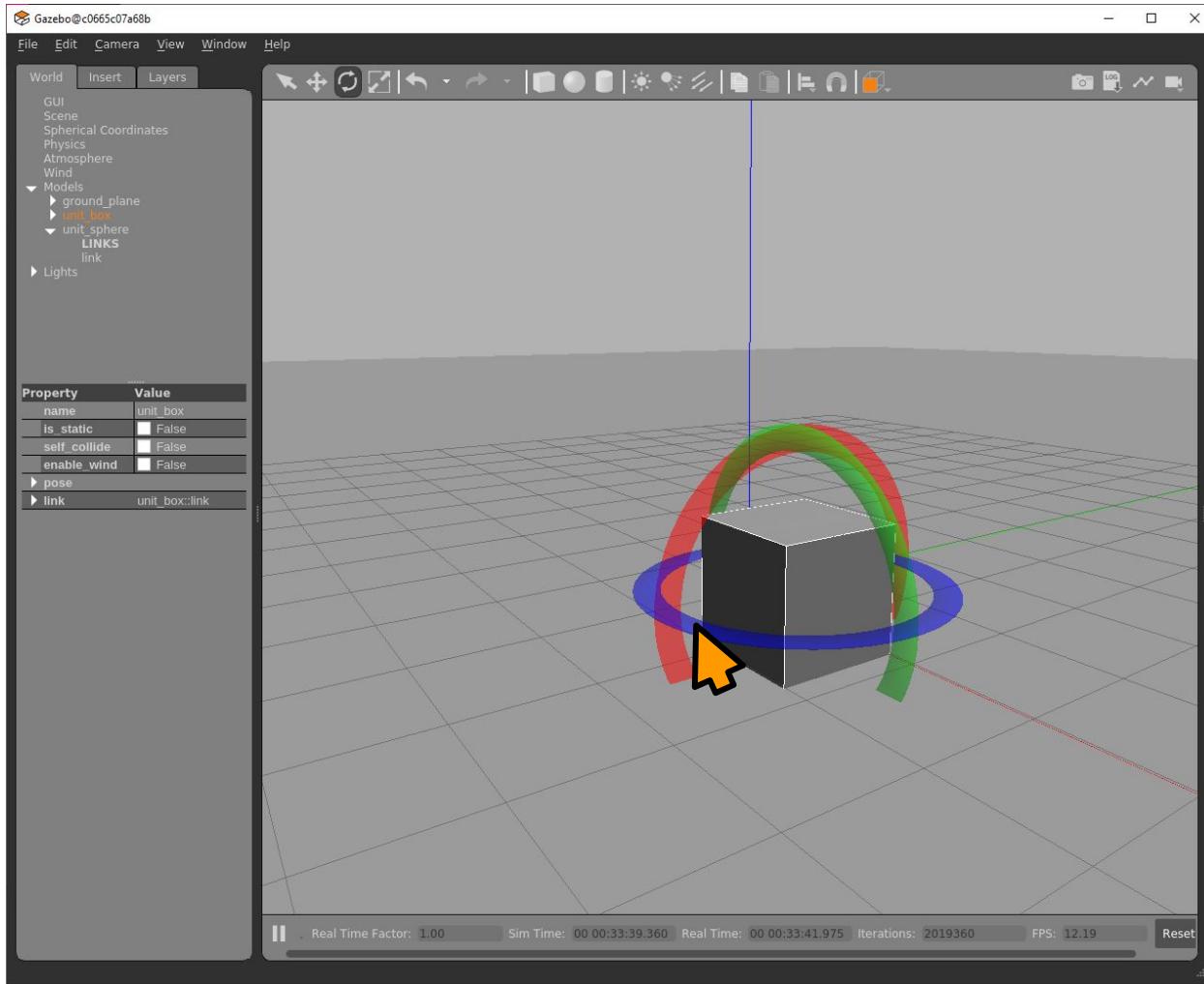


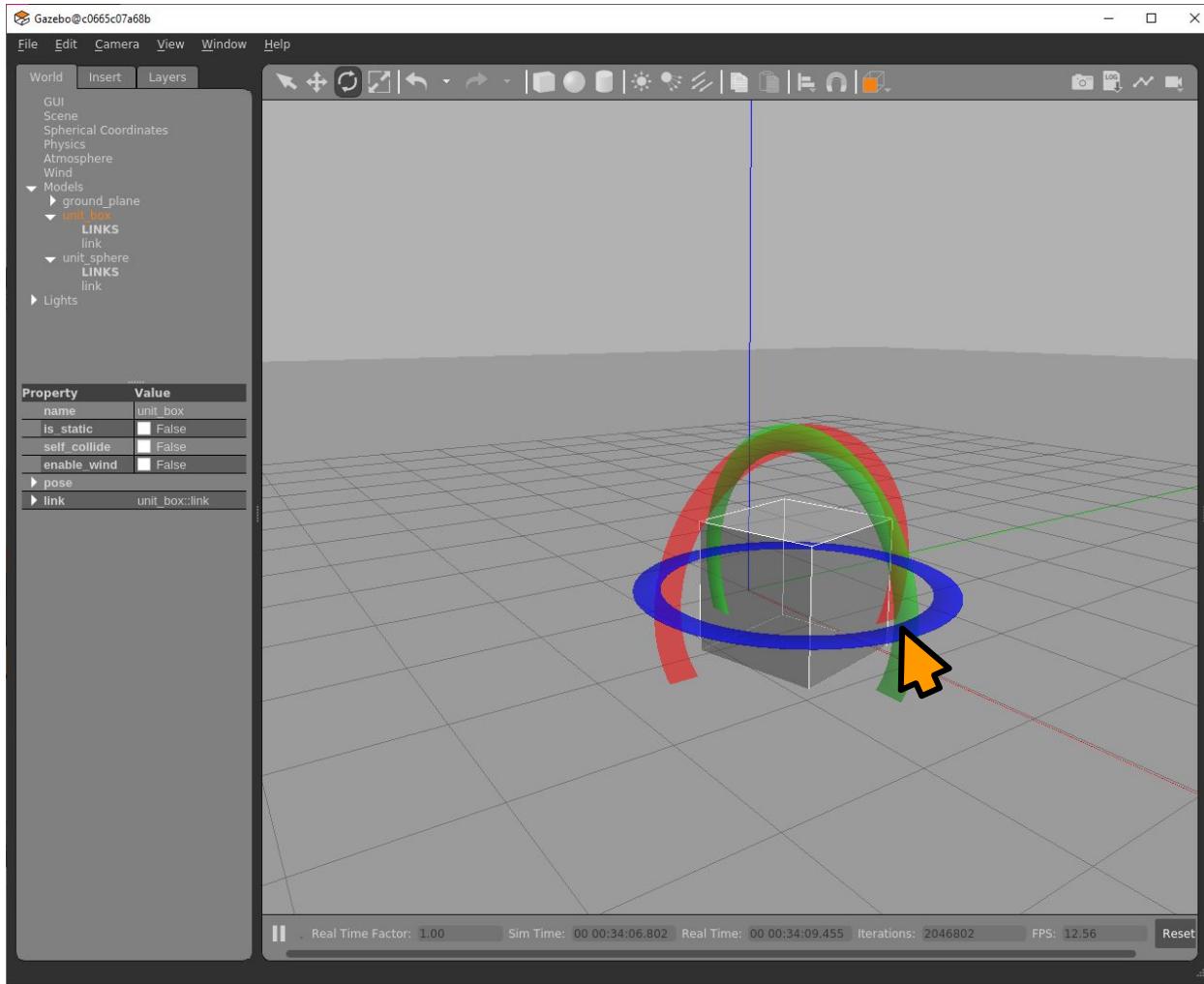


អំពី object

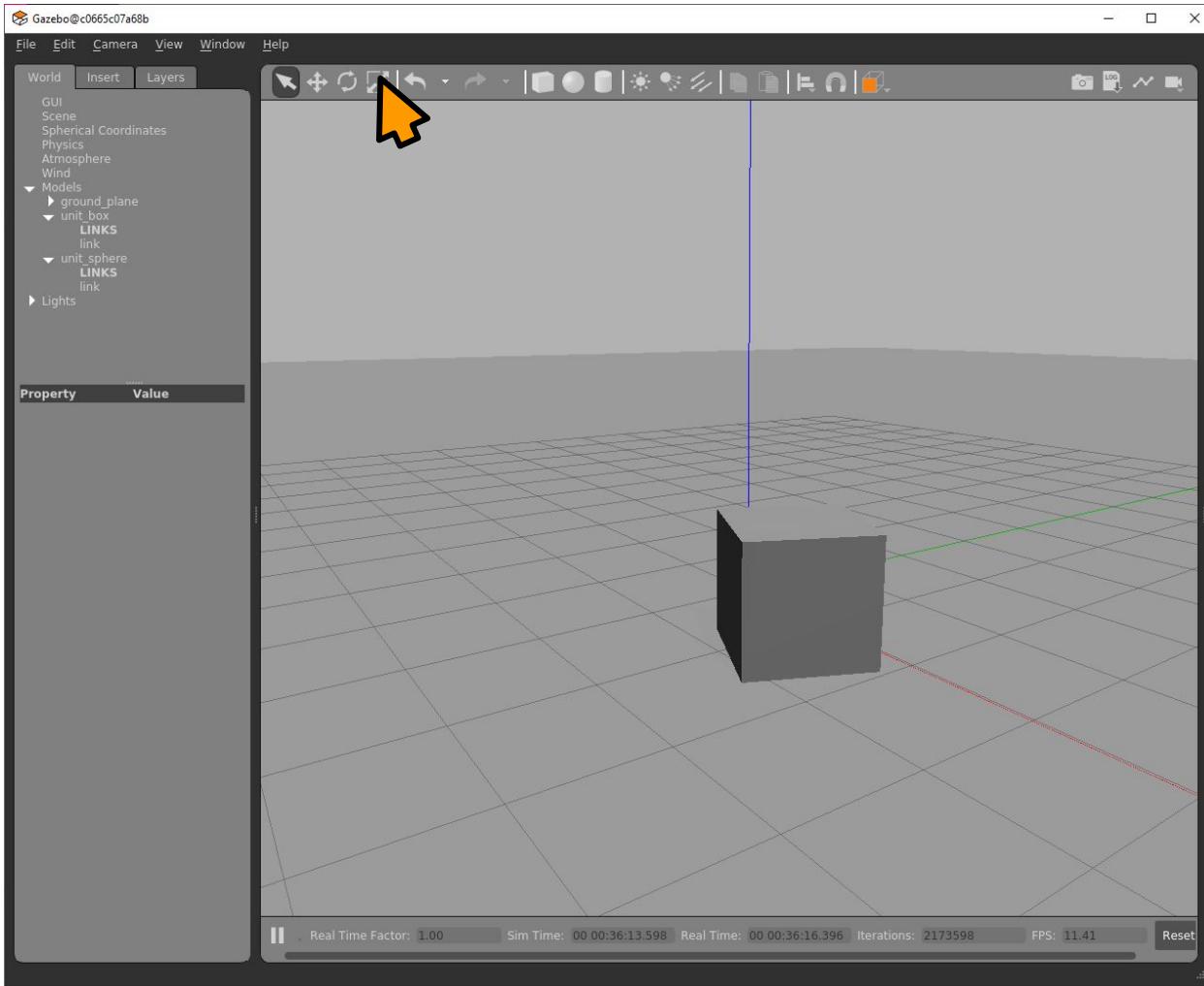


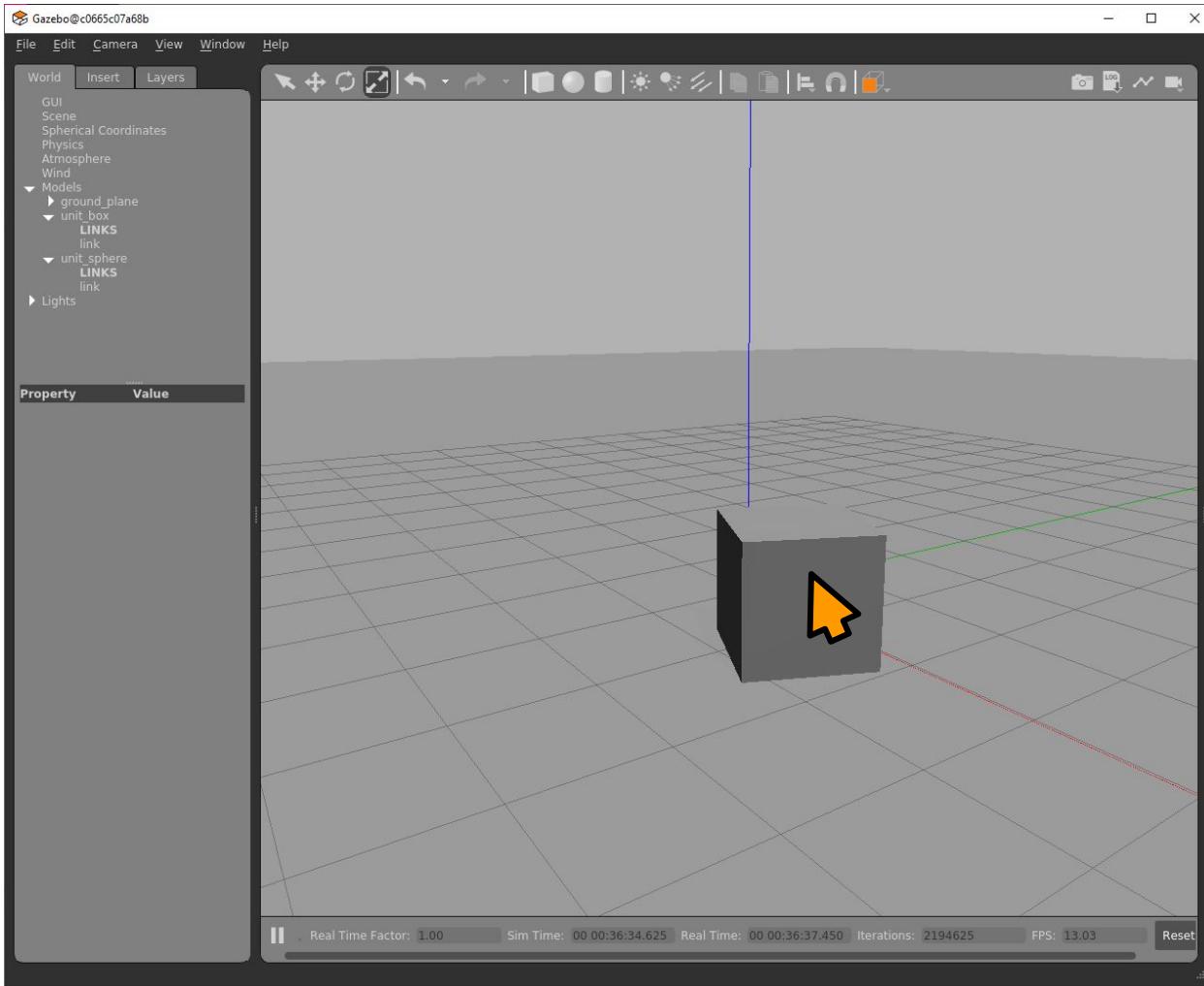


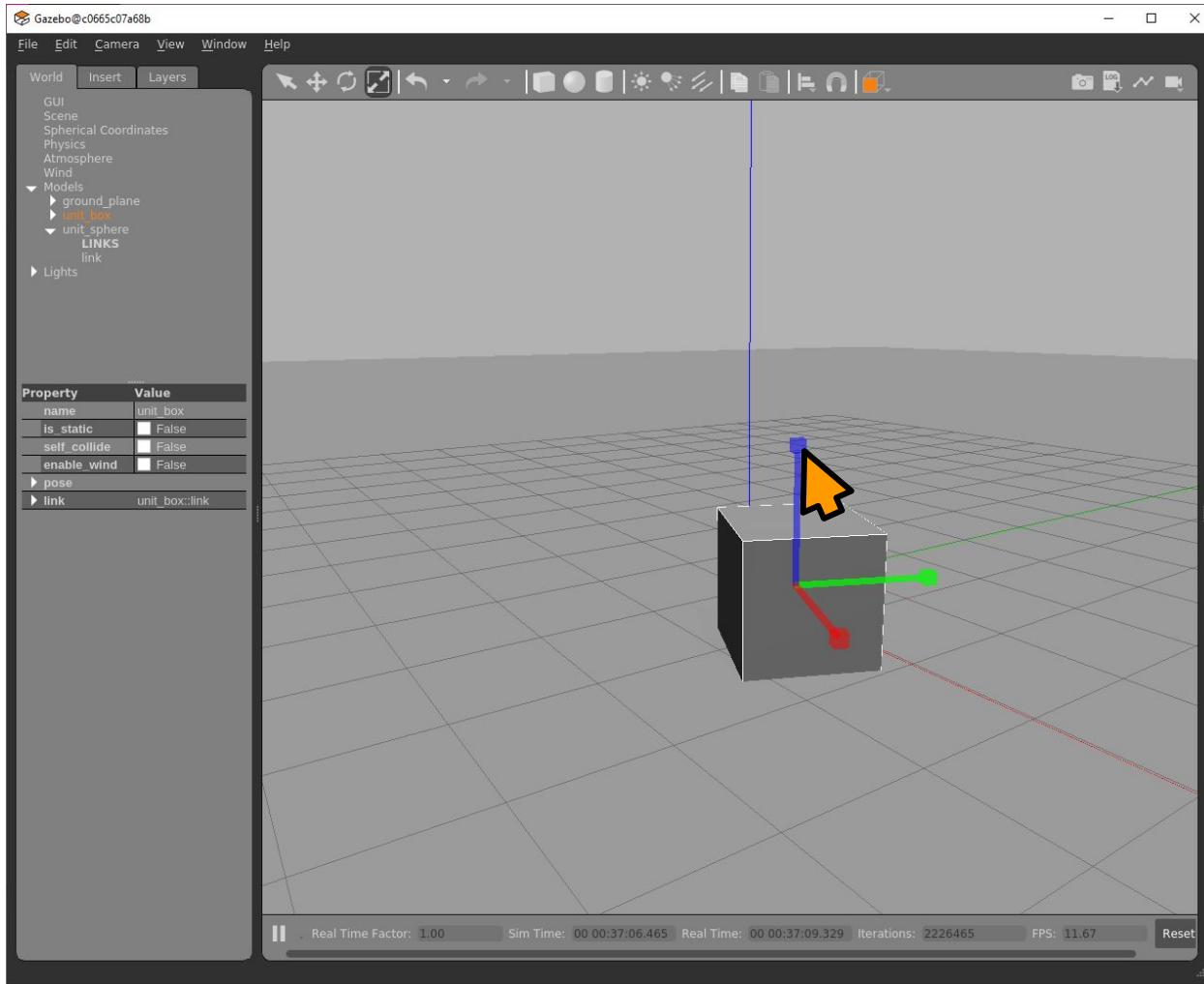


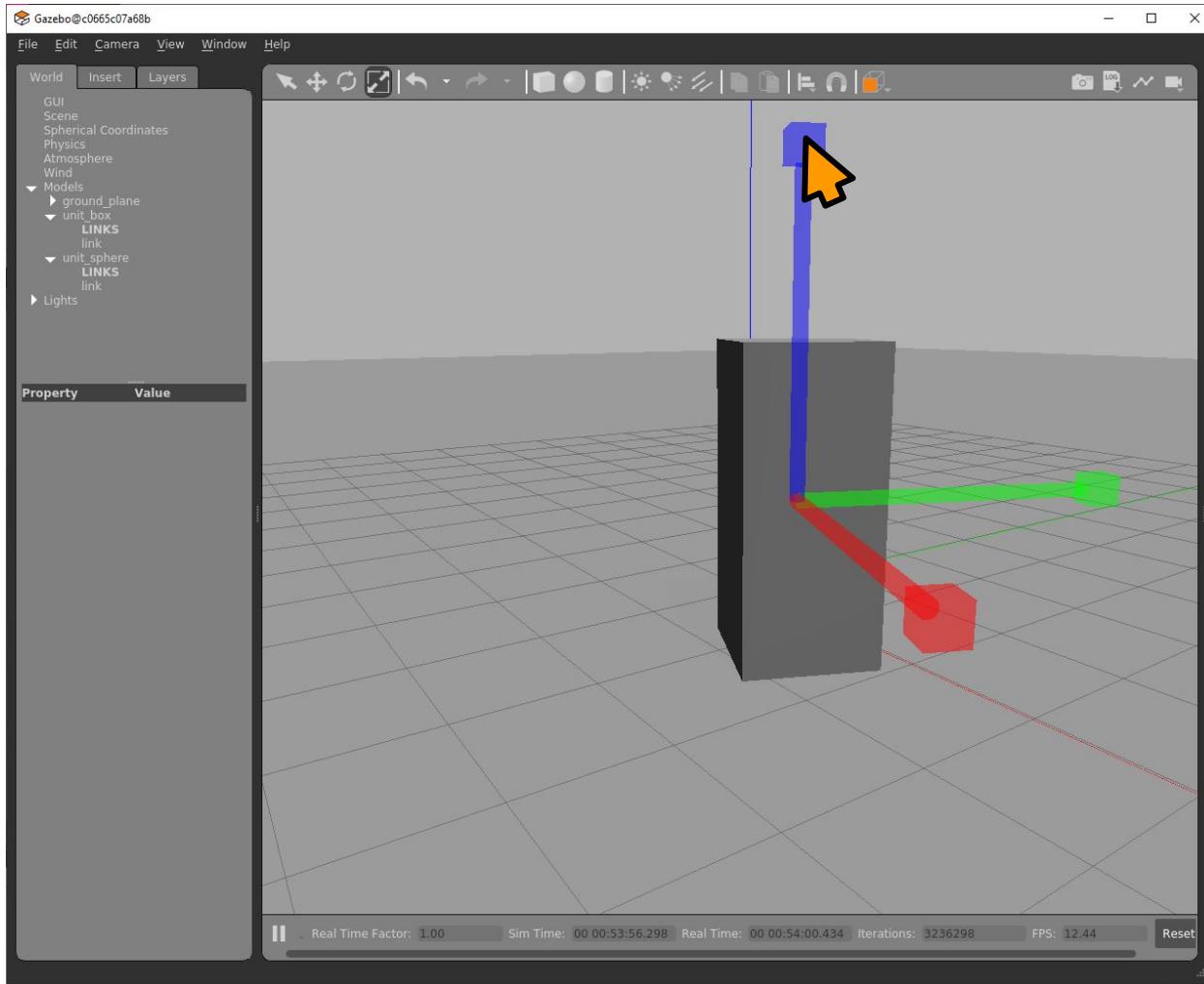


ຢ່ອ/ຂໍາຍ object

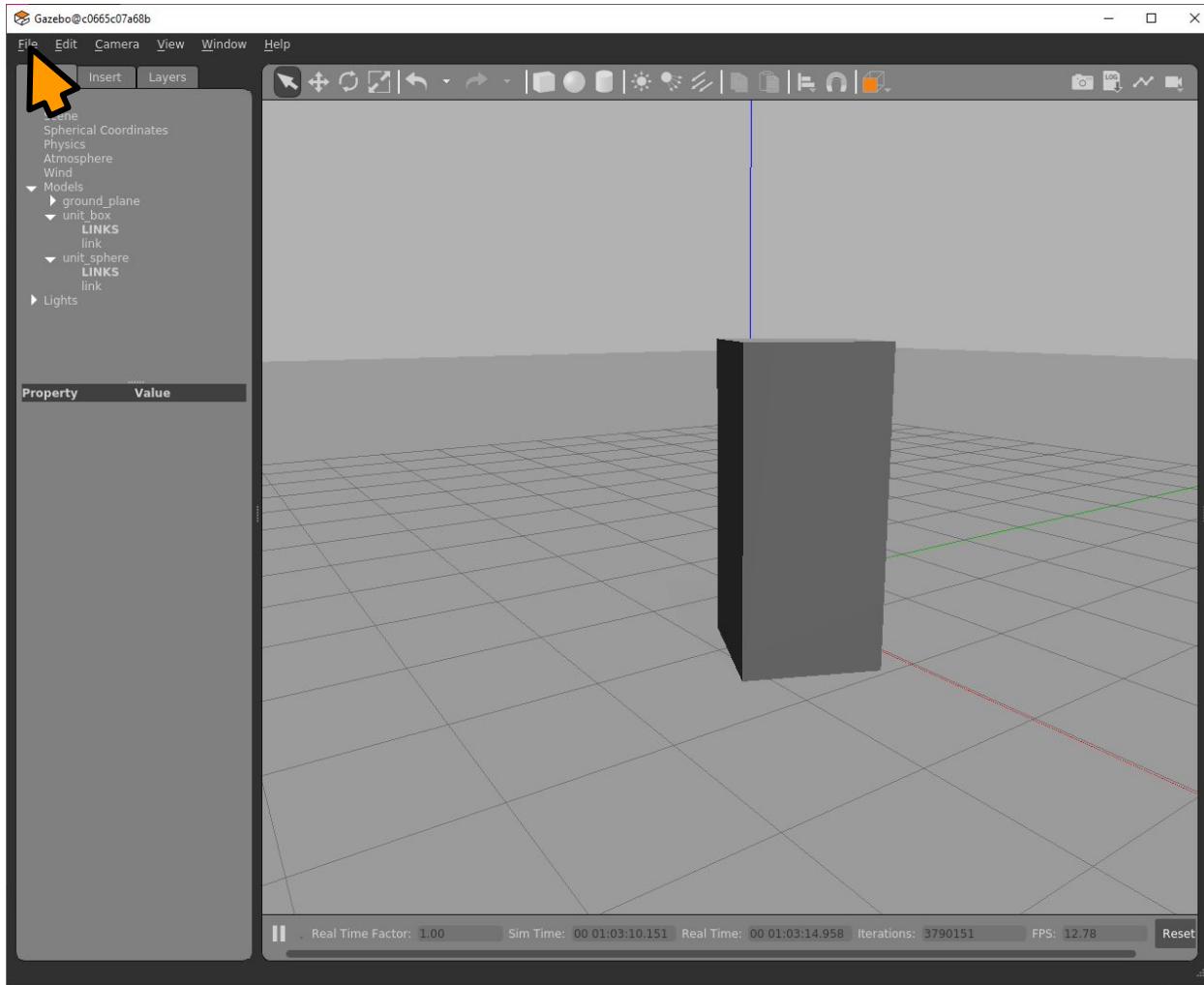


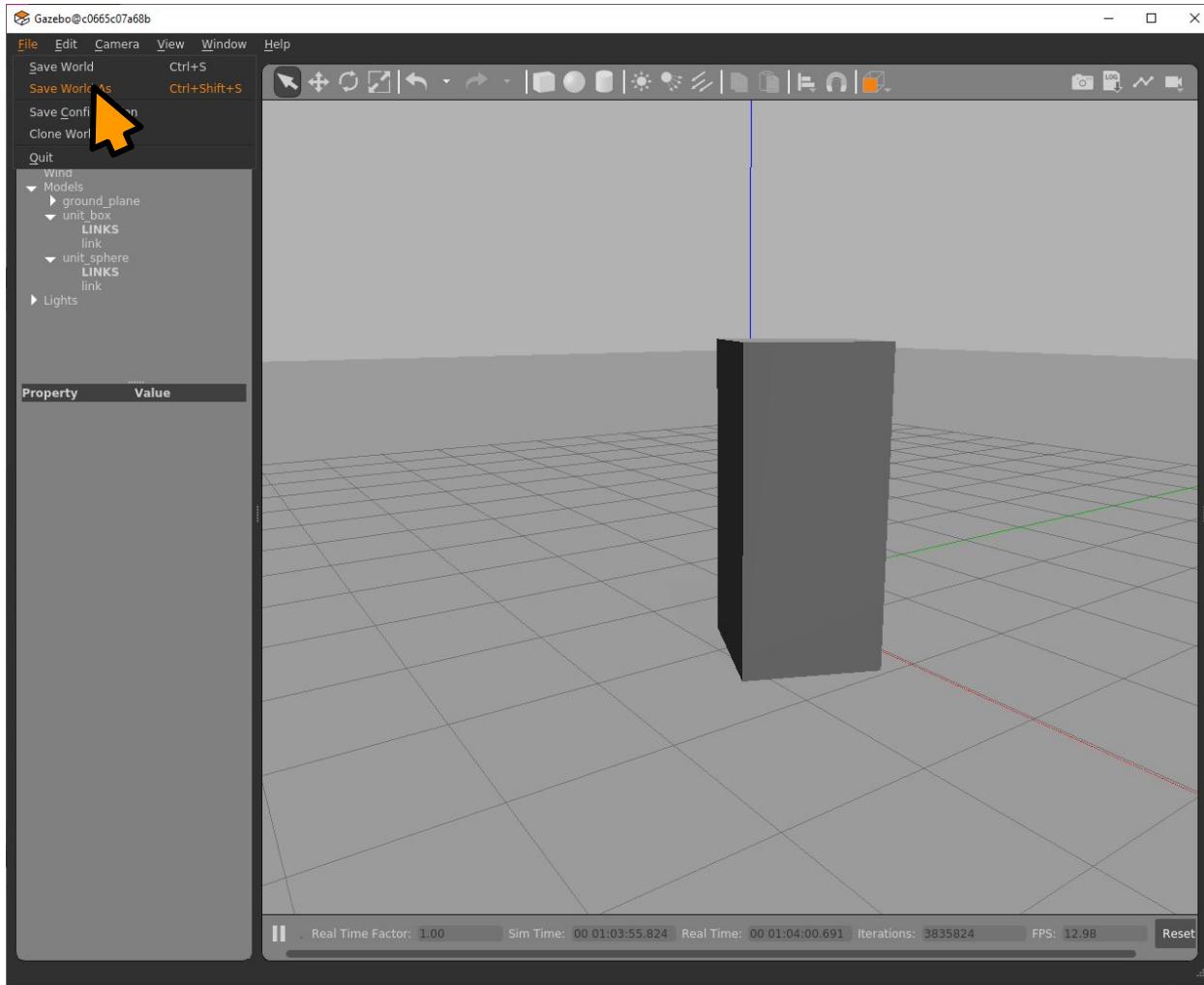






Save world





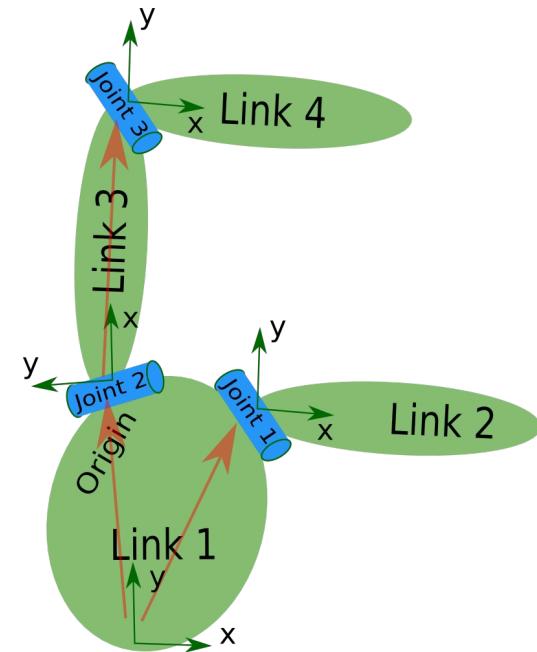
เลือกตำแหน่งที่ต้องการ save

URDF

Unified Robot Description Format

URDF

- เป็นไฟล์ที่ใช้อธิบาย element ต่างๆของหุ่นยนต์
- format จะเป็นในรูปแบบของ XML format
- การใช้ไฟล์ URDF กับ Gazebo จะมี tag พิเศษของ Gazebo เพื่อทำการใส่ plugins ต่างๆและ texture เข้าไปใน element ต่างๆได้
- การใช้ URDF ใน Gazebo จะถูกเปลี่ยนเป็น SDF ไฟล์อัตโนมัติ เนื่องจากไฟล์ใน Gazebo จะใช้ SDF เป็นหลัก

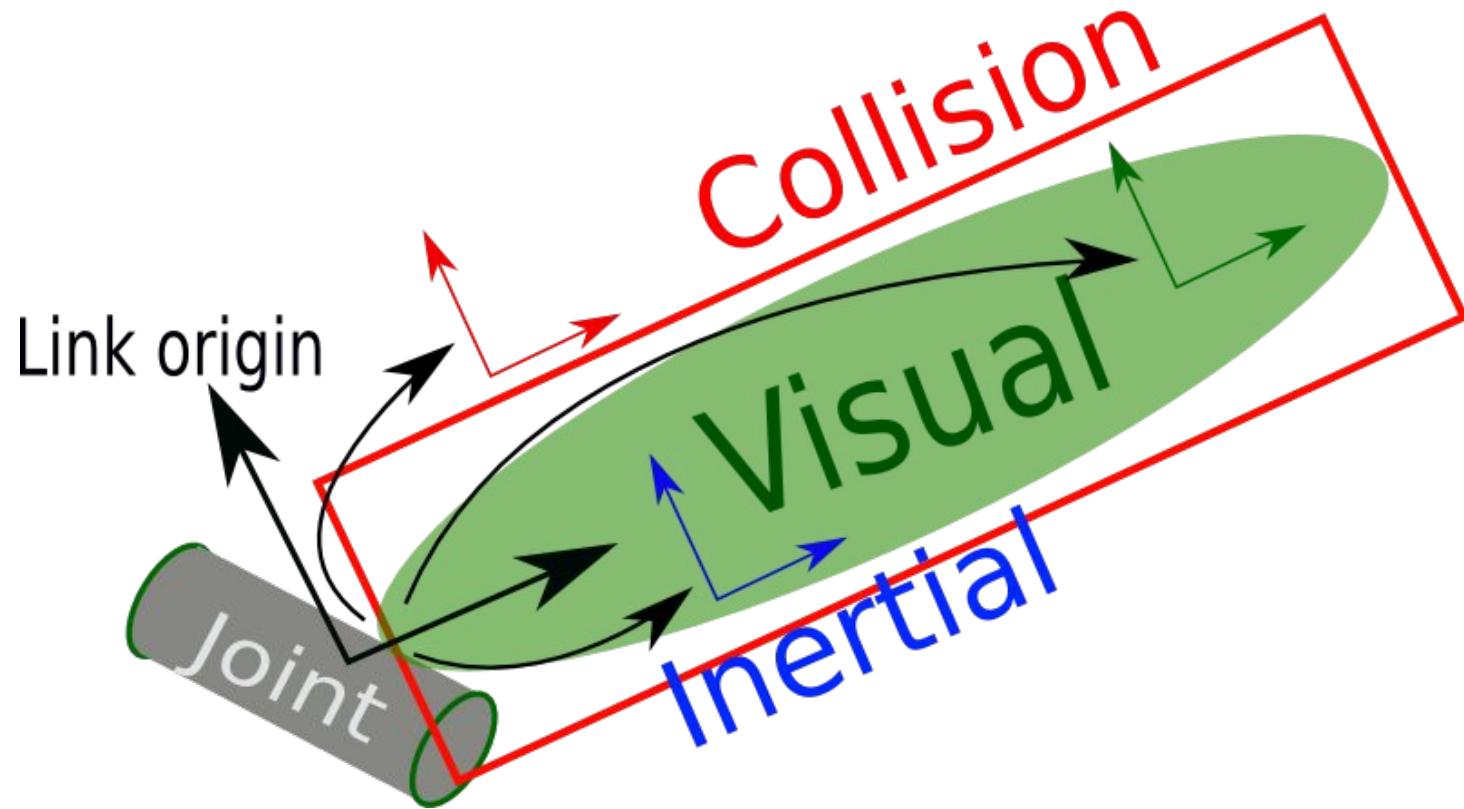


REF: [http://library.isr.ist.utl.pt/docs/roswiki/urdf\(2f\)XML.html](http://library.isr.ist.utl.pt/docs/roswiki/urdf(2f)XML.html)

URDF (link)

REF: <http://wiki.ros.org/urdf/XML/link>

URDF (link)



URDF (link)

```
<link name="my_link">
    <inertial>
        <origin xyz="0 0 0.5" rpy="0 0 0"/>
        <mass value="1"/>
        <inertia ixx="100" ixy="0" ixz="0" iyy="100" iyz="0" izz="100" />
    </inertial>
    <visual>
        <origin xyz="0 0 0" rpy="0 0 0" />
        <geometry>
            <box size="1 1 1" />
        </geometry>
        <material name="Cyan">
            <color rgba="0 1.0 1.0 1.0"/>
        </material>
    </visual>
    <collision>
        <origin xyz="0 0 0" rpy="0 0 0"/>
        <geometry>
            <cylinder radius="1" length="0.5"/>
        </geometry>
    </collision>
</link>
```

URDF (link)

```
<link name="my_link">
    <inertial>
        <origin xyz="0 0 0.5" rpy="0 0 0"/>
        <mass value="1"/>
        <inertia ixx="100" ixy="0" ixz="0" iyy="100" iyz="0" izz="100" />
    </inertial>
    <visual>
        <origin xyz="0 0 0" rpy="0 0 0" />
        <geometry>
            <box size="1 1 1" />
        </geometry>
        <material name="Cyan">
            <color rgba="0 1.0 1.0 1.0"/>
        </material>
    </visual>
    <collision>
        <origin xyz="0 0 0" rpy="0 0 0"/>
        <geometry>
            <cylinder radius="1" length="0.5"/>
        </geometry>
    </collision>
</link>
```

URDF (link)

```
<link name="my_link">
```

.

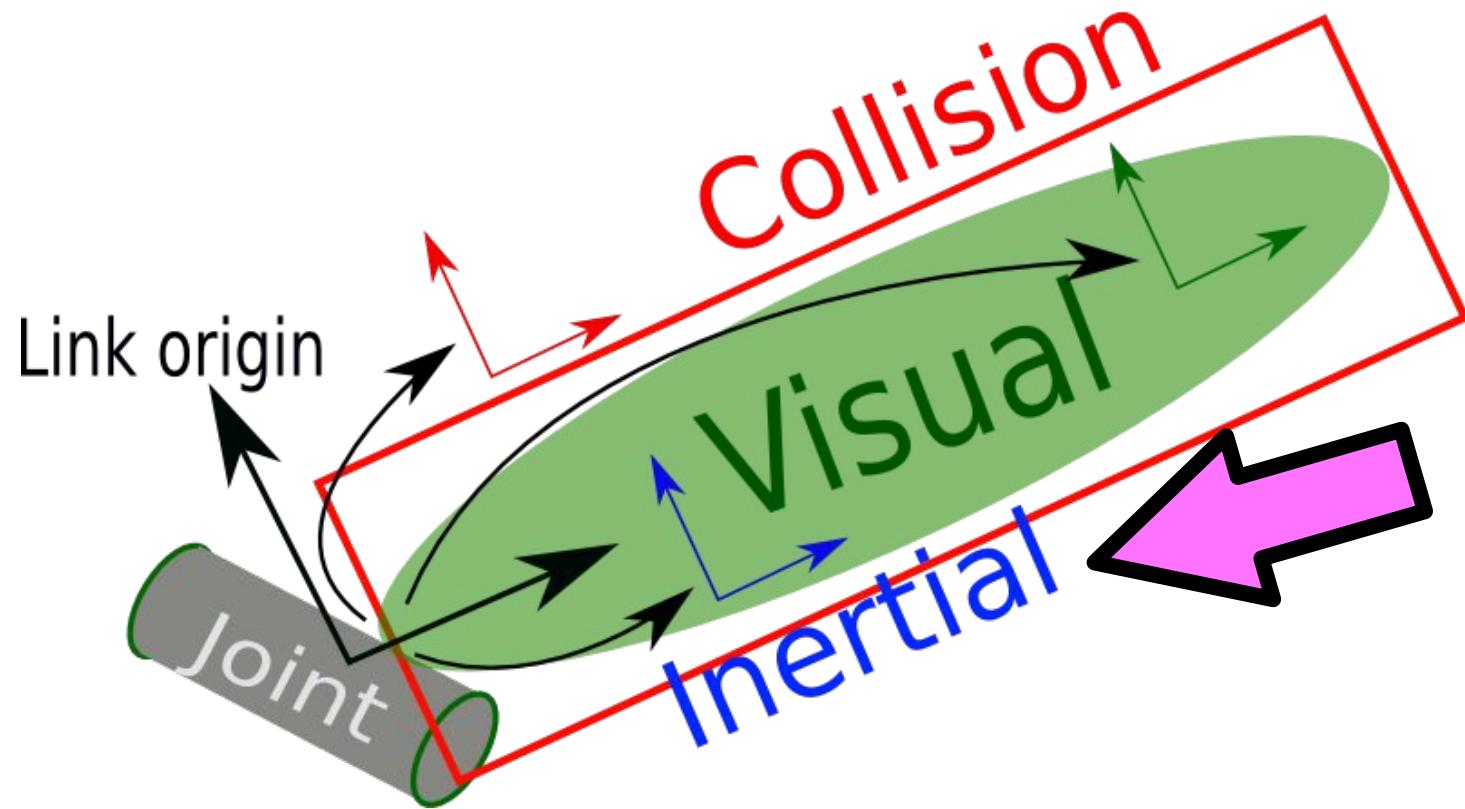
.

.

URDF (link)

```
<link name="my_link">
    <inertial>
        <origin xyz="0 0 0.5" rpy="0 0 0"/>
        <mass value="1"/>
        <inertia ixx="100" ixy="0" ixz="0" iyy="100" iyz="0" izz="100" />
    </inertial>
    <visual>
        <origin xyz="0 0 0" rpy="0 0 0" />
        <geometry>
            <box size="1 1 1" />
        </geometry>
        <material name="Cyan">
            <color rgba="0 1.0 1.0 1.0"/>
        </material>
    </visual>
    <collision>
        <origin xyz="0 0 0" rpy="0 0 0"/>
        <geometry>
            <cylinder radius="1" length="0.5"/>
        </geometry>
    </collision>
</link>
```

URDF (link)



URDF (link)

```
<inertial>
    <origin xyz="0 0 0.5" rpy="0 0 0"/>
    <mass value="1"/>
    <inertia ixx="100" ixy="0" ixz="0" iyy="100" iyz="0" izz="100" />
</inertial>

.
.
```

URDF (link)

```
<inertial>
    <origin xyz="0 0 0.5" rpy="0 0 0"/>
    <mass value="1"/>
    <inertia ixz="100" ixy="0" ixz="0" iyy="100" iyz="0" izz="100" />
</inertial>
.
.
```

URDF (link)

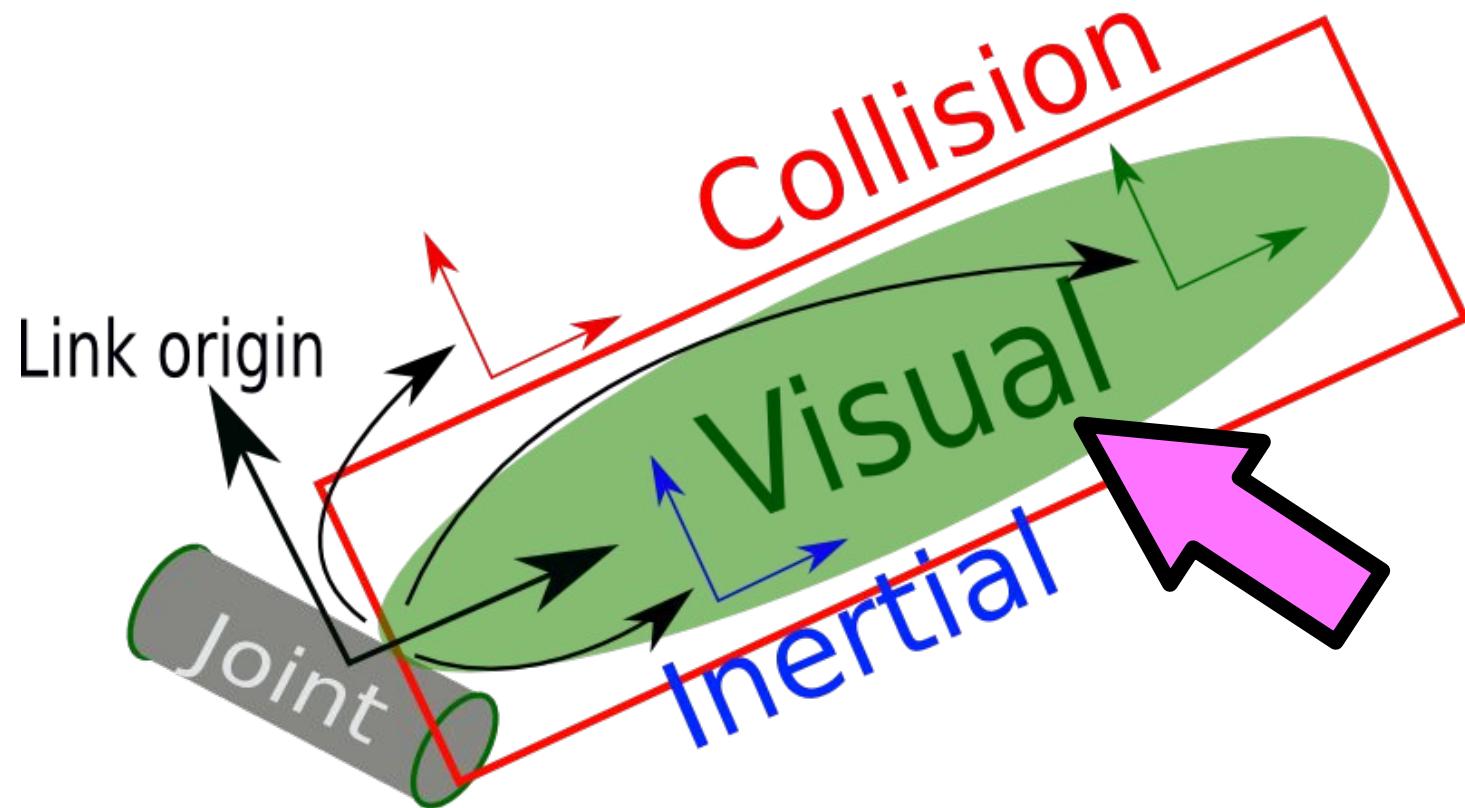
```
<inertial>
  <origin xyz="0 0 0.5" rpy="0 0 0"/>
  <mass value="1"/>
  <inertia ixx="100" ixy="0" ixz="0" iyy="100" iyz="0" izz="100" />
</inertial>

.
.
```

URDF (link)

```
<link name="my_link">
    <inertial>
        <origin xyz="0 0 0.5" rpy="0 0 0"/>
        <mass value="1"/>
        <inertia ixz="100" ixy="0" ixz="0" iyy="100" iyz="0" izz="100" />
    </inertial>
    <visual>
        <origin xyz="0 0 0" rpy="0 0 0" />
        <geometry>
            <box size="1 1 1" />
        </geometry>
        <material name="Cyan">
            <color rgba="0 1.0 1.0 1.0"/>
        </material>
    </visual>
    <collision>
        <origin xyz="0 0 0" rpy="0 0 0"/>
        <geometry>
            <cylinder radius="1" length="0.5"/>
        </geometry>
    </collision>
</link>
```

URDF (link)



URDF (link)

```
<visual>
    <origin xyz="0 0 0" rpy="0 0 0" />
    <geometry>
        <box size="1 1 1" />
    </geometry>
    <material name="Cyan">
        <color rgba="0 1.0 1.0 1.0"/>
    </material>
</visual>

.
.
```

URDF (link)

```
<visual>
    <origin xyz="0 0 0" rpy="0 0 0" />
    <geometry>
        <box size="1 1 1" />
    </geometry>
    <material name="Cyan">
        <color rgba="0 1.0 1.0 1.0"/>
    </material>
</visual>

.
.
```

URDF (link) (*<geometry>*)

<geometry> (required)

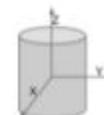
The shape of the visual object. This can be *one* of the following:

<box>

size attribute contains the three side lengths of the box. The origin of the box is in its center.

<cylinder>

Specify the **radius** and **length**. The origin of the cylinder is in its center.



<sphere>

Specify the **radius**. The origin of the sphere is in its center.

<mesh>

A trimesh element specified by a **filename**, and an optional **scale** that scales the mesh's axis-aligned-bounding-box. Any geometry format is acceptable but specific application compatibility is dependent on implementation. The recommended format for best texture and color support is Collada .dae files. The mesh file is not transferred between machines referencing the same model. It must be a local file. Prefix the filename with **package://<packagename>/<path>** to make the path to the mesh file relative to the package <packagename>.

URDF (link)

```
<visual>
    <origin xyz="0 0 0" rpy="0 0 0" />
    <geometry>
        <box size="1 1 1" />
    </geometry>
    <material name="Cyan">
        <color rgba="0 1.0 1.0 1.0"/>
    </material>
</visual>
.
.
```

URDF (link)

<material> (*optional*)

The material of the visual element. It is allowed to specify a material element outside of the 'link' object, in the top level 'robot' element. From within a link element you can then reference the material by name.

name name of the material

<color> (*optional*)

rgba The color of a material specified by set of four numbers representing red/green/blue/alpha, each in the range of [0,1].

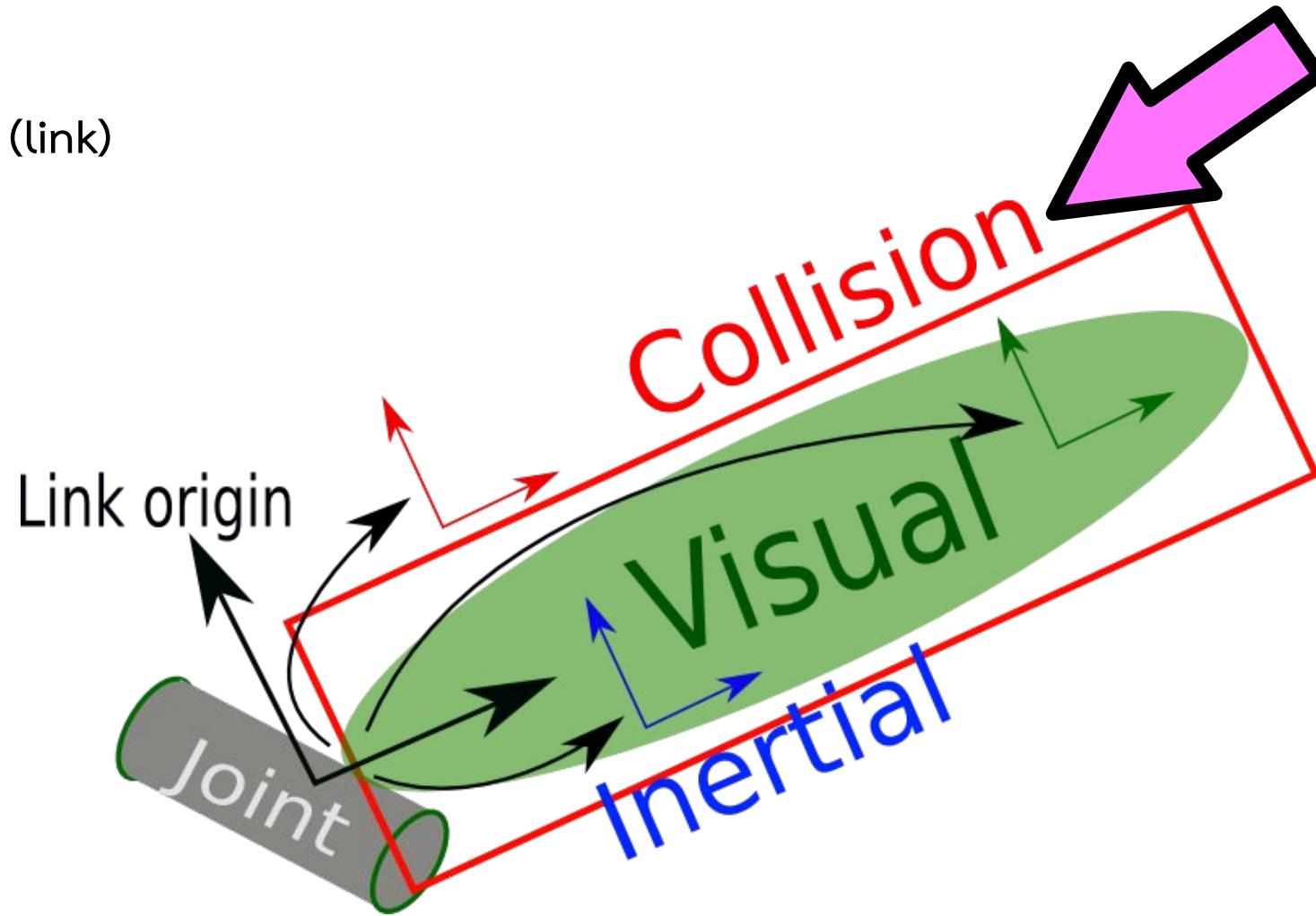
<texture> (*optional*)

The texture of a material is specified by a **filename**

URDF (link)

```
<link name="my_link">
    <inertial>
        <origin xyz="0 0 0.5" rpy="0 0 0"/>
        <mass value="1"/>
        <inertia ixx="100" ixy="0" ixz="0" iyy="100" iyz="0" izz="100" />
    </inertial>
    <visual>
        <origin xyz="0 0 0" rpy="0 0 0" />
        <geometry>
            <box size="1 1 1" />
        </geometry>
        <material name="Cyan">
            <color rgba="0 1.0 1.0 1.0"/>
        </material>
        <!-- collision geometry -->
        <collision>
            <origin xyz="0 0 0" rpy="0 0 0"/>
            <geometry>
                <cylinder radius="1" length="0.5"/>
            </geometry>
        </collision>
    </visual>
</link>
```

URDF (link)



URDF (link)

```
<collision>
    <origin xyz="0 0 0" rpy="0 0 0"/>
    <geometry>
        <cylinder radius="1" length="0.5"/>
    </geometry>
</collision>
```

.

.

URDF (link)

```
<collision>
    <origin xyz="0 0 0" rpy="0 0 0"/>
    <geometry>
        <cylinder radius="1" length="0.5"/>
    </geometry>
</collision>
```

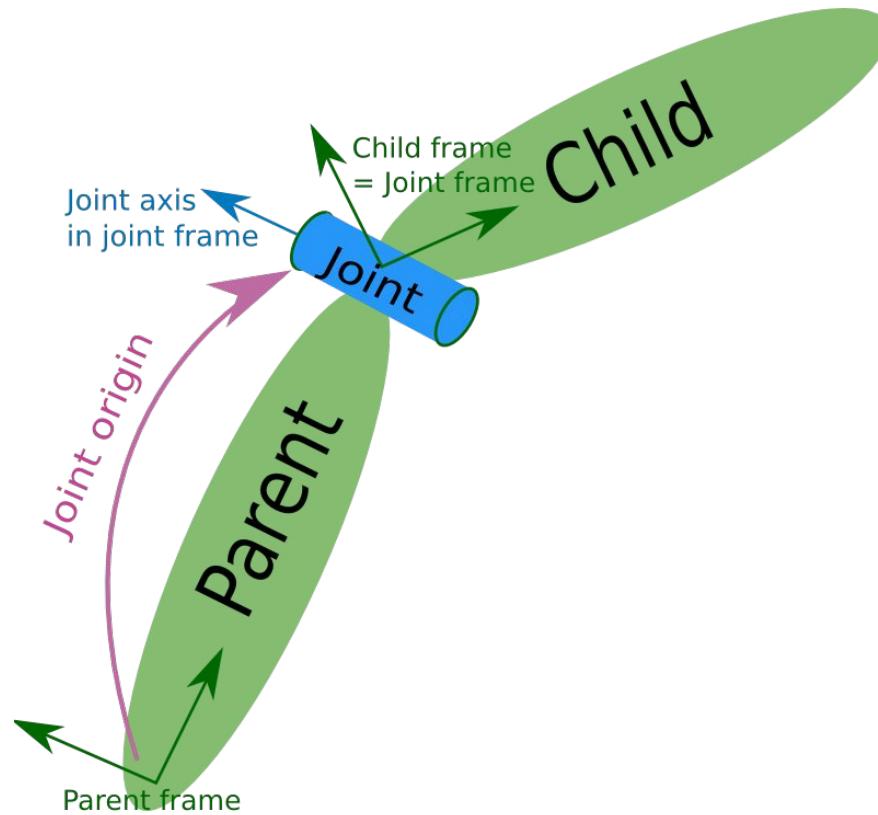
.

.

URDF (joint)

REF: <http://wiki.ros.org/urdf/XML/joint>

URDF (joint)



URDF (joint)

```
<joint name="my_joint" type="floating">  
  <origin xyz="0 0 1" rpy="0 0 3.1416"/>  
  <parent link="link1"/>  
  <child link="link2"/>  
  <calibration rising="0.0"/>  
  <dynamics damping="0.0" friction="0.0"/>  
  <limit effort="30" velocity="1.0" lower="-2.2" upper="0.7" />  
  <safety_controller k_velocity="10" k_position="15" soft_lower_limit="-2.0" soft_upper_limit="0.5" />  
</joint>
```

URDF (joint)

```
<joint name="my_joint" type="floating">  
  <origin xyz="0 0 1" rpy="0 0 3.1416"/>  
  <parent link="link1"/>  
  <child link="link2"/>  
  <calibration rising="0.0"/>  
  <dynamics damping="0.0" friction="0.0"/>  
  <limit effort="30" velocity="1.0" lower="-2.2" upper="0.7" />  
  <safety_controller k_velocity="10" k_position="15" soft_lower_limit="-2.0" soft_upper_limit="0.5" />  
</joint>
```

URDF (joint)

```
<joint name="my_joint" type="floating">
```

URDF (joint)

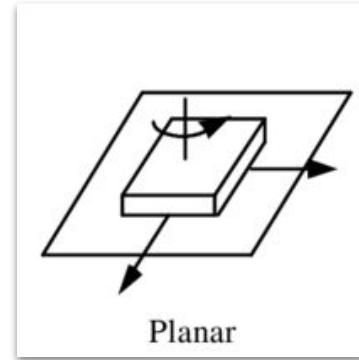
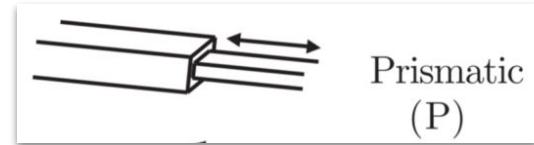
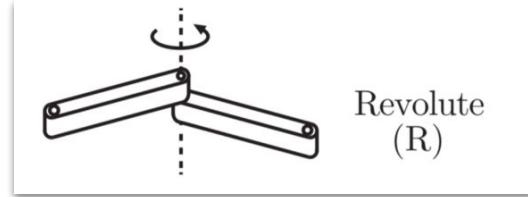
```
<joint name="my_joint" type="floating">
```

URDF (joint)

type

เป็นการกำหนดชนิดของ joint โดยมีให้เลือกดังนี้

- revolute
- continuous
- prismatic
- fixed
- floating
- planar



URDF (joint)

type (required)

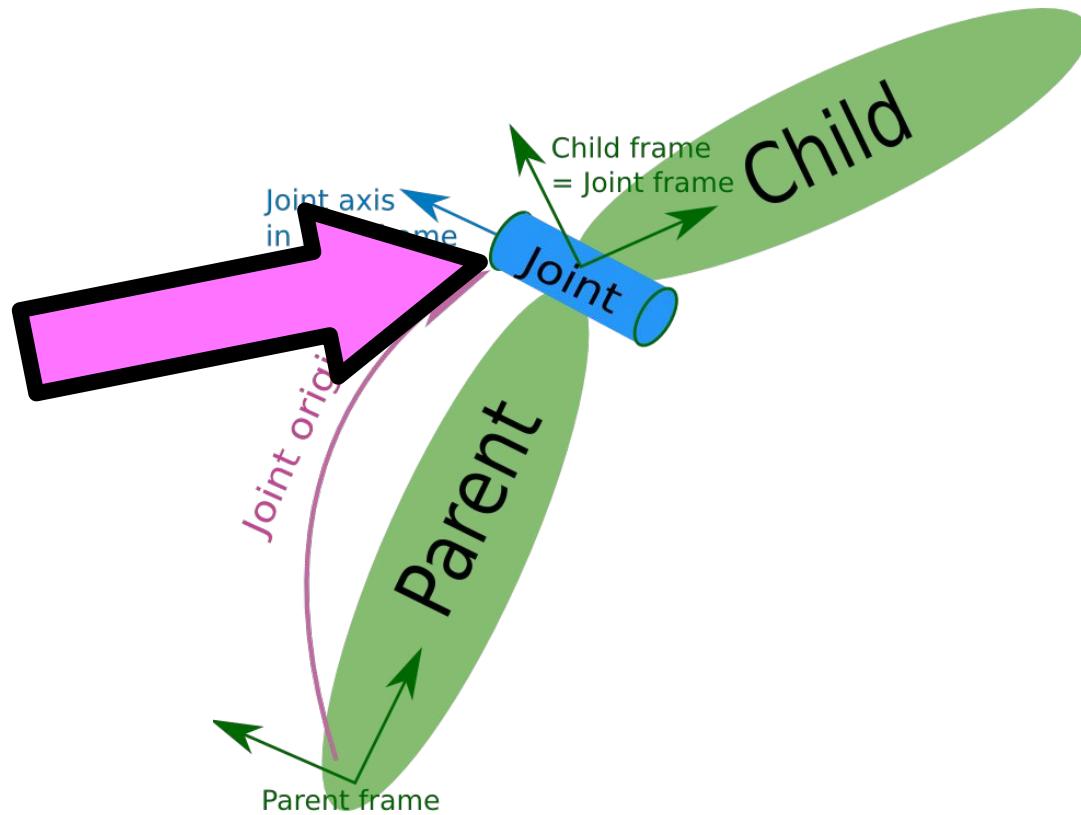
Specifies the type of joint, where type can be one of the following:

- revolute - a hinge joint that rotates along the axis and has a limited range specified by the upper and lower limits.
- continuous - a continuous hinge joint that rotates around the axis and has no upper and lower limits.
- prismatic - a sliding joint that slides along the axis, and has a limited range specified by the upper and lower limits.
- fixed - This is not really a joint because it cannot move. All degrees of freedom are locked. This type of joint does not require the axis, calibration, dynamics, limits or safety_controller.
- floating - This joint allows motion for all 6 degrees of freedom.
- planar - This joint allows motion in a plane perpendicular to the axis.

URDF (joint)

```
<joint name="my_joint" type="floating">  
    <origin xyz="0 0 1" rpy="0 0 3.1416"/>  
    <parent link="link1"/>  
    <child link="link2"/>  
    <calibration rising="0.0"/>  
    <dynamics damping="0.0" friction="0.0"/>  
    <limit effort="30" velocity="1.0" lower="-2.2" upper="0.7" />  
    <safety_controller k_velocity="10" k_position="15" soft_lower_limit="-2.0" soft_upper_limit="0.5" />  
</joint>
```

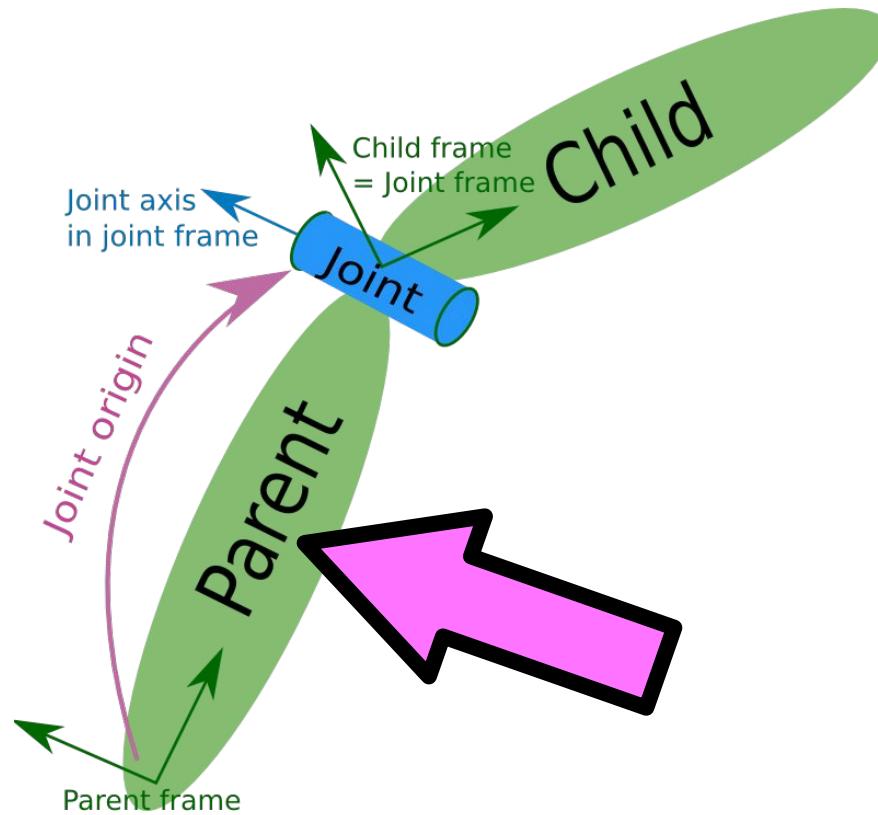
URDF (joint)



URDF (joint)

```
<joint name="my_joint" type="floating">  
    <origin xyz="0 0 1" rpy="0 0 3.1416"/>  
    <parent link="link1"/>  
    <child link="link2"/>  
    <calibration rising="0.0"/>  
    <dynamics damping="0.0" friction="0.0"/>  
    <limit effort="30" velocity="1.0" lower="-2.2" upper="0.7" />  
    <safety_controller k_velocity="10" k_position="15" soft_lower_limit="-2.0" soft_upper_limit="0.5" />  
</joint>
```

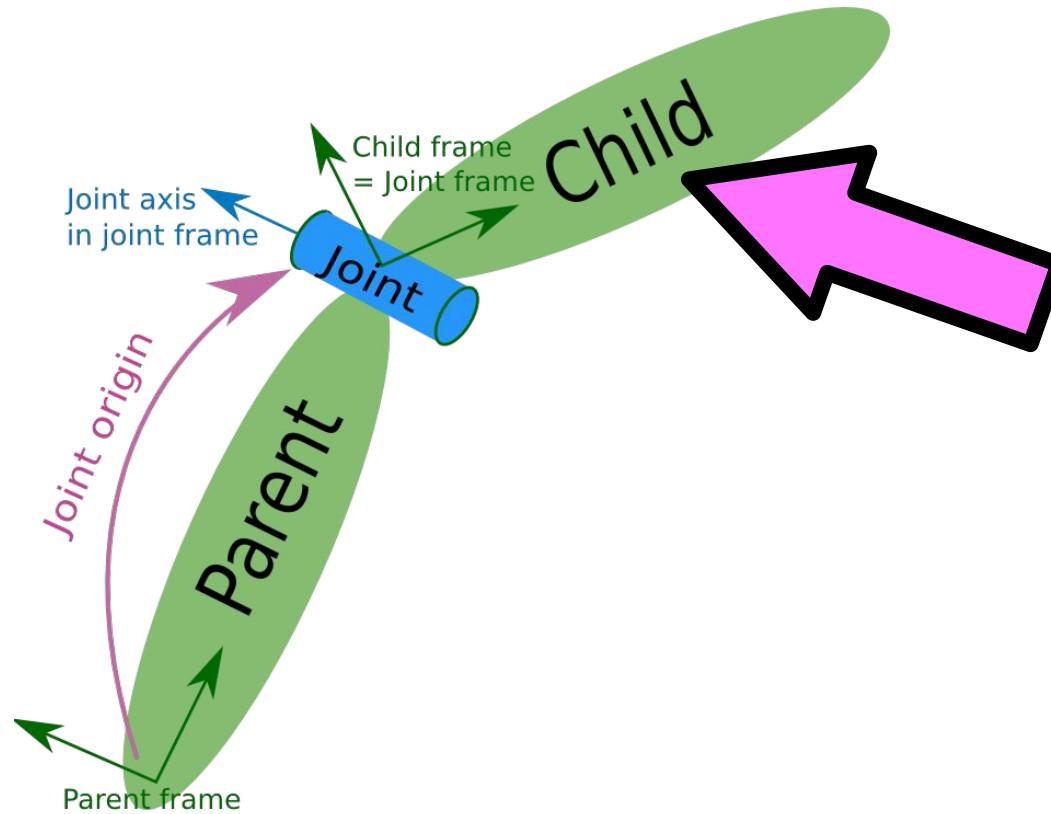
URDF (joint)



URDF (joint)

```
<joint name="my_joint" type="floating">  
  <origin xyz="0 0 1" rpy="0 0 3.1416"/>  
  <parent link="link1"/>  
  <child link="link2"/>  
  <calibration rising="0.0"/>  
  <dynamics damping="0.0" friction="0.0"/>  
  <limit effort="30" velocity="1.0" lower="-2.2" upper="0.7" />  
  <safety_controller k_velocity="10" k_position="15" soft_lower_limit="-2.0" soft_upper_limit="0.5" />  
</joint>
```

URDF (joint)



URDF (joint)

```
<joint name="my_joint" type="floating">  
  <origin xyz="0 0 1" rpy="0 0 3.1416"/>  
  <parent link="link1"/>  
  <child link="link2"/>  
  <calibration rising="0.0"/>  
  <dynamics damping="0.0" friction="0.0"/>  
  <limit effort="30" velocity="1.0" lower="-2.2" upper="0.7" />  
  <safety_controller k_velocity="10" k_position="15" soft_lower_limit="-2.0" soft_upper_limit="0.5" />  
</joint>
```

URDF (joint)

<calibration> (*optional*)

The reference positions of the joint, used to calibrate the absolute position of the joint.

rising (*optional*)

When the joint moves in a positive direction, this reference position will trigger a rising edge.

falling (*optional*)

When the joint moves in a positive direction, this reference position will trigger a falling edge.

URDF (joint)

```
<joint name="my_joint" type="floating">  
  <origin xyz="0 0 1" rpy="0 0 3.1416"/>  
  <parent link="link1"/>  
  <child link="link2"/>  
  <calibration rising="0.0"/>  
  <dynamics damping="0.0" friction="0.0"/>  
  <limit effort="30" velocity="1.0" lower="-2.2" upper="0.7" />  
  <safety_controller k_velocity="10" k_position="15" soft_lower_limit="-2.0" soft_upper_limit="0.5" />  
</joint>
```

URDF (joint)

`<dynamics>` (*optional*)

An element specifying physical properties of the joint. These values are used to specify modeling properties of the joint, particularly useful for simulation.

`damping` (*optional, defaults to 0*)

The physical damping value of the joint

`friction` (*optional, defaults to 0*)

The physical static friction value of the joint

Prismatic

$$\left(\frac{N \cdot s}{m} \right)$$

Revolute

$$\left(\frac{N \cdot m \cdot s}{rad} \right)$$

Prismatic

$$(N)$$

Revolute

$$(N \cdot m)$$

URDF (joint)

```
<joint name="my_joint" type="floating">  
  <origin xyz="0 0 1" rpy="0 0 3.1416"/>  
  <parent link="link1"/>  
  <child link="link2"/>  
  <calibration rising="0.0"/>  
  <dynamics damping="0.0" friction="0.0"/>  
  <limit effort="30" velocity="1.0" lower="-2.2" upper="0.7" />  
  <safety_controller k_velocity="10" k_position="15" soft_lower_limit="-2.0" soft_upper_limit="0.5" />  
</joint>
```

URDF (joint)

<limit> (*required only for revolute and prismatic joint*)

An element can contain the following attributes:

lower (*optional, defaults to 0*)

An attribute specifying the lower joint limit (radians for revolute joints, meters for prismatic joints). Omit if joint is continuous.

upper (*optional, defaults to 0*)

An attribute specifying the upper joint limit (radians for revolute joints, meters for prismatic joints). Omit if joint is continuous.

effort (*required*)

An attribute for enforcing the maximum joint effort.

velocity (*required*)

An attribute for enforcing the maximum joint velocity.

URDF (joint)

```
<joint name="my_joint" type="floating">  
  <origin xyz="0 0 1" rpy="0 0 3.1416"/>  
  <parent link="link1"/>  
  <child link="link2"/>  
  <calibration rising="0.0"/>  
  <dynamics damping="0.0" friction="0.0"/>  
  <limit effort="30" velocity="1.0" lower="-2.2" upper="0.7" />  
  <safety_controller k_velocity="10" k_position="15" soft_lower_limit="-2.0" soft_upper_limit="0.5" />  
</joint>
```

URDF (joint)

<safety_controller> (*optional*)

An element can contain the following attributes:

soft_lower_limit (*optional, defaults to 0*)

An attribute specifying the lower joint boundary where the safety controller starts limiting the position of the joint. This limit needs to be larger than the lower joint limit (see above). See [See safety limits](#) for more details.

soft_upper_limit (*optional, defaults to 0*)

An attribute specifying the upper joint boundary where the safety controller starts limiting the position of the joint. This limit needs to be smaller than the upper joint limit (see above). See [See safety limits](#) for more details.

k_position (*optional, defaults to 0*)

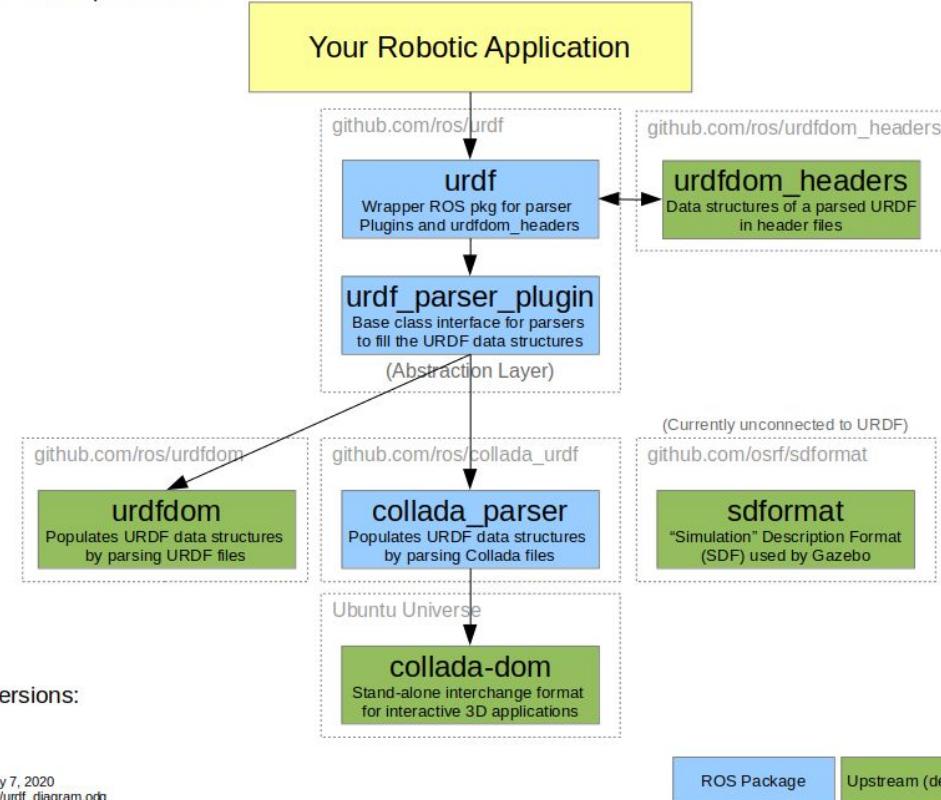
An attribute specifying the relation between position and velocity limits. See [See safety limits](#) for more details.

k_velocity (*required*)

An attribute specifying the relation between effort and velocity limits. See [See safety limits](#) for more details.

ROS URDF

Universal Robotic Description Format



URDF from SOLIDWORKS



URDF from SOLIDWORKS

- เข้าไปที่ http://wiki.ros.org/sw_urdf_exporter

The screenshot shows the ROS.org website with the URL http://wiki.ros.org/sw_urdf_exporter. The page title is "SolidWorks to URDF Exporter". A large orange arrow points to the "Download Installer" button. The page content includes sections on SolidWorks Version Compatibility and Some Important Items, along with links to documentation and support.

ROS.org

About | Support | Discussion Forum | Service Status | Q&A answers.ros.org

Search: Submit

Documentation Browse Software News Download

[sw_urdf_exporter](#)

SolidWorks to URDF Exporter

The SolidWorks to URDF exporter is a SolidWorks add-in that allows for the convenient export of SW Parts and Assemblies into a URDF file. The exporter will create a ROS-like package that contains a directory for meshes, textures and robots (urdf files). For single SolidWorks parts, the part exporter will pull the material properties and create a single link in the URDF. For assemblies, the exporter will build the links and create a tree based on the SW assembly hierarchy. The exporter can automatically determine the proper joint type, joint transforms, and axes.

If the above provided download fails to work on your system, please install [here](#) before reporting an issue. If installing by source does work, please submit an [Update Installer Request](#).

Download Installer

1. SolidWorks Version Compatibility

There is a known STL export bug with SolidWorks 2018 that exists up to Service Pack 4 that renders this add-in unusable. If you are using 2018, please update to service pack 5 or use SolidWorks 2019 or later. 2017 and below may also work.

2. Some Important Items

Development on this plugin as of recently has come from the generous donations of several ROS community members. Without this support or from pull requests from communities members, development would not be able to continue. We also appreciate any bugs or feature requests so that we can work on them when the resources become available.

This project is not dependent on ROS and can be used for exporting SolidWorks files for any URDF needs. The URDF will include rospack URI file locations ('package://'), so you will need to change those for non-ROS systems (some Gazebo systems can handle 'package' URLs).

This add-in has been tested on Windows 10 64bit with SolidWorks 2018 SP 5 64bit. It currently does not install on 32bit machines. The add-in makes use of the most up-to-date SW API so it may not work with versions earlier than SolidWorks 2018 (but this hasn't been confirmed).

To learn more about URDF, please review its [documentation](#).

ROS 2 Documentation

The ROS Wiki is for ROS 1. Are you using ROS 2 (Dashing/Foxy/Rolling)? Check out the [ROS 2 Documentation](#)

Wiki

Distributions
ROS/Installation
ROS/Tutorials
RecentChanges
sw_urdf_exporter

Page

Immutable Page
Info
Attachments

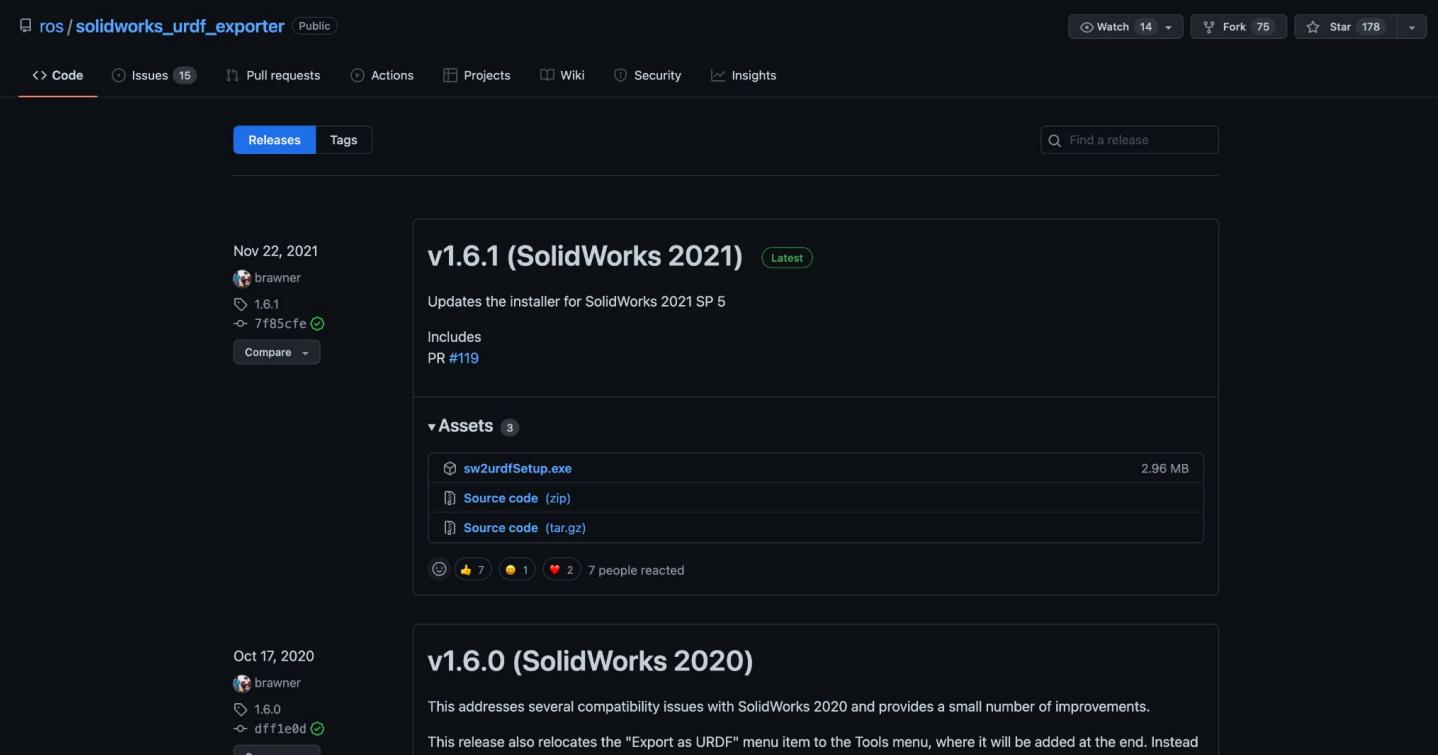
More Actions:

Raw Text

User

Login

URDF from SOLIDWORKS



The screenshot shows the GitHub repository page for `ros/solidworks_urdf_exporter`. The repository is public and has 14 watchers, 75 forks, and 178 stars. The main navigation bar includes links for Code, Issues (15), Pull requests, Actions, Projects, Wiki, Security, and Insights.

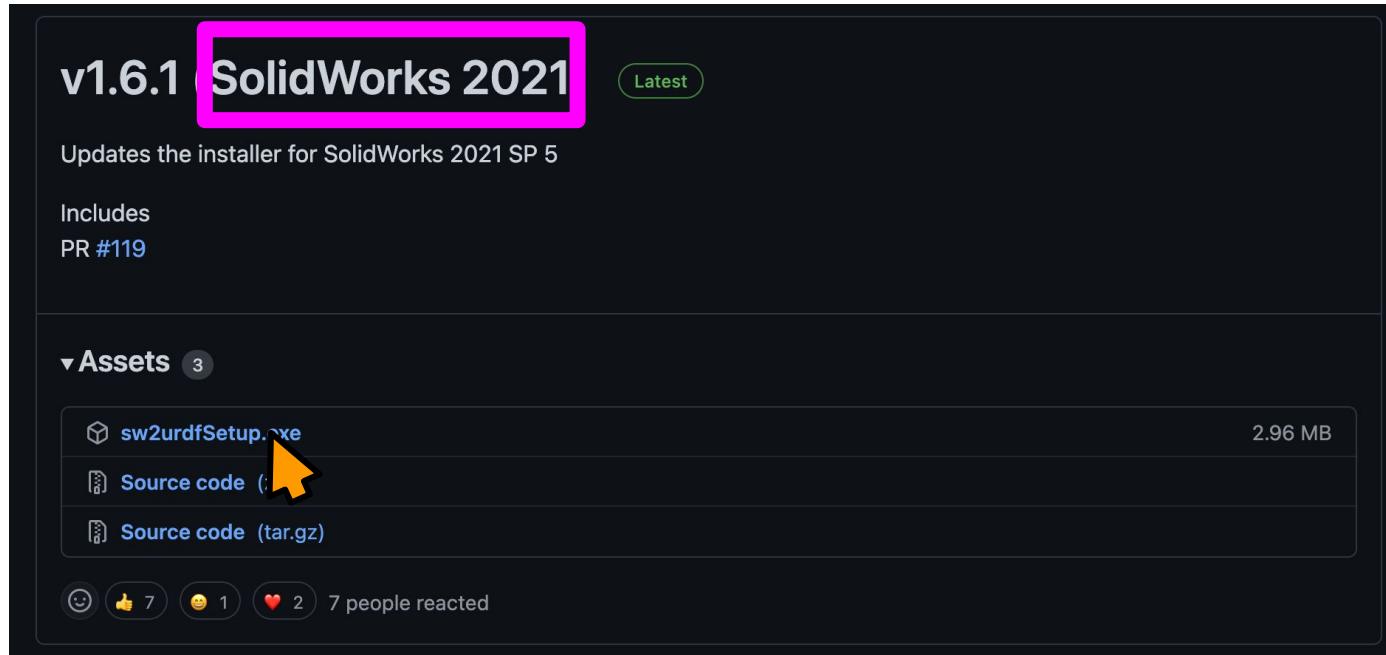
The **Releases** tab is selected, displaying two releases:

- v1.6.1 (SolidWorks 2021)** (Latest): Released on Nov 22, 2021, by brawner. It includes PR #119 and assets: `sw2urdfSetup.exe` (2.96 MB), `Source code (zip)`, and `Source code (tar.gz)`. The release has 7 reactions.
- v1.6.0 (SolidWorks 2020)**: Released on Oct 17, 2020, by brawner. It addresses compatibility issues with SolidWorks 2020 and relocates the "Export as URDF" menu item to the Tools menu. The release has 1 reaction.

A search bar at the top right says "Find a release".

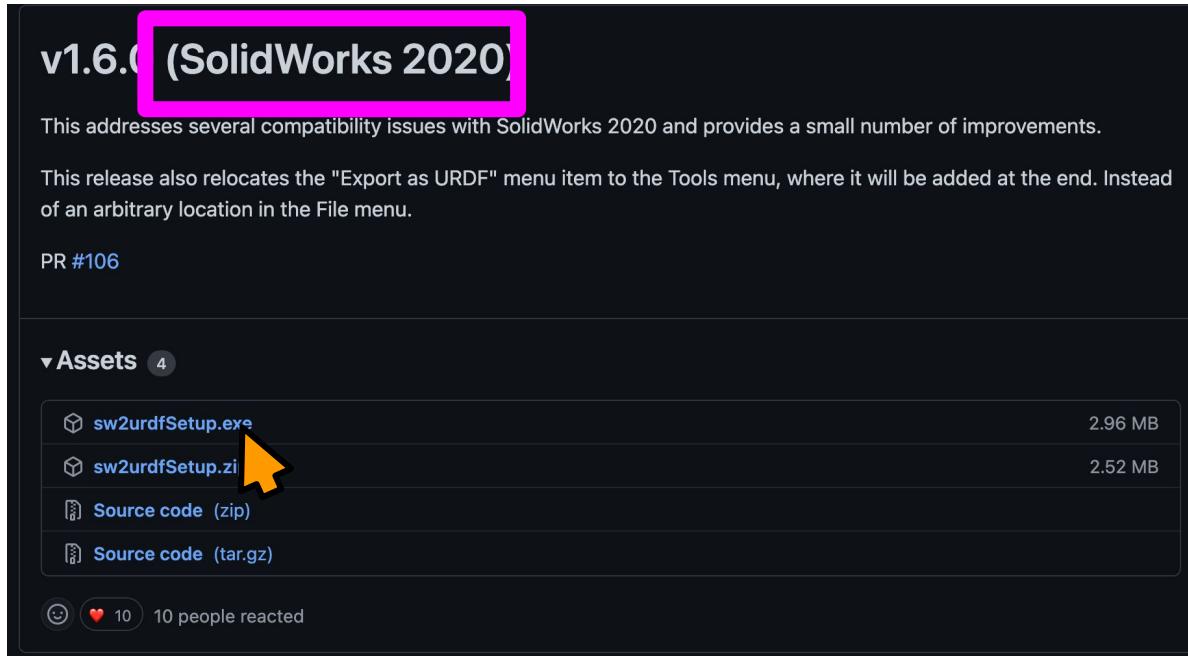
URDF from SOLIDWORKS

- ทำการเลือก version ให้ตรงกับ version ของ solidwork ของเรา

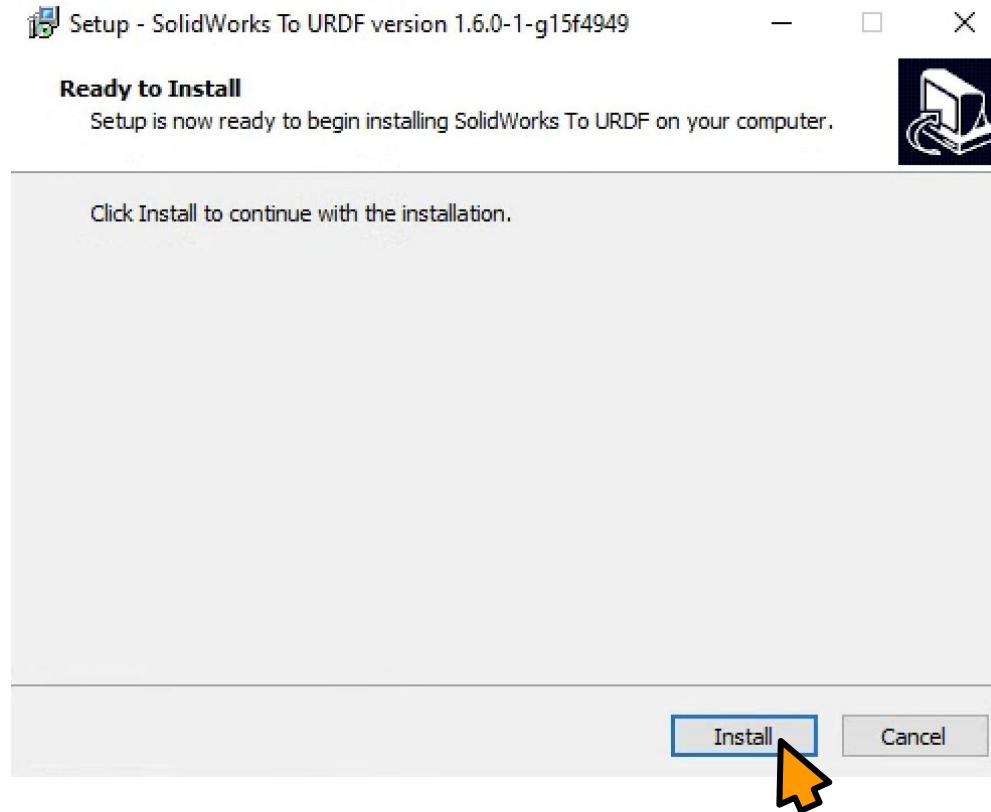


URDF from SOLIDWORKS

- ทำการเลือก version ให้ตรงกับ version ของ solidwork ของเรา



URDF from SOLIDWORKS

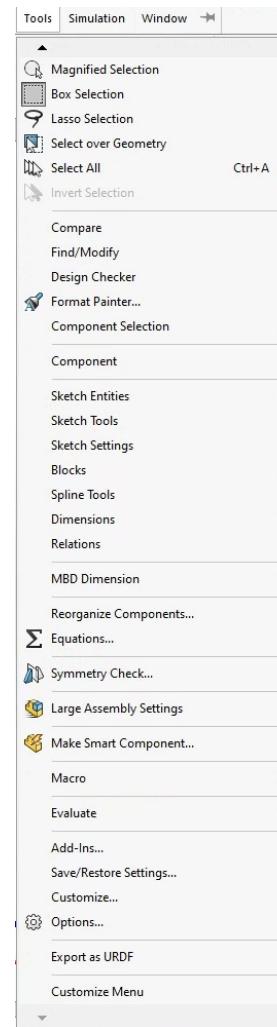


URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export

URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export
- กดเข้าไปที่ tools



URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export
- กดเข้าไปที่ tools > Export as URDF



URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export
- กดเข้าไปที่ tools > Export as URDF



URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export
- กดเข้าไปที่ tools > Export as URDF
- ทำการตั้งชื่อ link



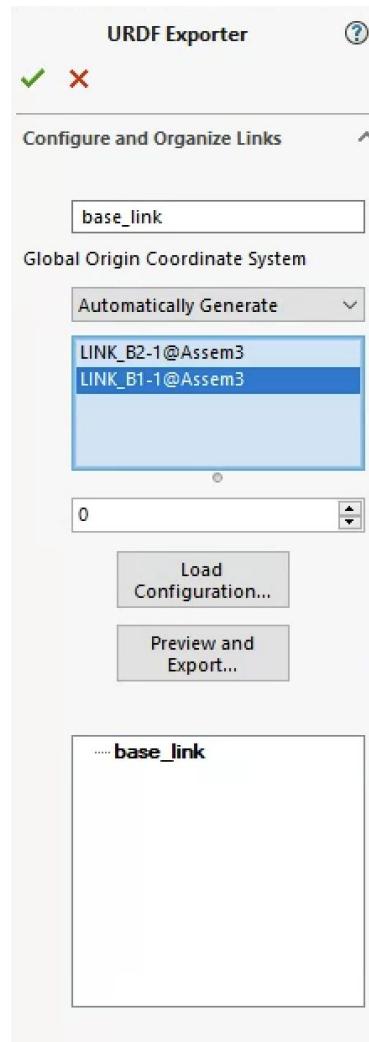
URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export
- กดเข้าไปที่ tools > Export as URDF
- ทำการตั้งชื่อ link
- ทำการเลือก part ที่ต้องการให้เป็น link นี้



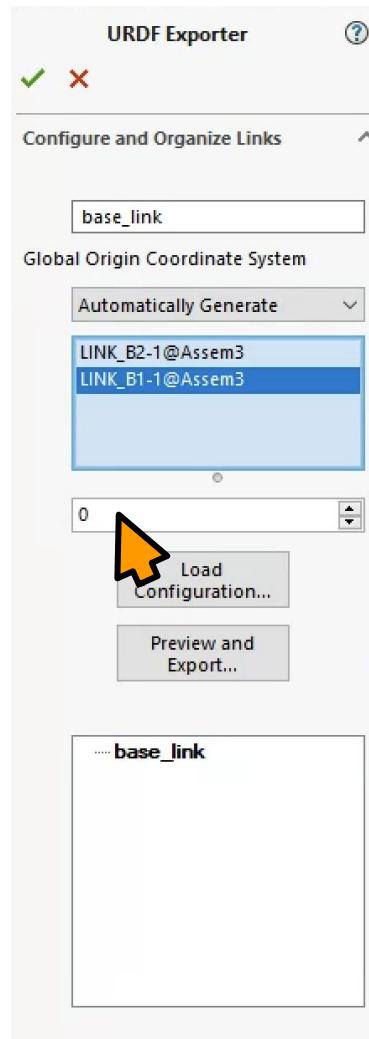
URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export
- กดเข้าไปที่ tools > Export as URDF
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URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export
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- ทำการเลือกจำนวนของ child link



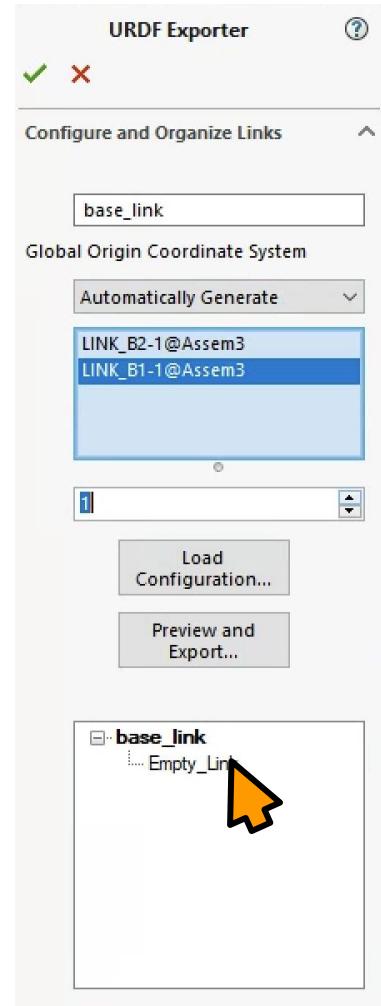
URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export
- กดเข้าไปที่ tools > Export as URDF
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- ทำการเลือกจำนวนของ child link



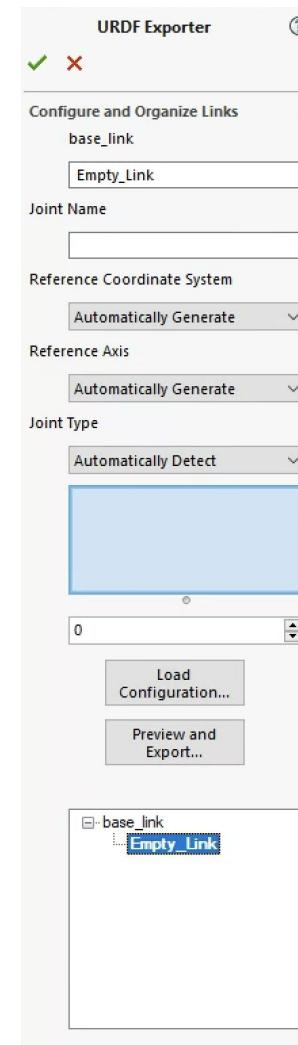
URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export
- กดเข้าไปที่ tools > Export as URDF
- ทำการตั้งชื่อ link
- ทำการเลือก part ที่ต้องการให้เป็น link นี้
- ทำการเลือกจำนวนของ child link
- ทำการเลือกที่ child link



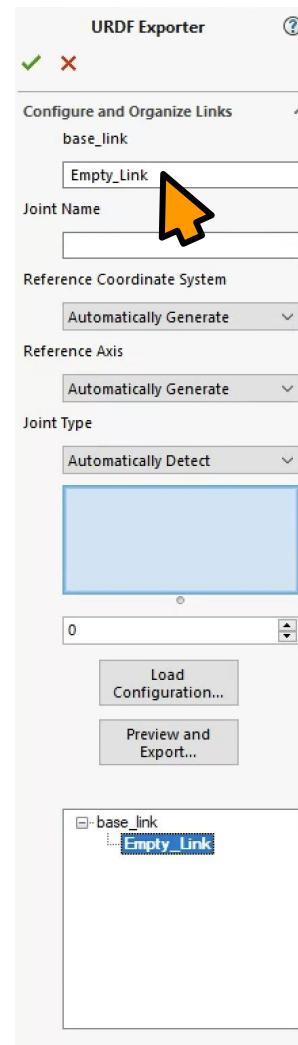
URDF from SOLIDWORKS 2020

- เปิด solidworks และเลือกงานที่ต้องการ export
- กดเข้าไปที่ tools > Export as URDF
- ทำการตั้งชื่อ link
- ทำการเลือก part ที่ต้องการให้เป็น link นี้
- ทำการเลือกจำนวนของ child link
- ทำการเลือกที่ child link



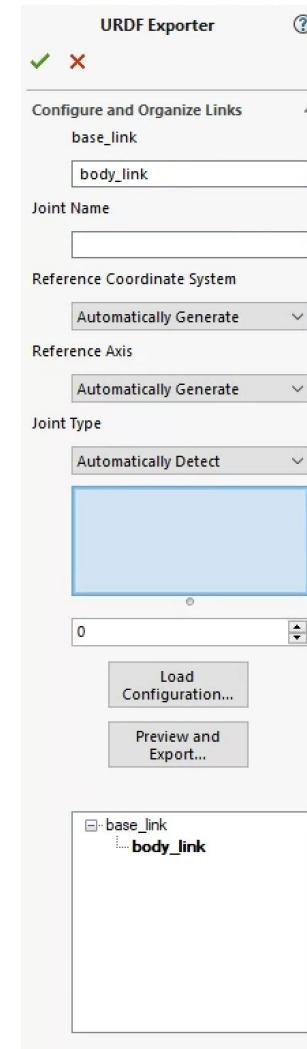
URDF from SOLIDWORKS 2020

- ทำการตั้งชื่อ link



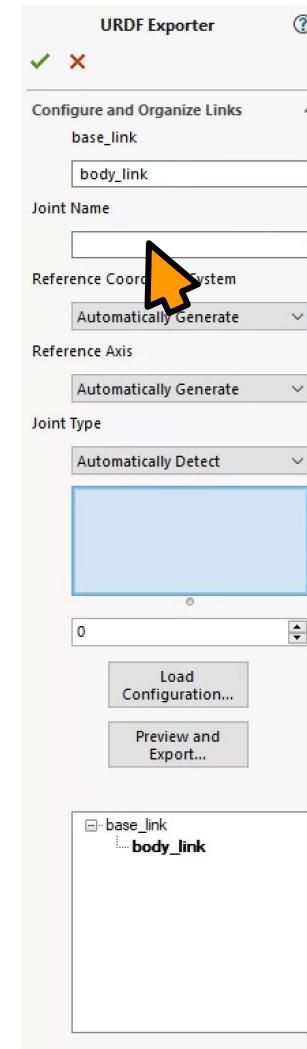
URDF from SOLIDWORKS 2020

- ทำการตั้งชื่อ link



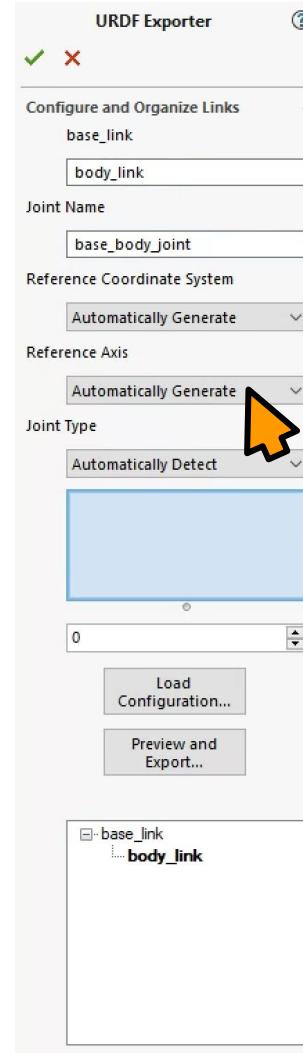
URDF from SOLIDWORKS 2020

- ทำการตั้งชื่อ link
- ทำการตั้งชื่อ joint



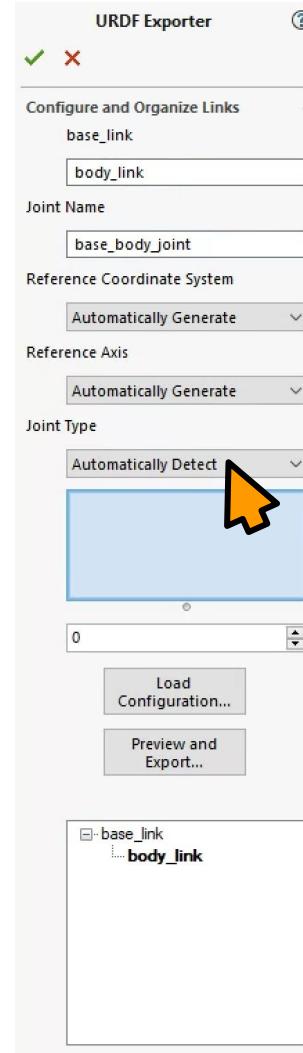
URDF from SOLIDWORKS 2020

- ทำการตั้งชื่อ link
- ทำการตั้งชื่อ joint
- ทำการเลือกแกน reference (optional)



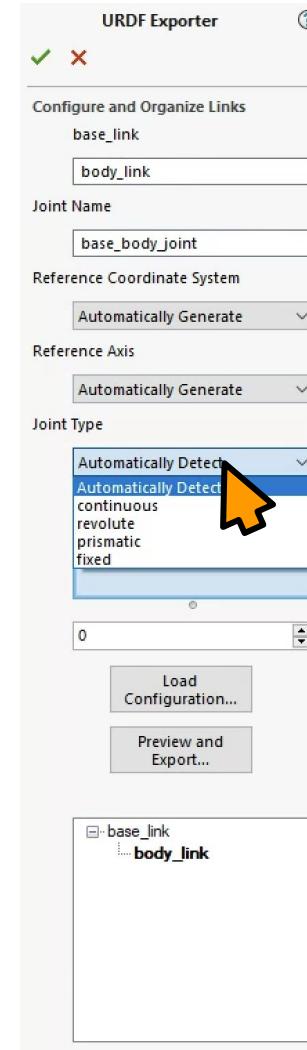
URDF from SOLIDWORKS 2020

- ทำการตั้งชื่อ link
- ทำการตั้งชื่อ joint
- ทำการเลือกแกน reference (optional)
- ทำการเลือก joint type



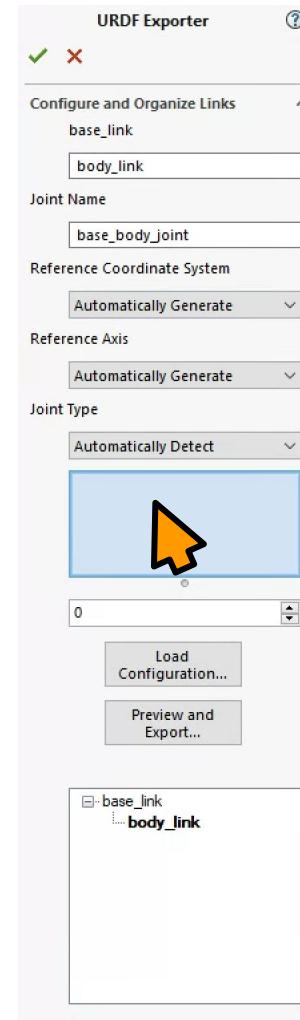
URDF from SOLIDWORKS 2020

- ทำการตั้งชื่อ link
- ทำการตั้งชื่อ joint
- ทำการเลือกแกน reference (optional)
- ทำการเลือก joint type



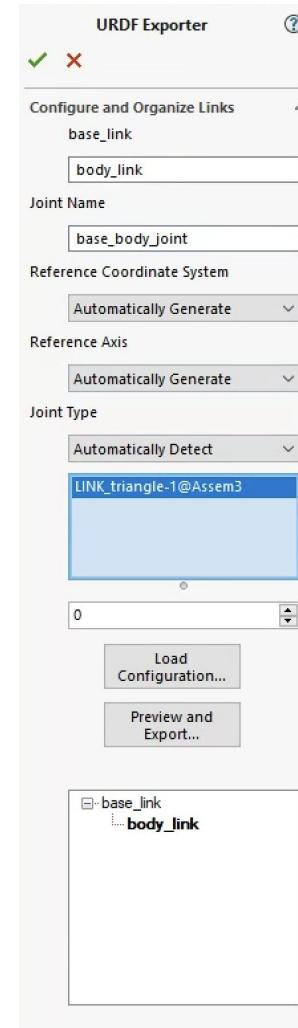
URDF from SOLIDWORKS 2020

- ทำการตั้งชื่อ link
- ทำการตั้งชื่อ joint
- ทำการเลือกแกน reference (optional)
- ทำการเลือก joint type
- ทำการเลือก part ที่จะให้เป็น link นี้



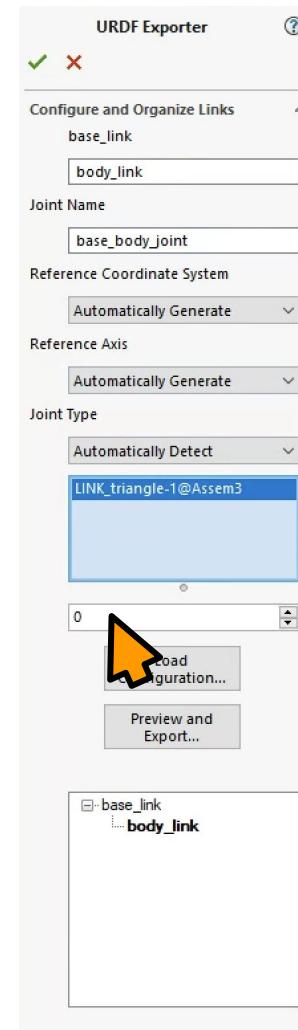
URDF from SOLIDWORKS 2020

- ทำการตั้งชื่อ link
- ทำการตั้งชื่อ joint
- ทำการเลือกแกน reference (optional)
- ทำการเลือก joint type
- ทำการเลือก part ที่จะให้เป็น link นี้



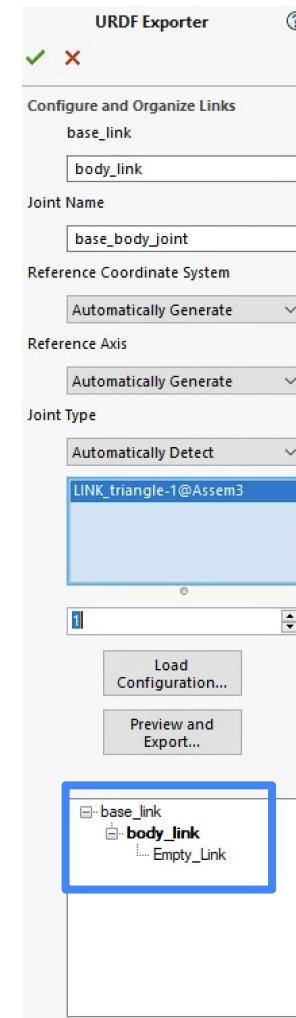
URDF from SOLIDWORKS 2020

- ทำการตั้งชื่อ link
- ทำการตั้งชื่อ joint
- ทำการเลือกแกน reference (optional)
- ทำการเลือก joint type
- ทำการเลือก part ที่จะให้เป็น link นี้
- เลือกจำนวน child link



URDF from SOLIDWORKS 2020

- ทำการตั้งชื่อ link
- ทำการตั้งชื่อ joint
- ทำการเลือกแกน reference (optional)
- ทำการเลือก joint type
- ทำการเลือก part ที่จะให้เป็น link นี้
- เลือกจำนวน child link



URDF from SOLIDWORKS 2020

- ทำงานໄປເຮືອຍໆ ຈນຄຣບທັງຕົວ

Spawn URDF by ROS

```
$ cd ~/tutorial_ws/src
```

```
$ catkin_create_pkg tutorial_gazebo rospy roscpp std_msgs gazebo_msgs
```

```
$ cd . . /
```

```
$ catkin_make
```

```
$ rospack profile
```

```
$ roscd tutorial_gazebo/
```

```
$ mkdir urdf
```

```
$ cd urdf/
```

```
$ gedit simple_robot.urdf
```

URDF file

```
<?xml version="1.0"?>
<robot name="simple_robot">
  <link name="base_link">
    <visual>
      <geometry>
        <cylinder length="0.6" radius="0.2"/>
      </geometry>
    </visual>
    <inertial>
      <mass value="0.05"/>
      <inertia ixz="0.0" ixy="0.0" ixz="0.0" iyy="0.0" iyz="0.0" izz="0.0"/>
    </inertial>
    <collision>
      <geometry>
        <cylinder length="0.6" radius="0.2"/>
      </geometry>
      <origin rpy="0 0 0" xyz="0 0 0"/>
    </collision>
  </link>

  <link name="right_arm">
    <visual>
      <geometry>
        <box size="0.2 0.1 0.4"/>
      </geometry>
      <origin rpy="0 0 0" xyz="0 0 0"/>
    </visual>
    <inertial>
      <mass value="0.05"/>
      <inertia ixz="0.0" ixy="0.0" ixz="0.0" iyy="0.0" iyz="0.0" izz="0.0"/>
    </inertial>
    <collision>
      <geometry>
        <box size="0.2 0.1 0.4"/>
      </geometry>
      <origin rpy="0 1.57 0" xyz="0 0 0"/>
    </collision>
  </link>

  <joint name="base_to_right_arm_joint" type="fixed">
    <parent link="base_link"/>
    <child link="right_arm"/>
    <origin rpy="0 0 0" xyz="0.2 0.01 0"/>
  </joint>

  <link name="left_arm">
    <visual>
      <geometry>
        <box size="0.2 0.1 0.4"/>
      </geometry>
      <origin rpy="0 0 0" xyz="0 0 0"/>
    </visual>
    <inertial>
      <mass value="0.05"/>
      <inertia ixz="0.0" ixy="0.0" ixz="0.0" iyy="0.0" iyz="0.0" izz="0.0"/>
      <origin rpy="0 1.57 0" xyz="0 0 0"/>
    </inertial>
    <collision>
      <geometry>
        <box size="0.2 0.1 0.4"/>
      </geometry>
      <origin rpy="0 0 0" xyz="0 0 0"/>
    </collision>
  </link>

  <joint name="base_to_left_arm_joint" type="fixed">
    <parent link="base_link"/>
    <child link="left_arm"/>
    <origin rpy="0 0 0" xyz="-0.2 0.01 0"/>
  </joint>
```

```
$ roscore
```

```
:~# roscore
... logging to /root/.ros/log/a4938efa-7c5b-11ec-b410-0242ac110002/roslaunch-c0665c07a68b-2984.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://[REDACTED]:39823/
ros_comm version 1.15.13

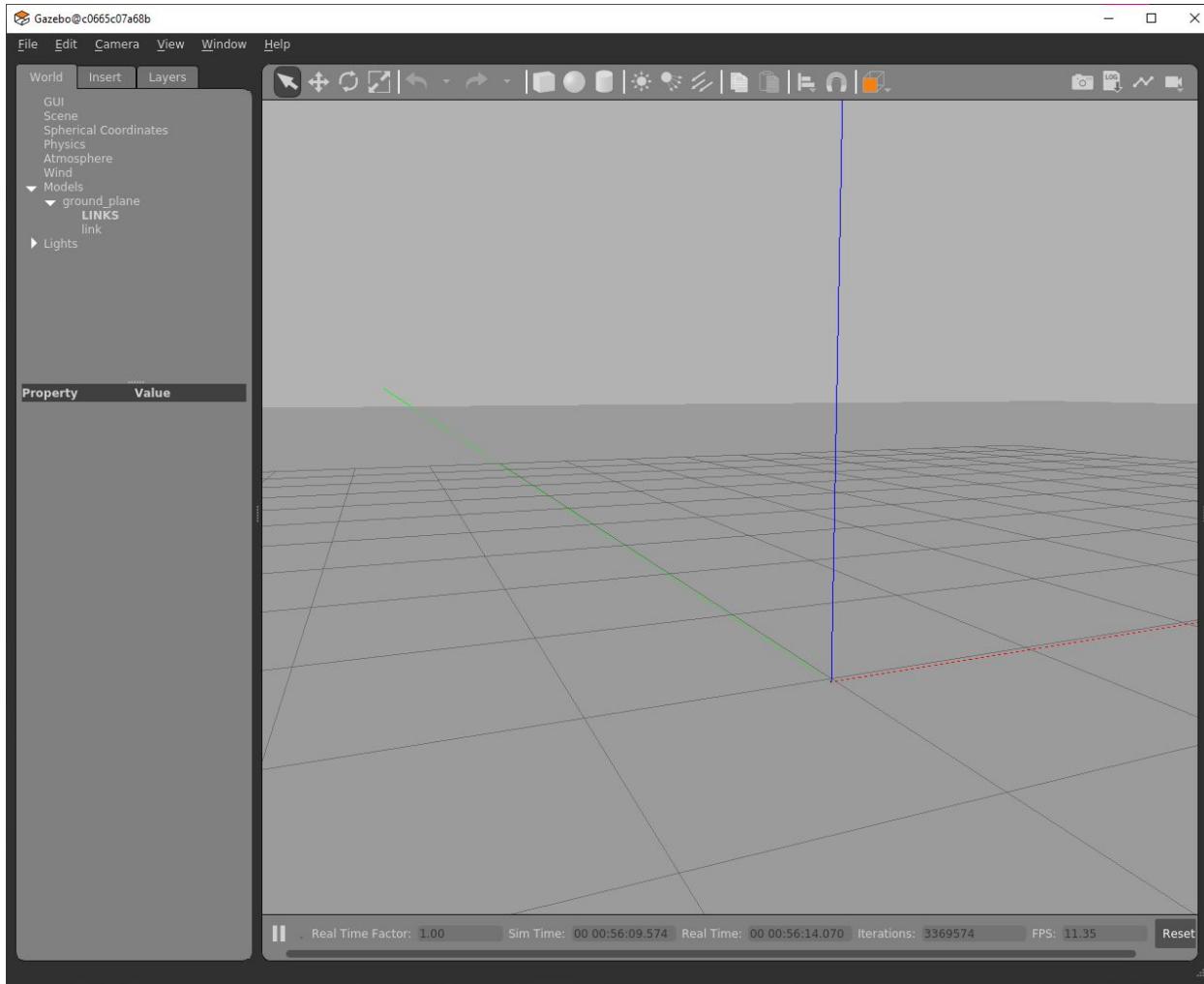
SUMMARY
=====
PARAMETERS
  * /rosdistro: noetic
  * /rosversion: 1.15.13

NODES

auto-starting new master
process[master]: started with pid [3008]
ROS_MASTER_URI=http://[REDACTED]:11311/

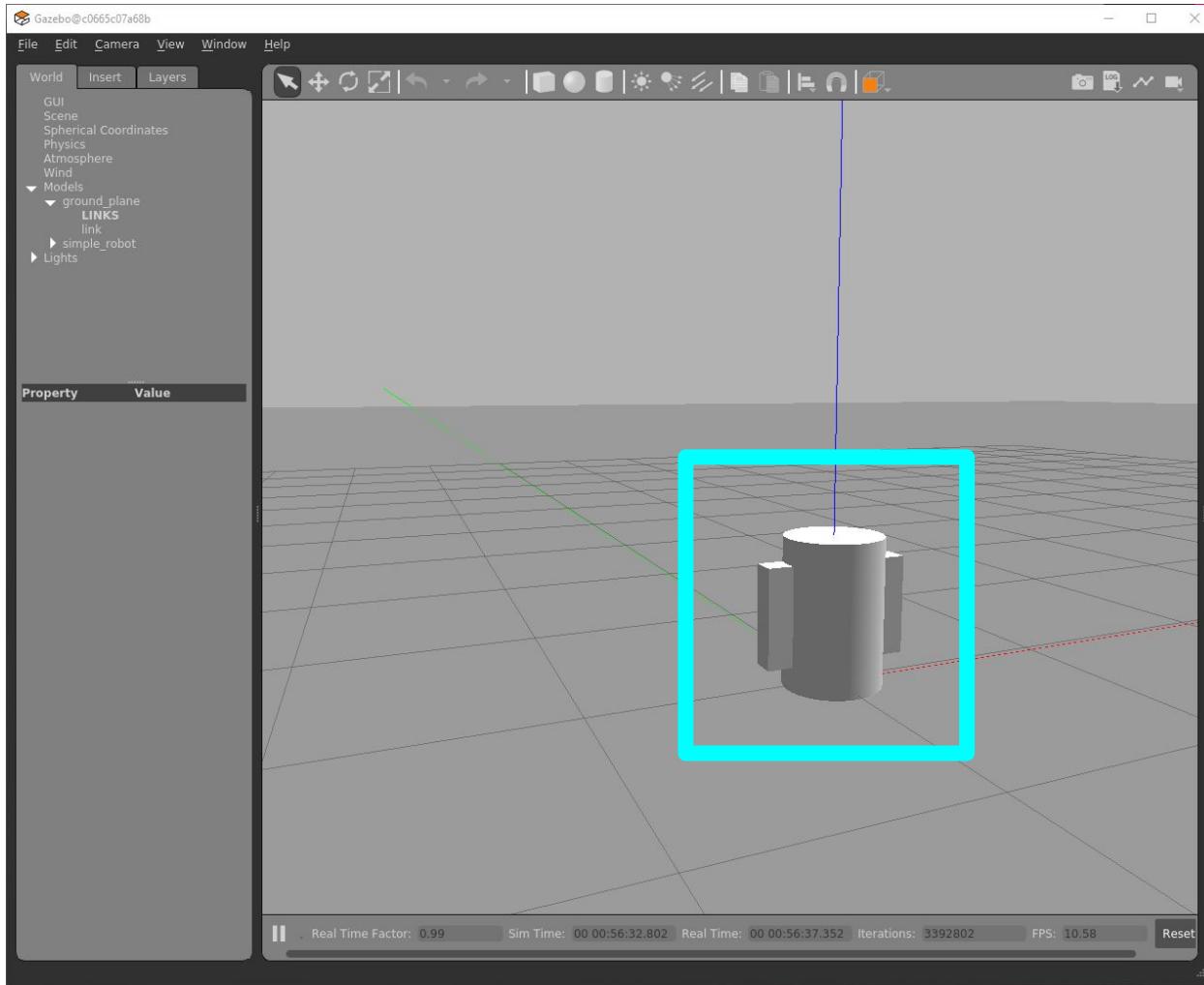
setting /run_id to [REDACTED]
process[rosout-1]: started with pid [3028]
started core service [/rosout]
-
```

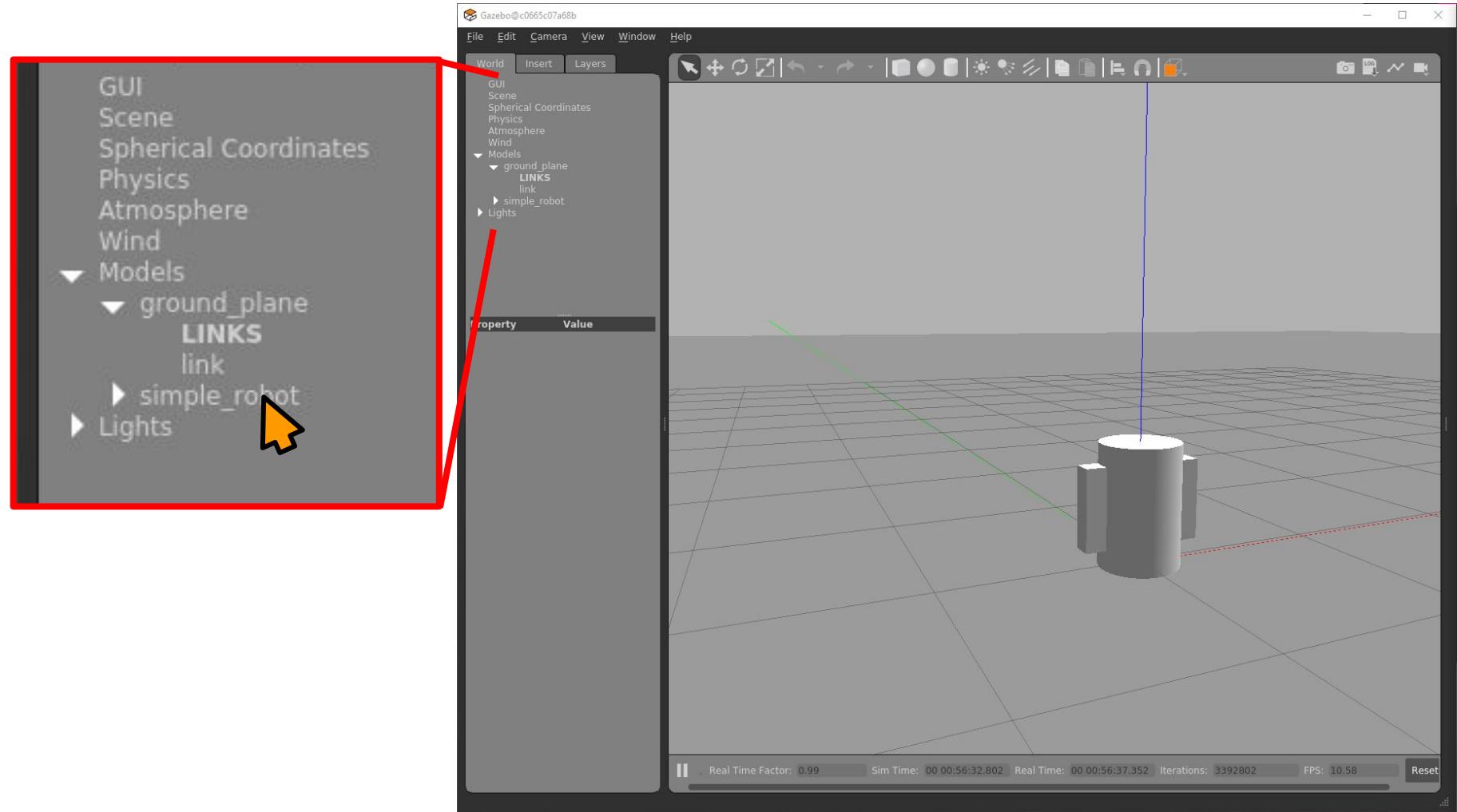
```
$ rosrun gazebo_ros empty_world.launch
```

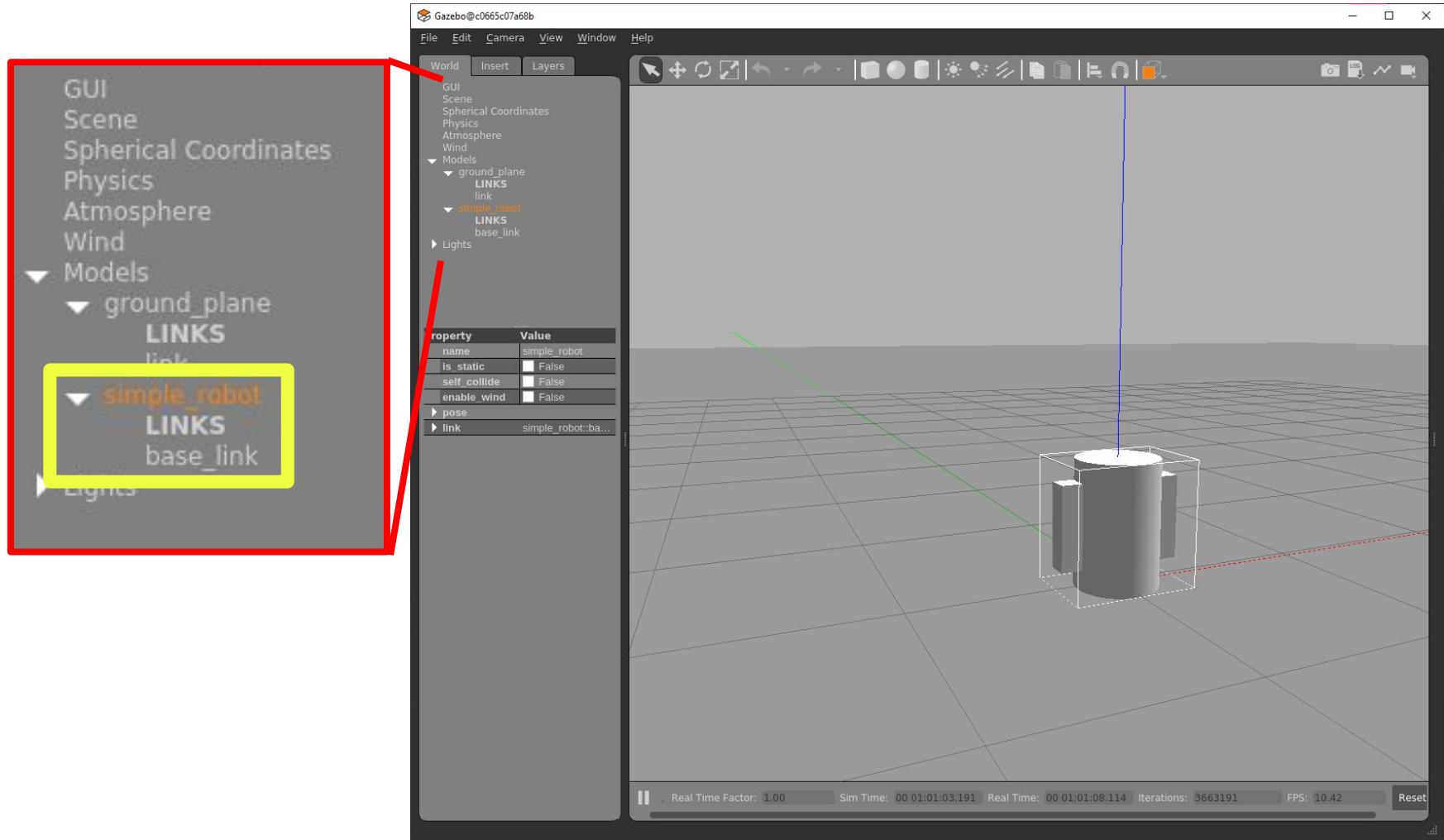


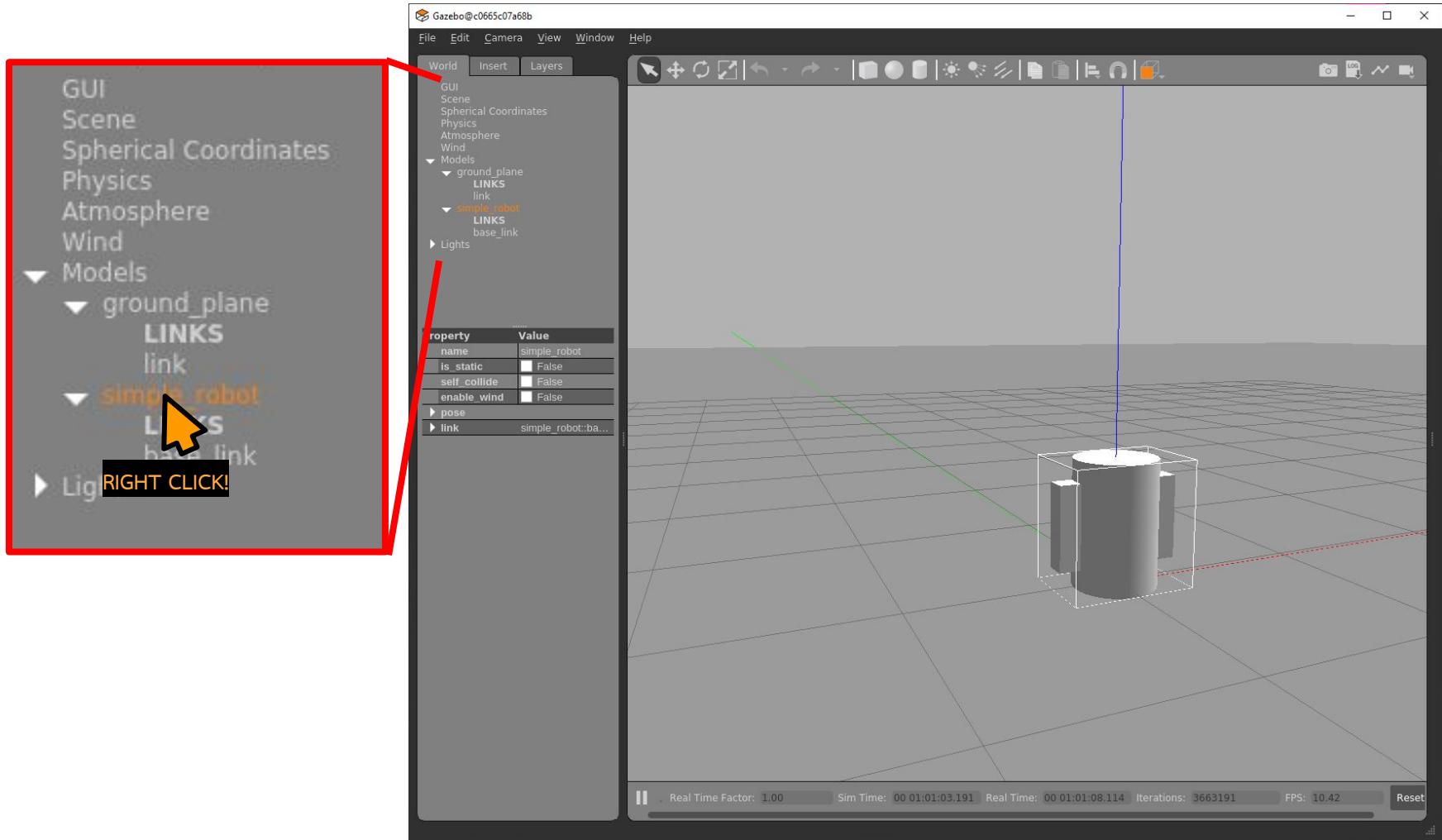
```
$ roscd tutorial_gazebo/urdf
```

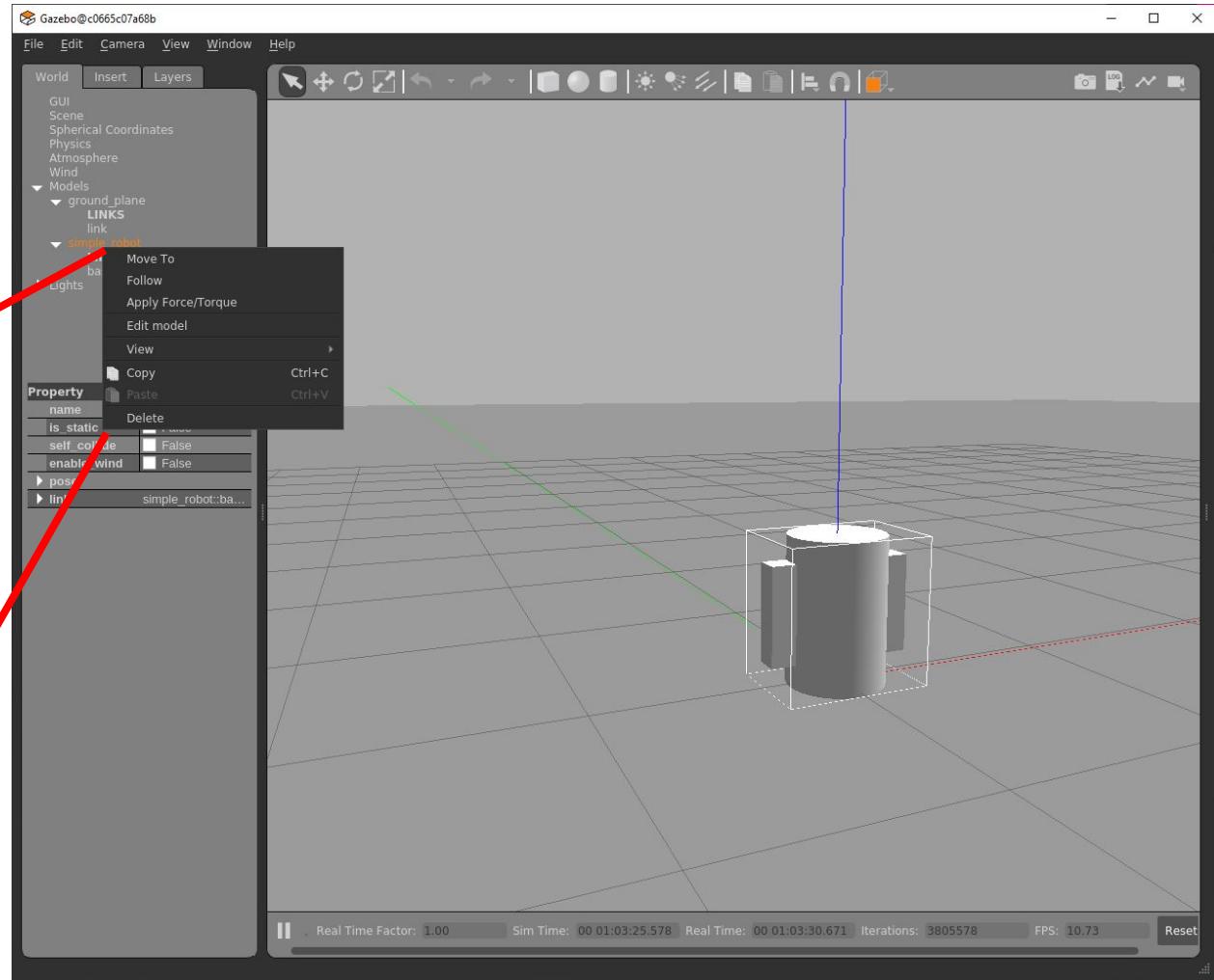
```
$ rosrun gazebo_ros spawn_model -file simple_robot.urdf \
-urdf -model simple_robot
```

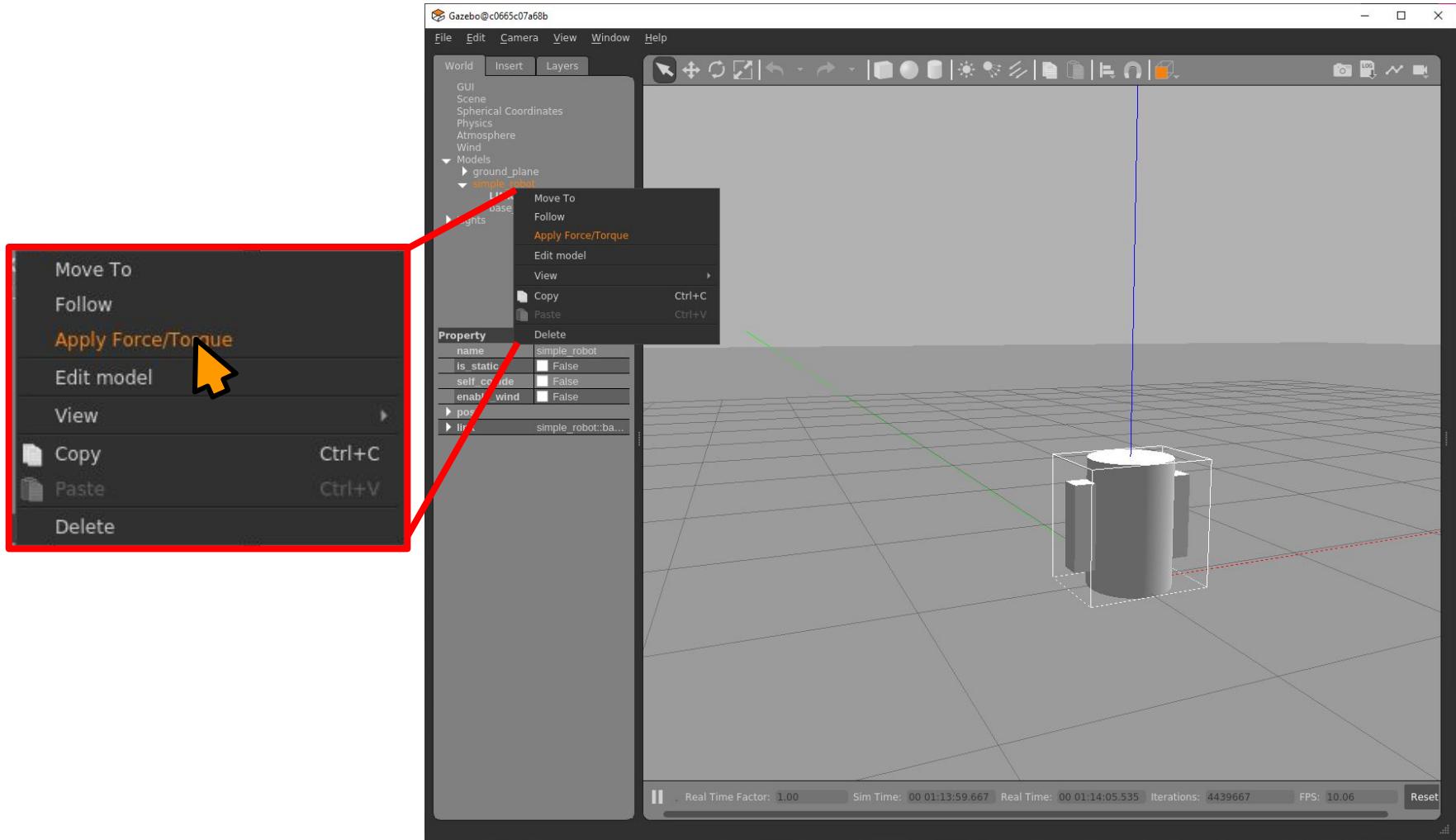














Apply Force and Torque@c0665c07a68b



Model: simple_robot

Apply to link: base_link

Force

X: 0.000

N

Y: 0.000

N

Z: 0.000

N

Mag: 0.000

N

Clear

Application Point:

Center of mass



X: 0.000

m

Y: 0.000

m

Z: 0.000

m

Apply Force

Torque

X: 0.000

Nm

Y: 0.000

Nm

Z: 0.000

Nm

Mag: 0.000

Nm

Clear

Apply Torque

Cancel

Apply All



Apply Force and Torque@c0665c07a68b



Model: simple_robot

Apply to link: base_link

Force

X: 0.000

N

Y: 0.000

N

Z: 300.000

N

Mag: 300.000

N

Clear

Application Point:

Center of mass



X: 0.000

m

Y: 0.000

m

Z: 0.000

m

Apply Force

Torque

X: 0.000

Nm

Y: 0.000

Nm

Z: 0.000

Nm

Mag: 0.000

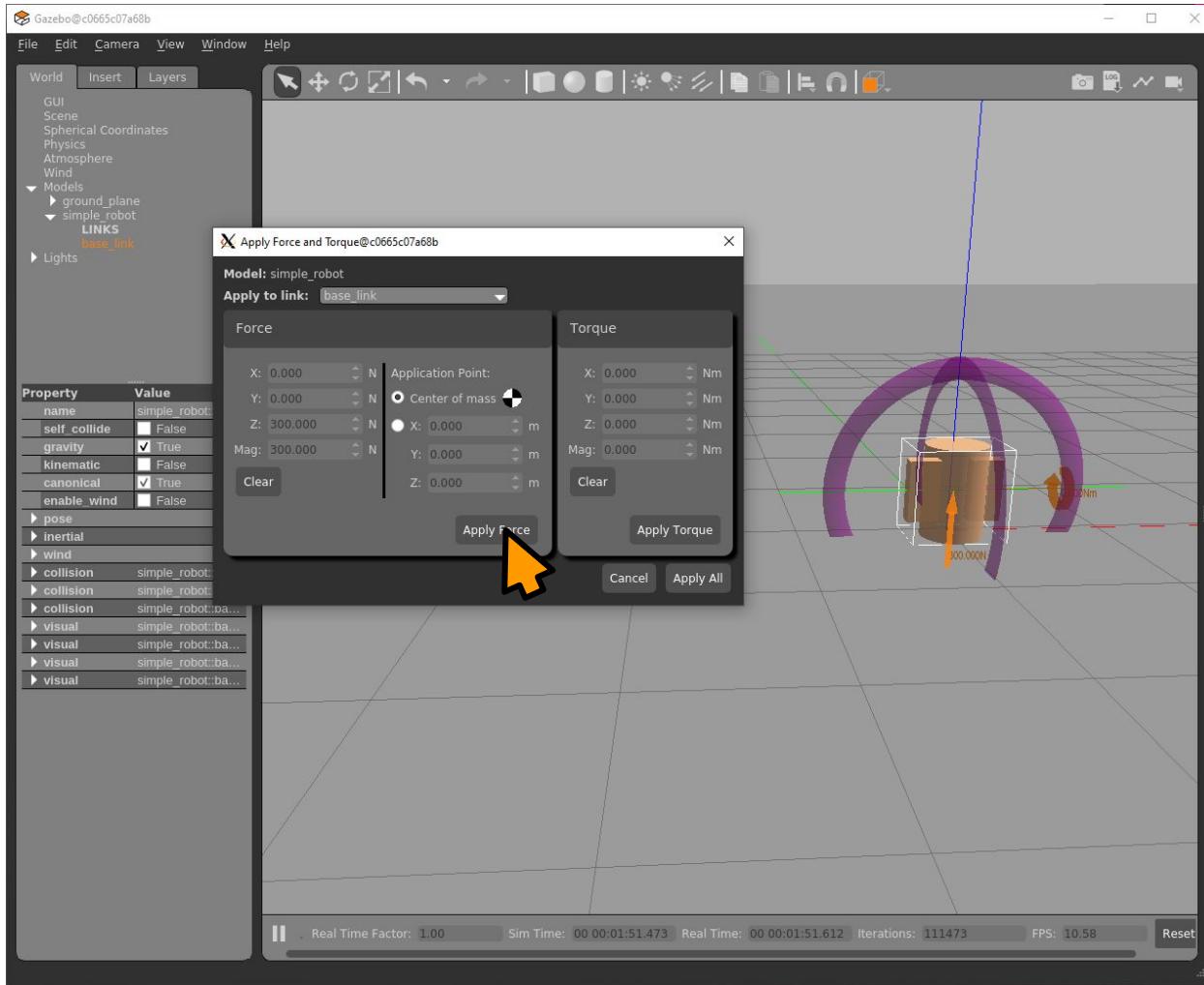
Nm

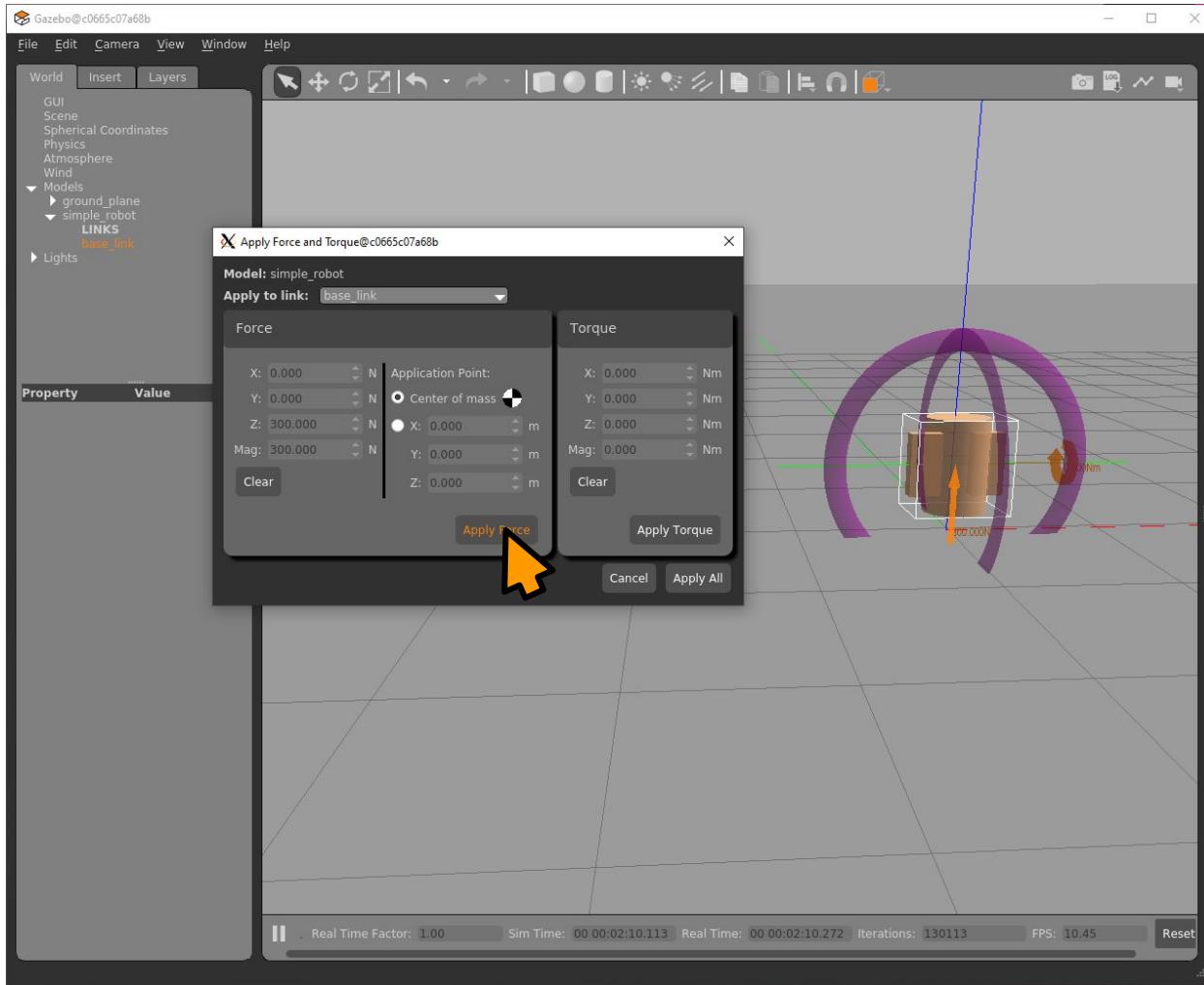
Clear

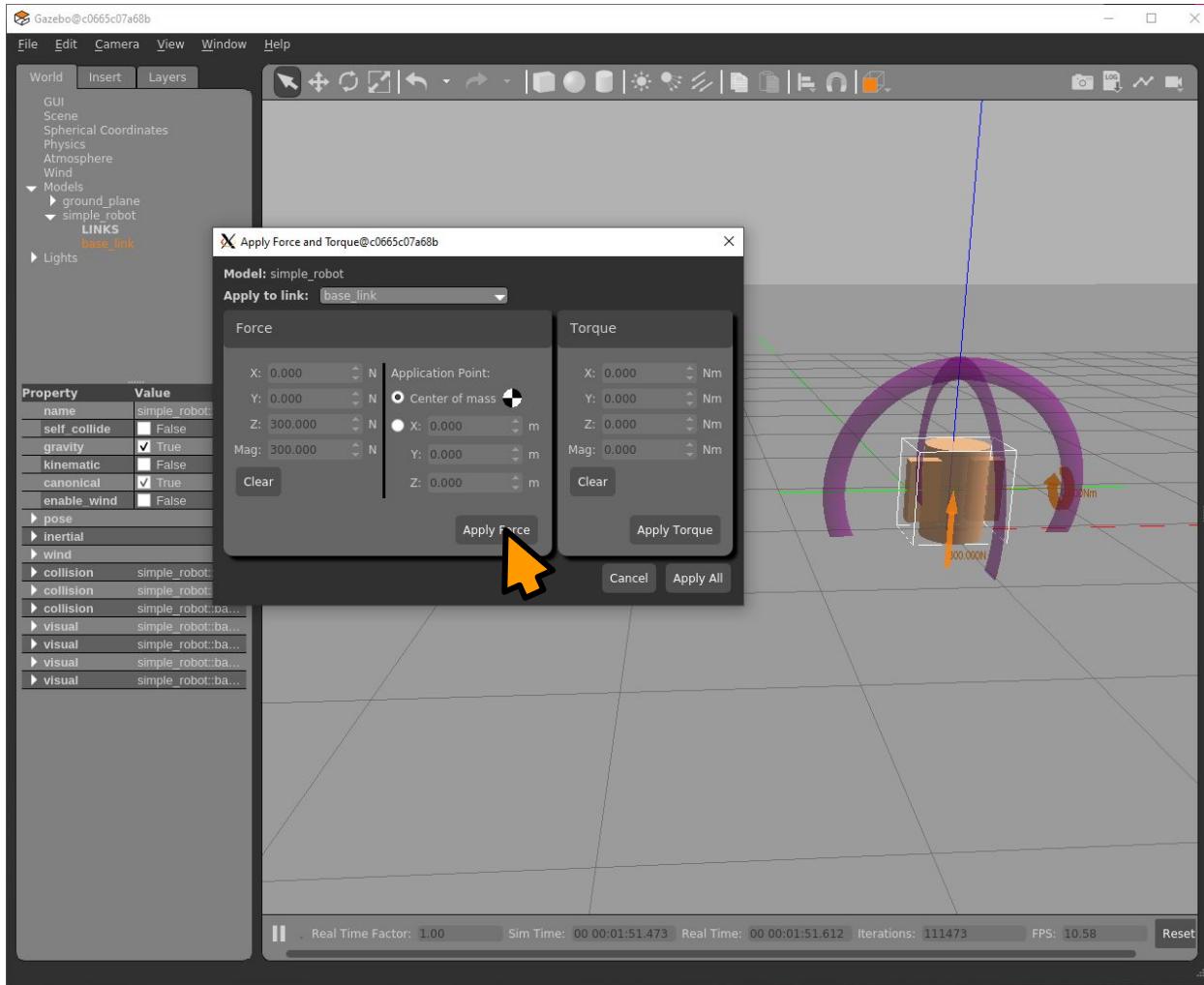
Apply Torque

Cancel

Apply All







กด `ctrl+r` ในหน้า gazebo

```
$ rqt
```

File Plugins Running Perspectives Help

- Container
 - Actions
 - Configuration
 - Introspection
 - Logging
 - Miscellaneous Tools
 - Services**
 - Topics
 - Visualization
- ▶ Service Caller
 - Service Type Br



Default - rqt@c0665c07a68b

- □ X

File Plugins Running Perspectives Help

Service Caller

D S O X



Service /gazebo/apply_body_wrench



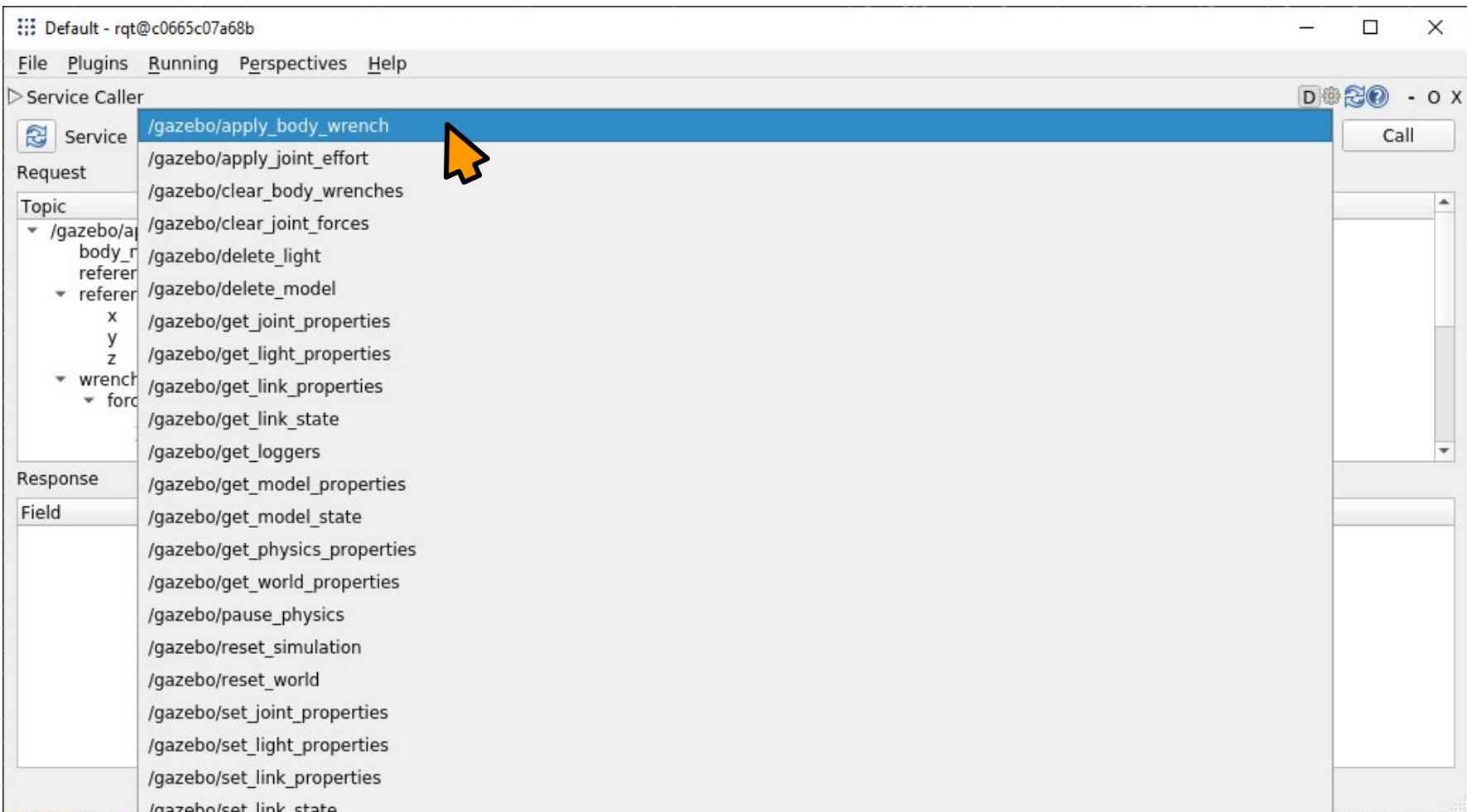
Call

Request

Topic	Type	Expression
✓ /gazebo/apply_body_wrench	gazebo_msgs/ApplyBodyWrenchRequest	
body_name	string	" "
reference_frame	string	" "
reference_point	geometry_msgs/Point	
x	float64	0.0
y	float64	0.0
z	float64	0.0
wrench	geometry_msgs/Wrench	
force	geometry_msgs/Vector3	
x	float64	0.0
y	float64	0.0
z	float64	0.0

Response

Field	Type	Value



Default - rqt@c0665c07a68b



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▷ Service Caller



Service /gazebo/apply_body_wrench

▼

Call

Request

Topic	Type	Expression
↳ /gazebo/apply_body_wrench	gazebo_msgs/ApplyBodyWrenchRequest	"
body_name	string	"
reference_frame	string	"
↳ reference_point	geometry_msgs/Point	
x	float64	0.0
y	float64	0.0
z	float64	0.0
↳ wrench	geometry_msgs/Wrench	
↳ force	geometry_msgs/Vector3	
x	float64	0.0
y	float64	0.0
z	float64	0.0

Response

Field	Type	Value

Default - rqt@c0665c07a68b

File Plugins Running Perspectives Help

Service Caller



Service /gazebo/apply_body_wrench

Call

Request

Topic	Type	Expression
/gazebo/apply_body_wrench	gazebo_msgs/ApplyBodyWrenchRequest	
body_name	string	'base_link'
reference_frame	string	"
reference_point	geometry_msgs/Point	
x	float64	0.0
y	float64	0.0
z	float64	0.0
wrench	geometry_msgs/Wrench	
force	geometry_msgs/Vector3	
x	float64	0.0
y	float64	0.0
z	float64	0.0

Response

Field	Type	Value

Default - rqt@c0665c07a68b

File Plugins Running Perspectives Help

Service Caller

Service /gazebo/apply_body_wrench

Request

Topic	Type	Expression
reference_point	geometry_msgs/Point	
x	float64	0.0
y	float64	0.0
z	float64	0.0
wrench	geometry_msgs/Wrench	
force	geometry_msgs/Vector3	
x	float64	0.0
y	float64	0.0
z	float64	0.0
torque	geometry_msgs/Vector3	
x	float64	0.0
y	float64	0.0
z	float64	0.0

Response

Field	Type	Value
-------	------	-------



Default - rqt@c0665c07a68b

File Plugins Running Perspectives Help

Service Caller

Service /gazebo/apply_body_wrench

Request

Topic	Type	Expression
reference_point	geometry_msgs/Point	
x	float64	0.0
y	float64	0.0
z	float64	0.0
wrench	geometry_msgs/Wrench	
force	geometry_msgs/Vector3	
x	float64	0.0
y	float64	0.0
z	float64	10
torque	geometry_msgs/Vector3	
x	float64	0.0
y	float64	0.0
z	float64	0.0

Response

Field	Type	Value
-------	------	-------



Default - rqt@c0665c07a68b

File Plugins Running Perspectives Help

Service Caller

Service /gazebo/apply_body_wrench Call

Request

Topic	Type	Expression
z	float64	10
torque	geometry_msgs/Vector3	
x	float64	0.0
y	float64	0.0
z	float64	0.0
start_time	time	
secs	int32	0
nsecs	int32	0
duration	duration	
secs	int32	0
nsecs	int32	0

Response

Field	Type	Value
-------	------	-------



Default - rqt@c0665c07a68b

File Plugins Running Perspectives Help

Service Caller

Service /gazebo/apply_body_wrench Call

Request

Topic	Type	Expression
z	float64	10
torque	geometry_msgs/Vector3	
x	float64	0.0
y	float64	0.0
z	float64	0.0
start_time	time	
secs	int32	0
nsecs	int32	0
duration	duration	
secs	int32	0
nsecs	int32	0

Response

Field	Type	Value
-------	------	-------



Default - rqt@c0665c07a68b

File Plugins Running Perspectives Help

Service Caller

D S O X

Service /gazebo/apply_body_wrench

Call

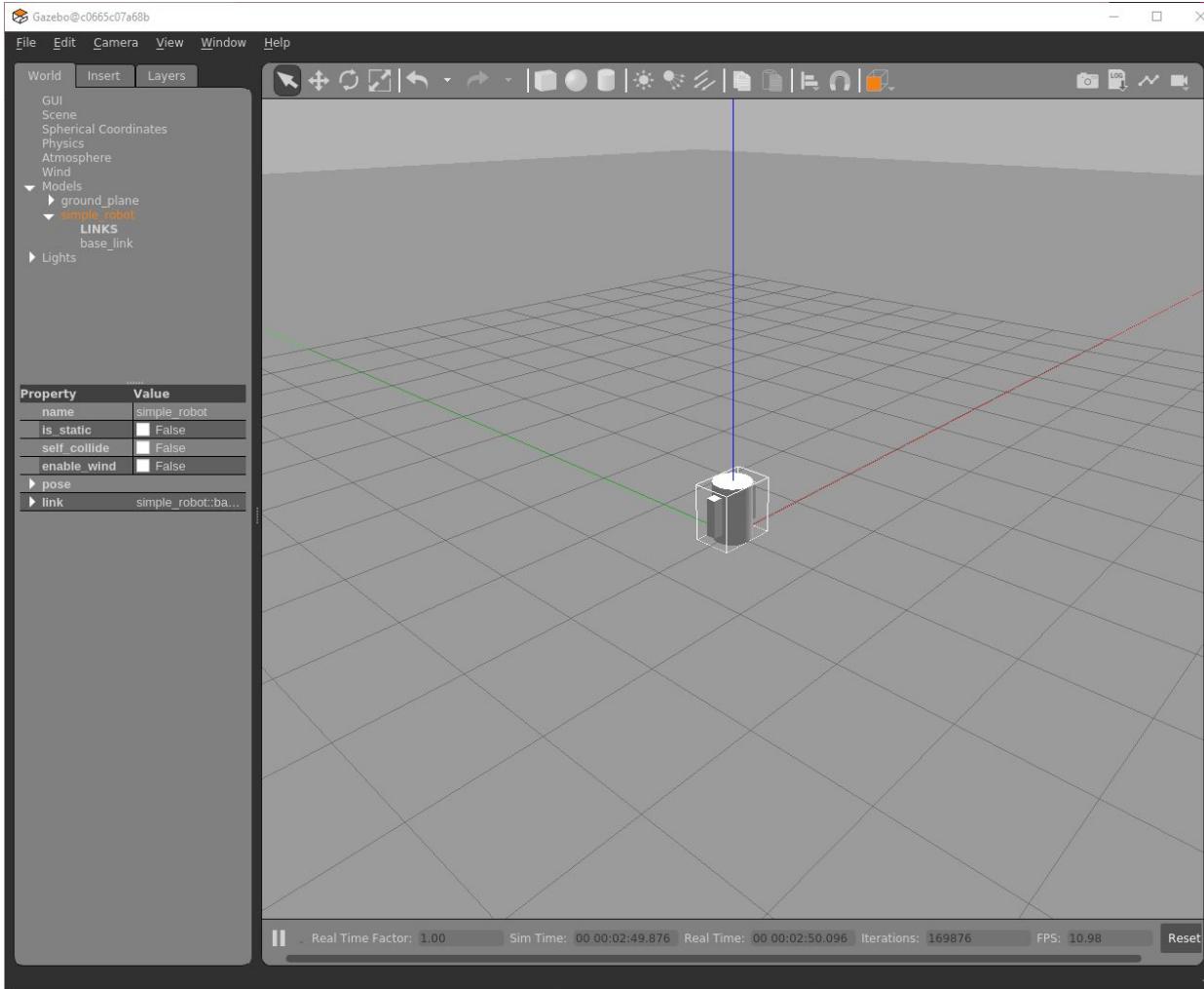


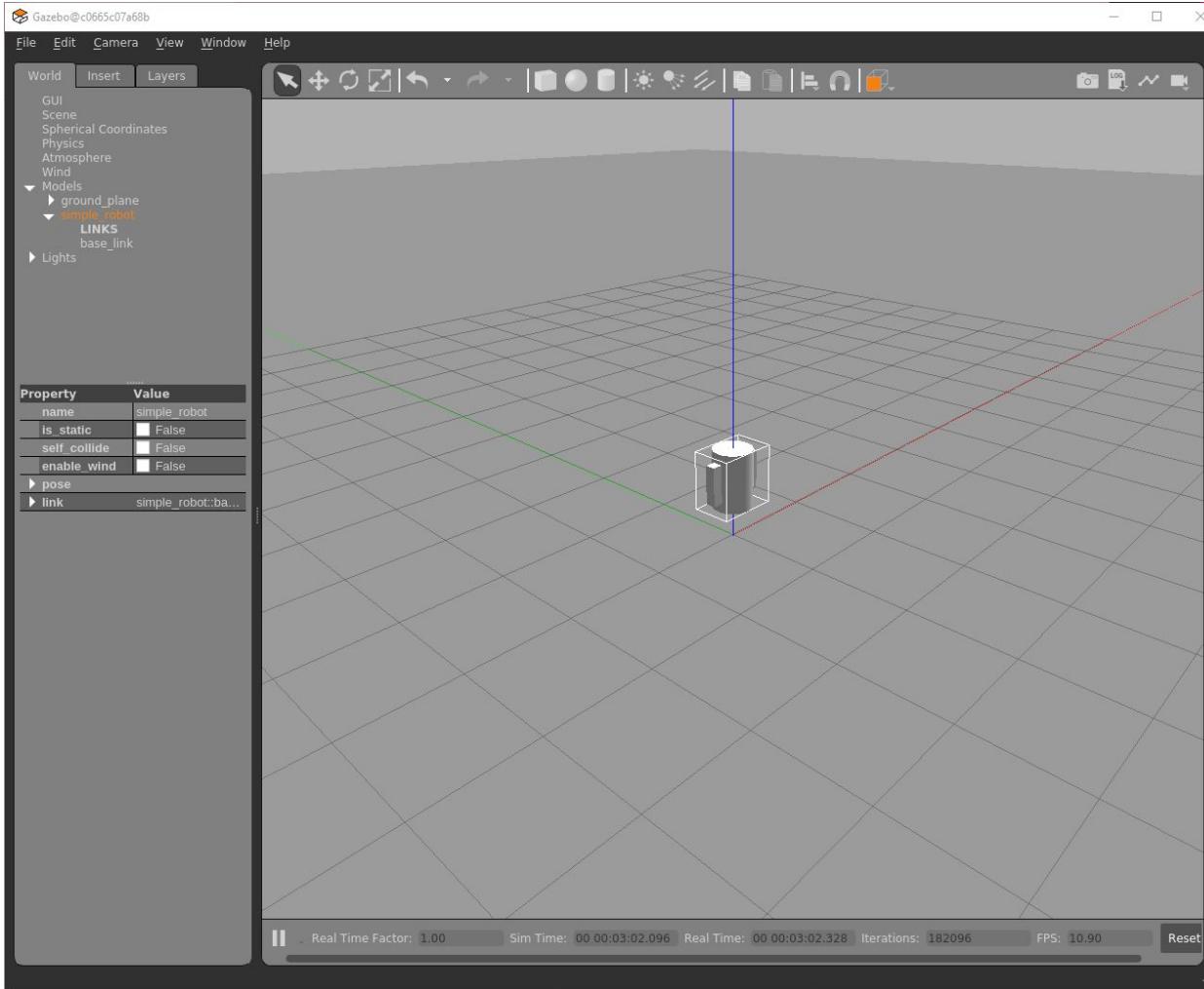
Request

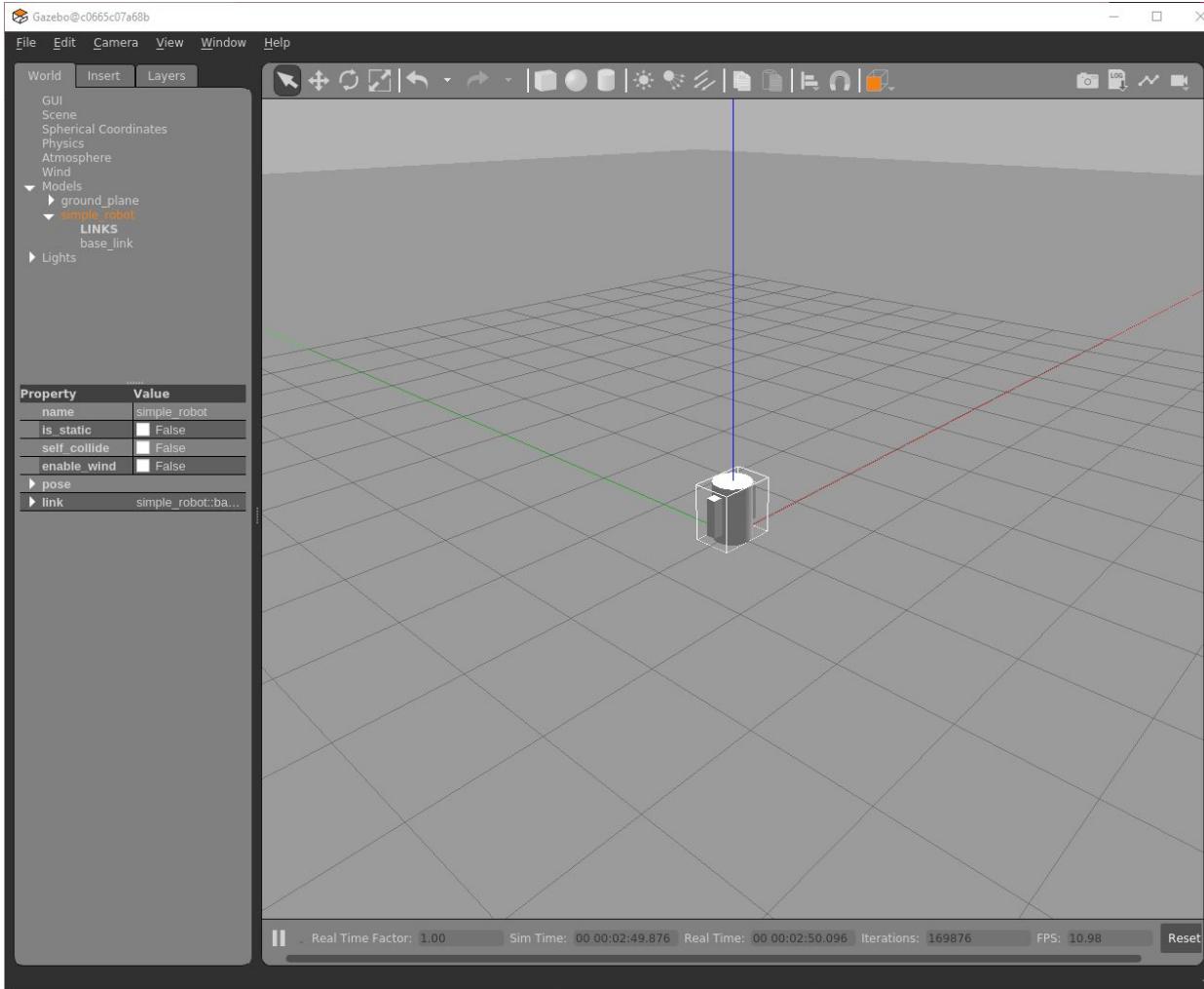
Topic	Type	Expression
z	float64	10
torque	geometry_msgs/Vector3	
x	float64	0.0
y	float64	0.0
z	float64	0.0
start_time	time	
secs	int32	0
nsecs	int32	0
duration	duration	
secs	int32	0
nsecs	int32	50000000

Response

Field	Type	Value
/	gazebo_msgs/ApplyBodyWrenchResponse	
success	bool	True
status_message	string	"







```
:~/tutorial_ws/src/tutorial_gazebo/urdf$ rossrv show gazebo_msgs/ApplyBodyWrench
string body_name
string reference_frame
geometry_msgs/Point reference_point
  float64 x
  float64 y
  float64 z
geometry_msgs/Wrench wrench
  geometry_msgs/Vector3 force
    float64 x
    float64 y
    float64 z
  geometry_msgs/Vector3 torque
    float64 x
    float64 y
    float64 z
time start_time
duration duration
---
bool success
string status_message
```

