7、URDF Model

Function pack path：~/software/transbot_library/src/transbot_description

7.1、Overview

URDF is Unified Robot Description Format.

```
<?xml version="1.0" encoding="utf-8"?>
<robot name="transbot_description">

</robot>
```

The first line is required for xml, which describes the version information of xml.

The second line describes the name of the current robot; all information about the current robot is contained in the [robot] tag.

URDF mainly includes two parts: Links and Joints, with the suffix .urdf.

Links: Links, coordinate systems and geometric relations.

Joints: The connection relationship between joints and Links.

7.2、Links

(1)、Introduction

In the URDF descriptive language, link is used to describe physical characteristics.

- Describe the visual display, the `<visual>` tag.
- Describe collision properties, `<collision>` tag.
- Describe physical inertia, `<inertial>` tag is not commonly used.

Links can also describe link size (size) \ color (shape) \ inertial matrix (inertial matrix) \ collision properties (collision properties), etc., each Link will become a coordinate system.

(2)、Sample code

```
    <link name="base_link">
        <inertial>
            <origin xyz="-0.011 0.0002 -0.00832" rpy="0 0 0"/>
            <mass value="1.1011218463245"/>
            <inertia
                    ixx="0.00683403160871643"
                    ixy="-1.43326126624159E-06"
                    ixz="0.000665507738691208"
                    iyy="0.0091844048006001"
                    iyz="3.7191085325542E-06"
                    izz="0.0114582299070878"/>
        </inertial>
        <visual>
            <origin xyz="0 0 0" rpy="0 0 -1.5708"/>
            <geometry>
                <mesh
filename="package://transbot_description/meshes/base_link.STL"/>
            </geometry>
            <material name="">
                <color rgba="0 0.7 0 1"/>
            </material>
        </visual>
        <collision>
            <origin xyz="0 0 0" rpy="0 0 -1.5708"/>
            <geometry>
                <mesh
filename="package://transbot_description/meshes/base_link.STL"/>
            </geometry>
        </collision>
    </link>
```

The `name` attribute in the `<link>` tag is **required**, which describes the name of the current link and is unique.

(3)、Label introduction

【origin】The tag describes the pose information; the `xyz` attribute describes the coordinate position in the large environment, and the `rpy` attribute describes its own posture.

【material】The tag describes the pose information; the `xyz` attribute describes the coordinate position in the large environment, and the `rpy` attribute describes its own posture.

【geometry】The tag describes the shape; the main function of the `mesh` attribute is to load the texture file, the file address of the `filename` attribute texture path.

【geometry】The label also includes other label descriptions:

```
<box size="1 2 3"/>
<cylinder length="1.6" radius="0.5"/>
<sphere radius="1"/>
```

7.3、Joints

(1)、Introduction

Describe the relationship between the two joints, motion position and speed limits, kinematics and dynamics properties.

Joint type:

fixed: Fixed joints. Movement is not allowed, it plays a role in connection.

continuous: Rotating joints. Can continue to rotate, there is no limit to the angle of rotation.

revolute: Rotating joints. Similar to continuous, there is a limit to the rotation angle.

prismatic: Sliding joints. Move along a certain axis, there are position restrictions.

floating: Floating joints. With six degrees of freedom, 3T3R.

planar: Planar joints. Allow translation or rotation above the plane orthogonal.

(2)、Sample code

```
    <joint name="astra_joint" type="revolute">
        <origin xyz="0.0484 0 0.10494" rpy="0 0 0"/>
        <parent link="base_link"/>
        <child link="astra_link"/>
        <axis xyz="0 0 1"/>
        <limit lower="-0.52358" upper="0.52358" effort="100" velocity="1"/>
    </joint>
```

The `name` attribute in the 【joint】 tag is **required**, which describes the name of the joint and is unique.

Fill in the six joint types corresponding to the `type` attribute in the 【joint】tab.

(3)、Label introduction

【parent】和【child】子标签代表的是两个要连接的【link】，和【link】中的`name`属性对应;在此处将【parent】作为参照物，【child】围绕【parent】进行旋转。

【origin】：子标签,指的是旋转关节于`parent`所在坐标系的相对位置。

【axis】：子标签表示【child】对应的【link】围绕哪一个轴旋转。

【limit】：子标签主要是限制【child】的。

【mimic】：描述该关节与已有关节的关系;

【safety_controller】：描述安全控制器参数。保护机器人关节的运动。

【parent】 and 【child】 subtags represent two [link] to be connected, corresponding to the `name` attribute in [link]; [parent] is used as a reference, and 【child】 surrounds 【parent】 to rotate.

【origin】: It is a subtag, which refers to the relative position of the revolute joint in the coordinate system where the `parent` is located.

【axis】: It is a child label, which indicates which axis the corresponding [link] of [child] rotates around.

【limit】: It is a child tag, mainly used to limit [child].

【mimic】: Describe the relationship between the joint and the existing joint;

【safety_controller】: Describe the safety controller parameters. Protect the movement of robot joints.

7.4、launch file introduction

The launch file is an xml file used to describe the startup of a node, and it can can start multiple nodes at the same time.

Sample code

```
<launch>
    <arg name="use_gui" default="false"/>
    <param name="robot_description" command="$(find xacro)/xacro '$(find
transbot_description)/urdf/transbot_astra.urdf'"/>
    <group if="$(arg use_gui)">
        <node name="joint_state_publisher" pkg="joint_state_publisher_gui"
type="joint_state_publisher_gui"/>
    </group>
    <group unless="$(arg use_gui)">
        <node name="joint_state_publisher" pkg="joint_state_publisher"
type="joint_state_publisher"/>
    </group>
    <node name="robot_state_publisher" pkg="robot_state_publisher"
type="robot_state_publisher"/>
    <node name="rviz" pkg="rviz" type="rviz" args="-d $(find
transbot_description)/rviz/transbot.rviz"/>
</launch>
```

The name of the package to be started with the `pkg` attribute, the name of the `type` executable file, and the name of the node after the `name` executable file is started.

【param】The sub-tag is the result output after xacro executes xxx.urdf as the value assigned to robot_description.

【arg】 subtag, the `name` attribute is the parameter name, and the `default` attribute is the default parameter.

7.5、URDF Visualization

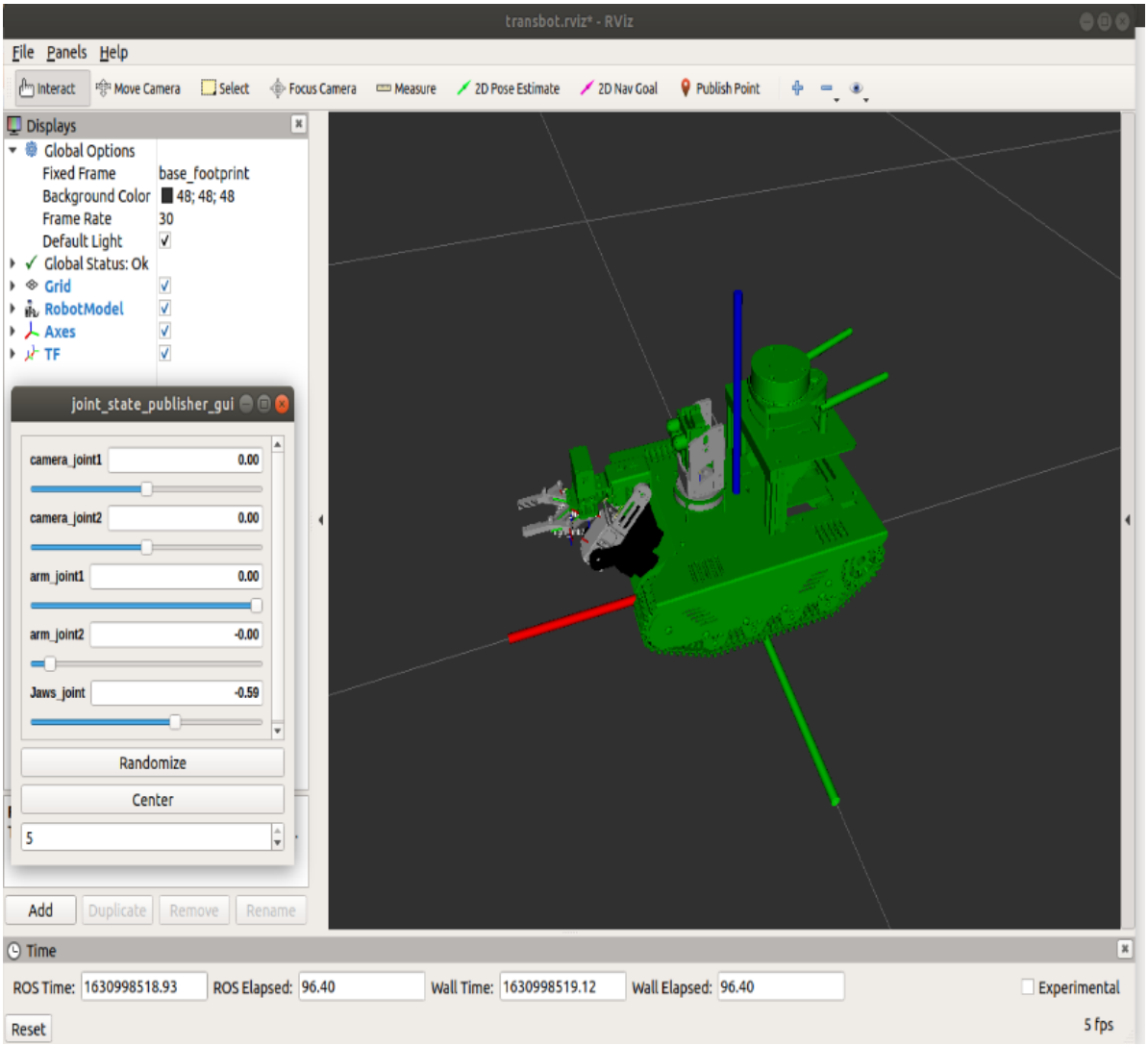
Open the command line and execute the following commands in sequence.

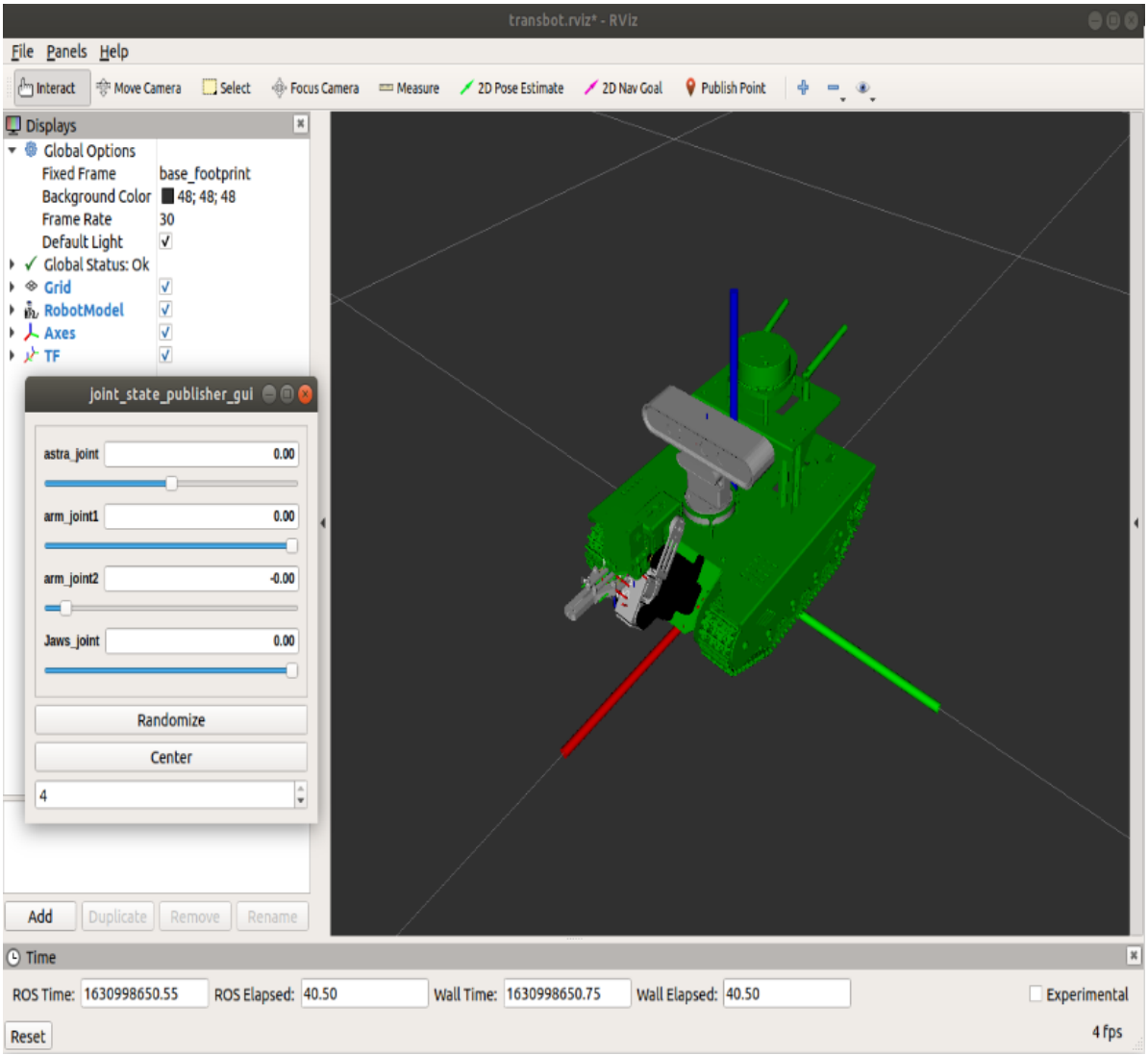
```
roslaunch transbot_description display_astra.launch   # Astra camera
roslaunch transbot_description display_camera.launch  # Ordinary camera
```

- Sample picture

The red axis is **X axis**; the green axis is **Y axis**; the blue axis is **Z axis**; the coordinate system composed of three axes is called the **base coordinate system**.

Adjust the [joint_state_publisher_gui] component to rotate the servo.


transbot.rviz* - RViz
File Panels Help
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Displays
Global Options
Fixed Frame
base_footprint
Background Color
48; 48; 48
Frame Rate
30
Default Light
Global Status: Ok
Grid
RobotModel
Axes
TF
joint_state_publisher_gui
camera_joint1
0.00
camera_joint2
0.00
arm_joint1
0.00
arm_joint2
-0.00
Jaws_joint
-0.59
Randomize
Center
5
Add
Duplicate
Remove
Rename
Time
ROS Time:
1630998518.93
ROS Elapsed:
96.40
Wall Time:
1630998519.12
Wall Elapsed:
96.40
Experimental
Reset
5 fps


transbot.rviz* - RViz
File Panels Help
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Displays
Global Options
Fixed Frame
base_footprint
Background Color
48; 48; 48
Frame Rate
30
Default Light
Global Status: Ok
Grid
RobotModel
Axes
TF
joint_state_publisher_gui
astra_joint
0.00
arm_joint1
0.00
arm_joint2
-0.00
Jaws_joint
0.00
Randomize
Center
4
Add
Duplicate
Remove
Rename
Time
ROS Time:
1630998650.55
ROS Elapsed:
40.50
Wall Time:
1630998650.75
Wall Elapsed:
40.50
Experimental
Reset
4 fps