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# XACRO Basics

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Estimated time to completion: **12 minutes**

## 7.8 Splitting Files

This section explores how XACRO files can help you organize your robot model in different files, making it easier to understand and maintain.

For an external XACRO file to be valid, it must contain the same two lines of code as the main XACRO file at the top of the file:

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

Also, close the `robot` element at the very bottom:

```
In [ ]: </robot>
```

To compose a larger robot description by including external XACRO files, use the **xacro:include** tag inside the main XACRO file like so:

```
In [ ]: <!-- Include Gazebo specific tags -->
        <xacro:include filename="$(find my_box_bot_description)/urdf/gazebo.urdf.xacro" />
```

External XACRO files are widely used to put Gazebo XML elements that are only needed for simulation into a separate file and to include those tags in the robot model based on an if-condition. Look at the following example:

```
In [ ]: <xacro:arg name="use_sim" default="true" />

<!-- if we use Gazebo -->
<xacro:if value="$(arg use_sim)">
  <xacro:include filename="$(find my_box_bot_description)/urdf/gazebo.urdf.xacro" />
</xacro:if>
```

- Exercise 7.7.1 -

Create the file **box\_bot.gazebo.xacro** file inside the existing **my\_box\_bot\_description** package, **URDF** folder.

► Execute in Webshell 1

```
In [ ]: cd ~/ros2_ws/src/my_box_bot_description/urdf
```

```
In [ ]: touch box_bot.gazebo.xacro
```

Based on the **URDF** robot model created in previous units, put the Gazebo elements used for simulation purposes in the Gazebo simulator as an XACRO macro with the name, **gazebo\_elements**.

Do not forget to add a **xacro:include** statement in the main **box\_bot.xacro** file.

- End of Exercise 7.7.1 -

- Solution to Exercise 7.7.1 -

📄 box\_bot.gazebo.xacro



```
</gazebo>

<gazebo reference="front_roll_link">
  <material>Gazebo/Red</material>
</gazebo>

<gazebo reference="back_yaw_link">
  <material>Gazebo/Blue</material>
</gazebo>

<gazebo reference="back_roll_link">
  <material>Gazebo/Red</material>
</gazebo>

</xacro:macro>
</robot>
```

 box\_bot.xacro

In [ ]:



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

  <xacro:include filename="$(find my_box_bot_description)/urdf/box_bot.gazebo.xacro" />

  <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>
  </link>
</robot>
```

```

</link>

<!-- Wheel Macro -->
<xacro:macro name="wheel" params="wheel_name">
  <link name="${wheel_name}">
    <visual>
      <origin rpy="0 1.5707 1.5707" xyz="0 0 0"/>
      <geometry>
        <cylinder length="${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>
</xacro:macro>

<!-- Wheel Left -->
<xacro:wheel wheel_name="left_wheel" />

<!-- Wheel Right -->
<xacro:wheel wheel_name="right_wheel" />

<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>

<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>

```

```

    </inertial>
  </link>
Exercise
<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>
```

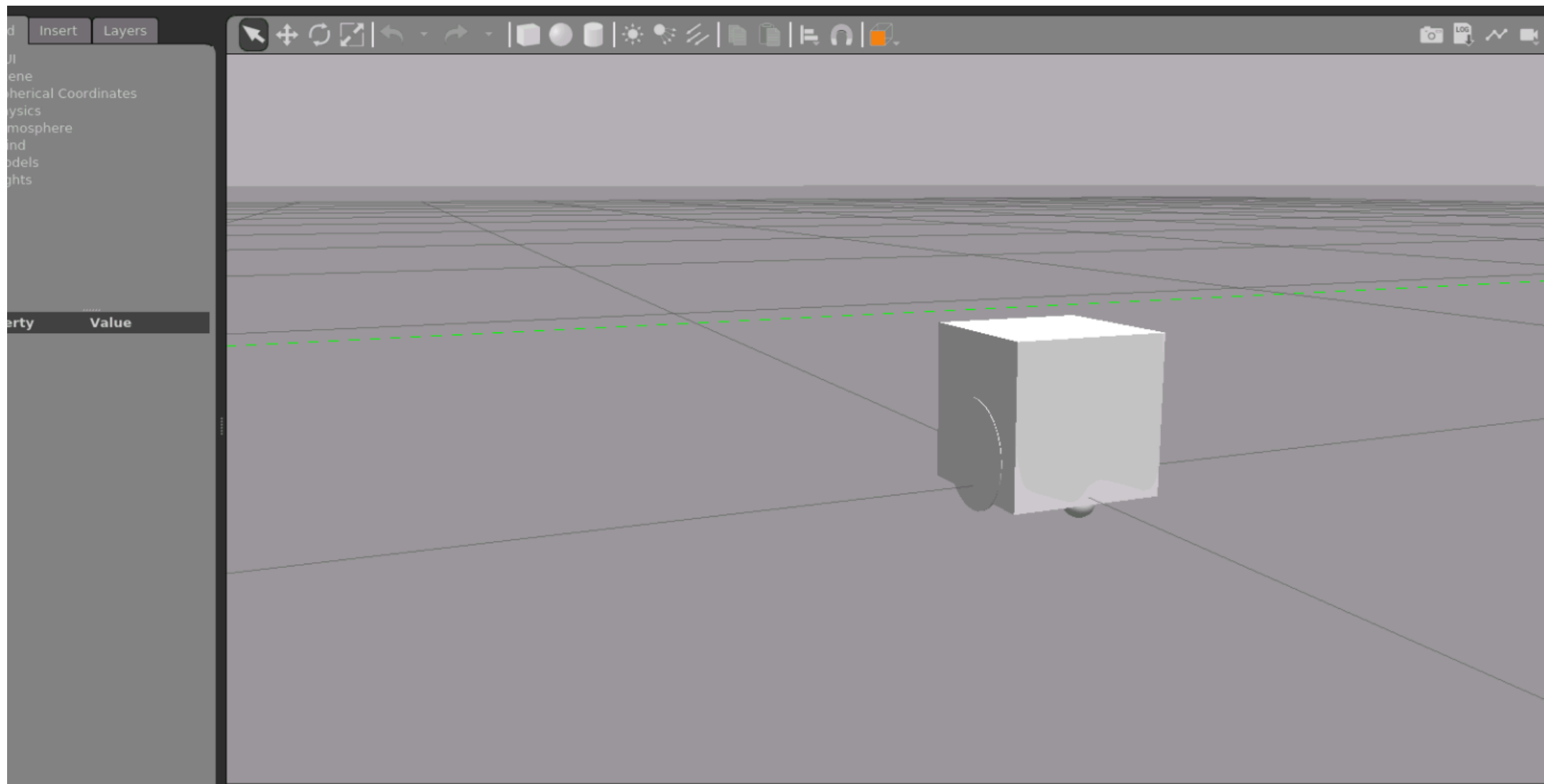
```
</robot>
```

► 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
```

Again, something this time with Gazebo properties in the links:



- End of Solution to Exercise 7.7.1 -

