XACRO Basics

Estimated time to completion: **25 minutes**

7.5 Properties

With XACRO, you can define a constant value, called **property**, and use it as a more flexible alternative than hard-coded values. Keeping constant values as **properties** and referencing them when needed allows you to easily adapt your robot model without changing the same value in different places.

The code block below shows the definition of three different properties:

In [ ]:
```
<xacro:property name="body_width" value="0.1"/>
<xacro:property name="body_lenght" value="0.1"/>
<xacro:property name="body_height" value="0.1"/>
```

XACRO properties can be declared anywhere. It does not need to be done at the beginning, but it is recommended to do so. That way, you do not have to scroll down a long file just to change a value.

In the example above, you have declared the following:

- body_width: 0.1
- body_lenght: 0.1
- body_height: 0.1

Resolution of properties: Once these properties are set, you can specify the actual robot width, length, and height in the geometry element by using a dollar sign and the property name enclosed in curly braces `{}` to denote the property value, for example, `${body_width}` .

So, for instance, this XACRO code here:

In [ ]:
```
<xacro:property name="body_width" value="0.1"/>
<xacro:property name="body_lenght" value="0.1"/>
<xacro:property name="body_height" value="0.1"/>

  <link name="chassis">
    <visual>
      <geometry>
        <box size="${body_width} ${body_lenght} ${body_height}"/>
      </geometry>
    </visual>

    <collision>
      <geometry>
        <box size="${body_width} ${body_lenght} ${body_height}"/>
      </geometry>
    </collision>

  </link>
```

It will generate this URDF code here:

In [ ]:
```
  <link name="chassis">
    <visual>
      <geometry>
        <box size="0.1 0.1 0.1"/>
      </geometry>
    </visual>

    <collision>
      <geometry>
        <box size="0.1 0.1 0.1"/>
      </geometry>
    </collision>

  </link>
```

As with URDF files, the measuring units are meters and radians.

- Exercise 7.4.1 -

Task 1:

- Modify the box_bot XACRO description from Exercise 7.1.1 and define the XACRO properties **body_width**, **body_lenght**, **body_height**.
- Modify the launch file **urdf_visualize.launch.py** and replace **box_bot_simple.urdf** with **box_bot.xacro**.

For your convenience, the starter code for this exercise is made available here:

box_bot.xacro

In [ ]:

```
<?xml version="1.0"?>
<robot xmlns:xacro="http://www.ros.org/wiki/xacro" name="my_box_bot">

<link name="base_link">
  </link>

  <joint name="base_link_joint" type="fixed">
    <origin rpy="0 0 0" xyz="0 0 0" />
    <parent link="base_link" />
    <child link="chassis" />
  </joint>

  <link name="chassis">
    <visual>
      <geometry>
        <box size="0.1 0.1 0.1"/>
      </geometry>
    </visual>

    <collision>
      <geometry>
        <box size="0.1 0.1 0.1"/>
      </geometry>
    </collision>

    <inertial>
      <mass value="0.5"/>
      <origin rpy="0 0 0" xyz="0 0 0"/>
      <inertia ixx="0.0008333333333333335" ixy="0" ixz="0" iyy="0.0008333333333333335" iyz="0" izz="0.0008333333333333335"/>
    </inertial>

  </link>

</robot>
```

- End of Exercise 7.4.1 -

- Solution to Exercise 7.4.1 -

box_bot.xacro

In [ ]:

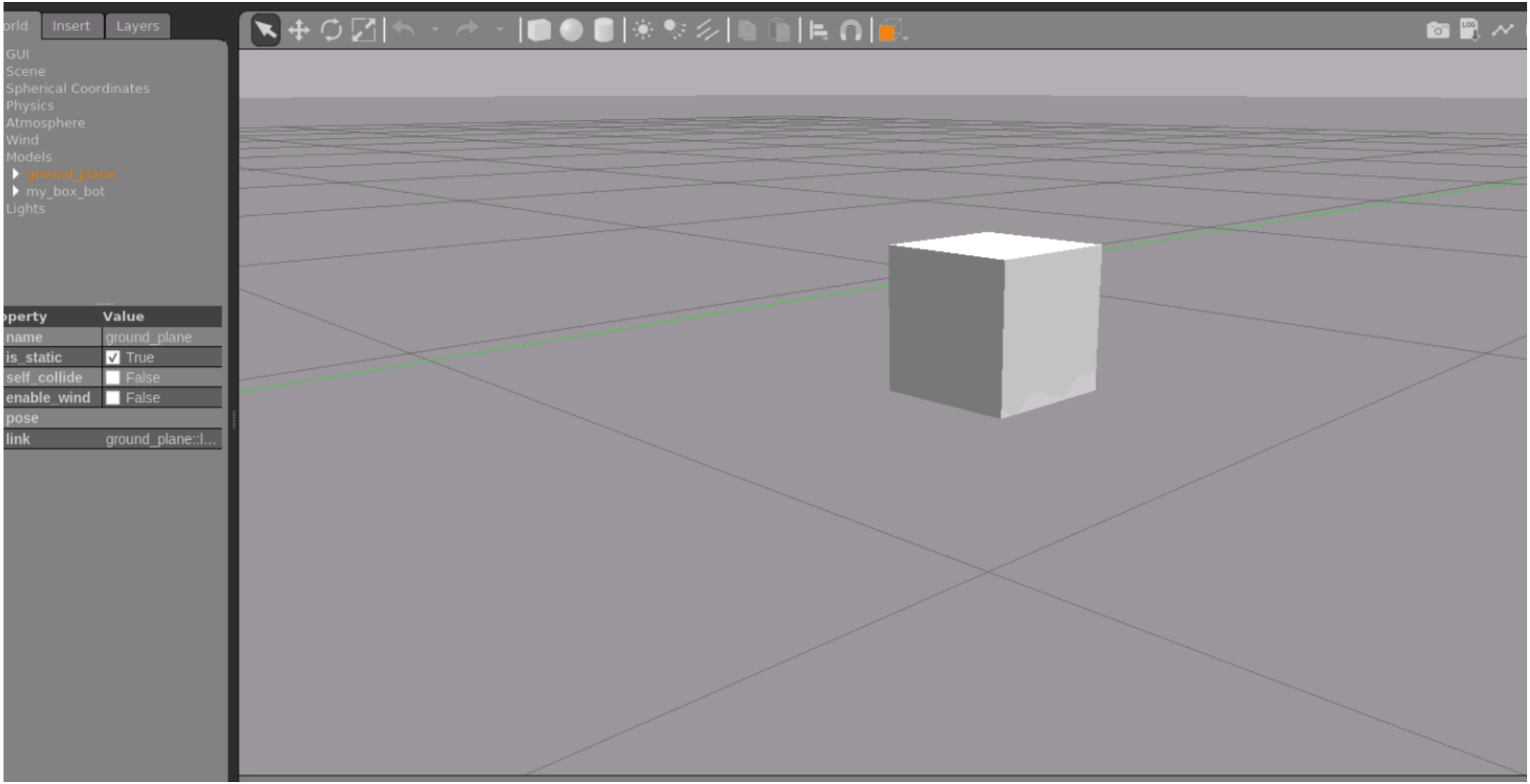
```
<?xml version="1.0"?>
<robot xmlns:xacro="http://www.ros.org/wiki/xacro" name="my_box_bot">

<xacro:property name="body_width" value="0.1"/>
<xacro:property name="body_lenght" value="0.1"/>
<xacro:property name="body_height" value="0.1"/>

<link name="base_link">
  </link>

  <joint name="base_link_joint" type="fixed">
    <origin rpy="0 0 0" xyz="0 0 0" />
    <parent link="base_link" />
    <child link="chassis" />
  </joint>

  <link name="chassis">
    <visual>
      <geometry>
        <box size="${body_width} ${body_lenght} ${body_height}"/>
      </geometry>
    </visual>

    <collision>
      <geometry>
        <box size="${body_width} ${body_lenght} ${body_height}"/>
      </geometry>
    </collision>

    <inertial>
      <mass value="0.5"/>
      <origin rpy="0 0 0" xyz="0 0 0"/>
      <inertia ixx="0.0008333333333333335" ixy="0" ixz="0" iyy="0.0008333333333333335" iyz="0" izz="0.0008333333333333335"/>
    </inertial>

  </link>

</robot>
```

▶ Execute in Webshell 1

In [ ]:
```
cd ~/ros2_ws && colcon build && source install/setup.bash
```

In [ ]:
```
ros2 launch my_box_bot_description box_bot_xacro.launch.py
```

It appears to be the same cube.



- End of Solution to Exercise 7.4.1 -

- Exercise 7.4.2 -

Task 2:

- Continue by adding the URDF elements shown below. There is no need to add sensors and control for the moment.
- Create the properties **wheel_width** and **wheel_radius** and then use them to create the main drive wheels on each side of the robot.
- Remember to install your robot model using **colcon build**.
- Remember to run `ros2 run joint_state_publisher_gui joint_state_publisher_gui` to see the wheels in RVIZ2.

In [ ]:

```
<!-- Wheel Left -->
<link name="left_wheel">
    <visual>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.035"/>
      </geometry>
      <material name="red"/>
    </visual>

    <collision>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.035"/>
      </geometry>
    </collision>

    <inertial>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <mass value="0.05"/>
      <inertia ixx="1.531666666666667e-05" ixy="0" ixz="0" iyy="1.531666666666667e-05" iyz="0" izz="3.0625000000000006e-05"/>
    </inertial>

</link>

<joint name="joint_left_wheel" type="continuous">
  <origin rpy="0 0 0" xyz="0 0.05 -0.025"/>
  <child link="left_wheel"/>
  <parent link="chassis"/>
  <axis rpy="0 0 0" xyz="0 1 0"/>
  <limit effort="10000" velocity="1000"/>
  <joint_properties damping="1.0" friction="1.0"/>
</joint>

<!-- Wheel Right -->
<link name="right_wheel">
    <visual>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
```

```
        <cylinder length="0.001" radius="0.035"/>
      </geometry>
      <material name="green"/>
    </visual>

    <collision>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.035"/>
      </geometry>
    </collision>

    <inertial>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <mass value="0.05"/>
      <inertia ixx="1.531666666666667e-05" ixy="0" ixz="0" iyy="1.531666666666667e-05" iyz="0" izz="3.0625000000000006e-05"/>
    </inertial>
</link>

<joint name="joint_right_wheel" type="continuous">
  <origin rpy="0 0 0" xyz="0 -0.05 -0.025"/>
  <child link="right_wheel"/>
  <parent link="chassis"/>
  <axis rpy="0 0 0" xyz="0 1 0"/>
  <limit effort="10000" velocity="1000"/>
  <joint_properties damping="1.0" friction="1.0"/>
</joint>


<!-- Caster Wheel Front -->
<link name="front_yaw_link">
    <visual>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
      <material name="blue"/>
    </visual>

    <collision>
```

```
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
    </collision>

    <inertial>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <mass value="0.001"/>
        <inertia ixx="5.145833333333334e-09" ixy="0" ixz="0" iyy="5.145833333333334e-09" iyz="0" izz="1.0125000000000003e-08"/>
    </inertial>

</link>

<joint name="front_yaw_joint" type="continuous">
  <origin rpy="0 0 0" xyz="0.04 0 -0.05" />
  <parent link="chassis" />
  <child link="front_yaw_link" />
  <axis xyz="0 0 1" />
  <limit effort="1000.0" velocity="100.0" />
  <dynamics damping="0.0" friction="0.1"/>
</joint>


<link name="front_roll_link">
    <visual>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
      <material name="red"/>
    </visual>

    <collision>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
    </collision>
```

```
    <inertial>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <mass value="0.001"/>
        <inertia ixx="5.145833333333334e-09" ixy="0" ixz="0" iyy="5.145833333333334e-09" iyz="0" izz="1.0125000000000003e-08"/>
    </inertial>
</link>

<joint name="front_roll_joint" type="continuous">
  <origin rpy="0 0 0" xyz="0 0 0" />
  <parent link="front_yaw_link" />
  <child link="front_roll_link" />
  <axis xyz="1 0 0" />
  <limit effort="1000.0" velocity="100.0" />
  <dynamics damping="0.0" friction="0.1"/>
</joint>


<link name="front_pitch_link">
  <visual>
    <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
    <geometry>
      <sphere radius="0.010"/>
    </geometry>
    <material name="green_dark"/>
  </visual>

  <collision>
    <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
    <geometry>
      <sphere radius="0.010"/>
    </geometry>
  </collision>

  <inertial>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <mass value="0.001"/>
      <inertia ixx="4e-08" ixy="0" ixz="0" iyy="4e-08" iyz="0" izz="4e-08"/>
  </inertial>
</link>
```

```
  <joint name="front_pitch_joint" type="continuous">
    <origin rpy="0 0 0" xyz="0 0 0" />
    <parent link="front_roll_link" />
    <child link="front_pitch_link" />
    <axis xyz="0 1 0" />
    <limit effort="1000.0" velocity="100.0" />
    <dynamics damping="0.0" friction="0.1"/>
  </joint>

<!-- Caster Wheel Back -->
  <link name="back_yaw_link">
    <visual>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <geometry>
          <cylinder length="0.001" radius="0.0045000000000000005"/>
        </geometry>
        <material name="blue"/>
      </visual>

      <collision>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <geometry>
          <cylinder length="0.001" radius="0.0045000000000000005"/>
        </geometry>
      </collision>

      <inertial>
          <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
          <mass value="0.001"/>
          <inertia ixx="5.145833333333334e-09" ixy="0" ixz="0" iyy="5.145833333333334e-09" iyz="0" izz="1.0125000000000003e-08"/>
      </inertial>
  </link>

  <joint name="back_yaw_joint" type="continuous">
    <origin rpy="0 0 0" xyz="-0.04 0 -0.05" />
    <parent link="chassis" />
    <child link="back_yaw_link" />
    <axis xyz="0 0 1" />
    <limit effort="1000.0" velocity="100.0" />
    <dynamics damping="0.0" friction="0.1"/>
```

```
</joint>


<link name="back_roll_link">
    <visual>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
      <material name="red"/>
    </visual>

    <collision>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
    </collision>

    <inertial>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <mass value="0.001"/>
        <inertia ixx="5.145833333333334e-09" ixy="0" ixz="0" iyy="5.145833333333334e-09" iyz="0" izz="1.0125000000000003e-08"/>
    </inertial>
</link>

<joint name="back_roll_joint" type="continuous">
  <origin rpy="0 0 0" xyz="0 0 0" />
  <parent link="back_yaw_link" />
  <child link="back_roll_link" />
  <axis xyz="1 0 0" />
  <limit effort="1000.0" velocity="100.0" />
  <dynamics damping="0.0" friction="0.1"/>
</joint>


<link name="back_pitch_link">
  <visual>
    <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
    <geometry>
```

```
      <sphere radius="0.010"/>
    </geometry>
    <material name="green_light"/>
  </visual>

  <collision>
    <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
    <geometry>
      <sphere radius="0.010"/>
    </geometry>
  </collision>

  <inertial>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <mass value="0.001"/>
      <inertia ixx="4e-08" ixy="0" ixz="0" iyy="4e-08" iyz="0" izz="4e-08"/>
  </inertial>
</link>

<joint name="back_pitch_joint" type="continuous">
  <origin rpy="0 0 0" xyz="0 0 0" />
  <parent link="back_roll_link" />
  <child link="back_pitch_link" />
  <axis xyz="0 1 0" />
  <limit effort="1000.0" velocity="100.0" />
  <dynamics damping="0.0" friction="0.1"/>
</joint>
```

- End of Exercise 7.4.2 -

- Solution to Exercise 7.4.2 -

box_bot.xacro

In [ ]:

```
<?xml version="1.0"?>
<robot xmlns:xacro="http://www.ros.org/wiki/xacro" name="my_box_bot">

<xacro:property name="body_width" value="0.1"/>
<xacro:property name="body_lenght" value="0.1"/>
<xacro:property name="body_height" value="0.1"/>
<xacro:property name="wheel_width" value="0.001"/>
<xacro:property name="wheel_radius" value="0.035"/>

<link name="base_link">
  </link>

  <joint name="base_link_joint" type="fixed">
    <origin rpy="0 0 0" xyz="0 0 0" />
    <parent link="base_link" />
    <child link="chassis" />
  </joint>

  <link name="chassis">
    <visual>
      <geometry>
        <box size="${body_width} ${body_lenght} ${body_height}"/>
      </geometry>
    </visual>

    <collision>
      <geometry>
        <box size="${body_width} ${body_lenght} ${body_height}"/>
      </geometry>
    </collision>

    <inertial>
      <mass value="0.5"/>
      <origin rpy="0 0 0" xyz="0 0 0"/>
      <inertia ixx="0.0008333333333333335" ixy="0" ixz="0" iyy="0.0008333333333333335" iyz="0" izz="0.0008333333333333335"/>
    </inertial>

  </link>
```

```
<!-- Wheel Left -->
<link name="left_wheel">
    <visual>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="${wheel_width}" radius="${wheel_radius}"/>
      </geometry>
    </visual>

    <collision>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="${wheel_width}" radius="${wheel_radius}"/>
      </geometry>
    </collision>

    <inertial>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <mass value="0.05"/>
      <inertia ixx="1.531666666666667e-05" ixy="0" ixz="0" iyy="1.531666666666667e-05" iyz="0" izz="3.0625000000000006e-05"/>
    </inertial>

</link>

<joint name="joint_left_wheel" type="continuous">
  <origin rpy="0 0 0" xyz="0 0.05 -0.025"/>
  <child link="left_wheel"/>
  <parent link="chassis"/>
  <axis rpy="0 0 0" xyz="0 1 0"/>
  <limit effort="10000" velocity="1000"/>
  <joint_properties damping="1.0" friction="1.0"/>
</joint>

<!-- Wheel Right -->
<link name="right_wheel">
    <visual>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="${wheel_width}" radius="${wheel_radius}"/>
      </geometry>
```

```
    </visual>

    <collision>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="${wheel_width}" radius="${wheel_radius}"/>
      </geometry>
    </collision>

    <inertial>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <mass value="0.05"/>
      <inertia ixx="1.531666666666667e-05" ixy="0" ixz="0" iyy="1.531666666666667e-05" iyz="0" izz="3.0625000000000006e-05"/>
    </inertial>
</link>

<joint name="joint_right_wheel" type="continuous">
  <origin rpy="0 0 0" xyz="0 -0.05 -0.025"/>
  <child link="right_wheel"/>
  <parent link="chassis"/>
  <axis rpy="0 0 0" xyz="0 1 0"/>
  <limit effort="10000" velocity="1000"/>
  <joint_properties damping="1.0" friction="1.0"/>
</joint>


<!-- Caster Wheel Front -->
<link name="front_yaw_link">
    <visual>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
    </visual>

    <collision>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
```

```
    </collision>

    <inertial>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <mass value="0.001"/>
        <inertia ixx="5.145833333333334e-09" ixy="0" ixz="0" iyy="5.145833333333334e-09" iyz="0" izz="1.0125000000000003e-08"/>
    </inertial>

</link>

<joint name="front_yaw_joint" type="continuous">
  <origin rpy="0 0 0" xyz="0.04 0 -0.05" />
  <parent link="chassis" />
  <child link="front_yaw_link" />
  <axis xyz="0 0 1" />
  <limit effort="1000.0" velocity="100.0" />
  <dynamics damping="0.0" friction="0.1"/>
</joint>


<link name="front_roll_link">
    <visual>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
    </visual>

    <collision>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
    </collision>

    <inertial>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <mass value="0.001"/>
        <inertia ixx="5.145833333333334e-09" ixy="0" ixz="0" iyy="5.145833333333334e-09" iyz="0" izz="1.0125000000000003e-08"/>
    </inertial>
```

```
</link>

<joint name="front_roll_joint" type="continuous">
  <origin rpy="0 0 0" xyz="0 0 0" />
  <parent link="front_yaw_link" />
  <child link="front_roll_link" />
  <axis xyz="1 0 0" />
  <limit effort="1000.0" velocity="100.0" />
  <dynamics damping="0.0" friction="0.1"/>
</joint>


<link name="front_pitch_link">
  <visual>
    <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
    <geometry>
      <sphere radius="0.010"/>
    </geometry>
  </visual>

  <collision>
    <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
    <geometry>
      <sphere radius="0.010"/>
    </geometry>
  </collision>

  <inertial>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <mass value="0.001"/>
      <inertia ixx="4e-08" ixy="0" ixz="0" iyy="4e-08" iyz="0" izz="4e-08"/>
  </inertial>
</link>

<joint name="front_pitch_joint" type="continuous">
  <origin rpy="0 0 0" xyz="0 0 0" />
  <parent link="front_roll_link" />
  <child link="front_pitch_link" />
  <axis xyz="0 1 0" />
  <limit effort="1000.0" velocity="100.0" />
```

```
    <dynamics damping="0.0" friction="0.1"/>
  </joint>

<!-- Caster Wheel Back -->
  <link name="back_yaw_link">
    <visual>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <geometry>
          <cylinder length="0.001" radius="0.0045000000000000005"/>
        </geometry>
      </visual>

      <collision>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <geometry>
          <cylinder length="0.001" radius="0.0045000000000000005"/>
        </geometry>
      </collision>

      <inertial>
          <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
          <mass value="0.001"/>
          <inertia ixx="5.145833333333334e-09" ixy="0" ixz="0" iyy="5.145833333333334e-09" iyz="0" izz="1.0125000000000003e-08"/>
      </inertial>
  </link>

  <joint name="back_yaw_joint" type="continuous">
    <origin rpy="0 0 0" xyz="-0.04 0 -0.05" />
    <parent link="chassis" />
    <child link="back_yaw_link" />
    <axis xyz="0 0 1" />
    <limit effort="1000.0" velocity="100.0" />
    <dynamics damping="0.0" friction="0.1"/>
  </joint>


  <link name="back_roll_link">
      <visual>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <geometry>
```

```
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
    </visual>

    <collision>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="0.001" radius="0.0045000000000000005"/>
      </geometry>
    </collision>

    <inertial>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <mass value="0.001"/>
        <inertia ixx="5.145833333333334e-09" ixy="0" ixz="0" iyy="5.145833333333334e-09" iyz="0" izz="1.0125000000000003e-08"/>
    </inertial>
</link>

<joint name="back_roll_joint" type="continuous">
  <origin rpy="0 0 0" xyz="0 0 0" />
  <parent link="back_yaw_link" />
  <child link="back_roll_link" />
  <axis xyz="1 0 0" />
  <limit effort="1000.0" velocity="100.0" />
  <dynamics damping="0.0" friction="0.1"/>
</joint>


<link name="back_pitch_link">
  <visual>
    <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
    <geometry>
      <sphere radius="0.010"/>
    </geometry>
  </visual>

  <collision>
    <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
    <geometry>
      <sphere radius="0.010"/>
```

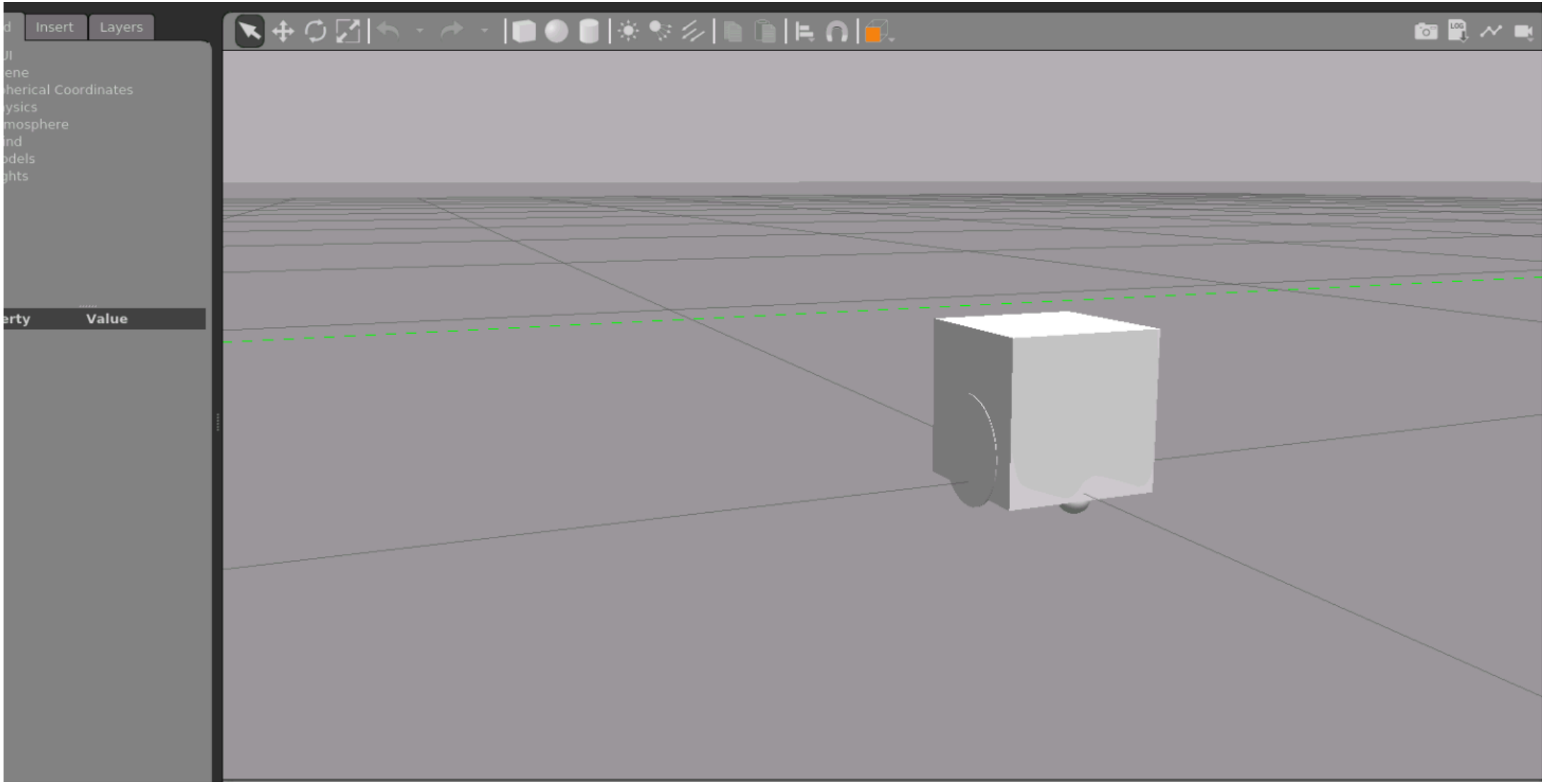
```
      </geometry>
    </collision>

    <inertial>
        <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
        <mass value="0.001"/>
        <inertia ixx="4e-08" ixy="0" ixz="0" iyy="4e-08" iyz="0" izz="4e-08"/>
    </inertial>
  </link>

  <joint name="back_pitch_joint" type="continuous">
    <origin rpy="0 0 0" xyz="0 0 0" />
    <parent link="back_roll_link" />
    <child link="back_pitch_link" />
    <axis xyz="0 1 0" />
    <limit effort="1000.0" velocity="100.0" />
    <dynamics damping="0.0" friction="0.1"/>
  </joint>


</robot>
```

▶ Execute in Webshell 1

In [ ]:
```
cd ~/ros2_ws && colcon build && source install/setup.bash
```

In [ ]:
```
ros2 launch my_box_bot_description box_bot_xacro.launch.py
```

It appears to be the same cube with wheels:



- Solution to Exercise 7.4.2 -

16/11/2023