6、Robot URDF model

This lesson uses ROSMASTER-X3 as an example.

6.1、URDF Overview

Feature package reference path：~/driver_ws/src/yahboomcar_description

6.1.1、Introduction

URDF, the full name of Unified Robot Description Format, translated into Chinese as Unified Robot Description Format, is a robot model file described in xml format, similar to D-H parameters.

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

</robot>
```

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

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

6.1.2、Component

1）、link，The connecting rod, which can be imagined as a human arm。

2）、joint, which can be thought of as human elbows。

The relationship between link and joint: two links are connected by joints.

6.1.3、link

1）、Introduction

In the URDF descriptive language, links are used to describe physical properties.

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

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

2）、Sample Code：~/driver_ws/src/yahboomcar_description/urdf/yahboomcar_X3.urdf

```
    <link name="front_left_wheel">
        <inertial>
            <origin xyz="2.3728E-06 -9.4228E-07 0.00064068" rpy="0 0 0"/>
            <mass value="0.051543"/>
            <inertia ixx="1.4597E-05" ixy="-4.7945E-10" ixz="-2.4786E-10"
                     iyy="1.4598E-05" iyz="1.7972E-09" izz="2.4267E-05"/>
        </inertial>
        <visual>
            <origin xyz="0 0 0" rpy="0 0 0"/>
```

```
            <geometry>
                <mesh
filename="package://yahboomcar_description/meshes/mecanum/front_left_wheel.STL"/
>
            </geometry>
            <material name="">
                <color rgba="0.7 0.7 0.7 1"/>
            </material>
        </visual>
        <collision>
            <origin xyz="0 0 0" rpy="0 0 0"/>
            <geometry>
                <mesh
filename="package://yahboomcar_description/meshes/mecanum/front_left_wheel.STL"/
>
            </geometry>
        </collision>
    </link>
```

3）、Introduction to labels

- origin

  It describes the pose information; the `xyz` attribute describes the coordinate position in the large environment, and the `rpy` attribute describes its own attitude.

- mess

  Describes the quality of the link.

- inertia

  The inertial reference frame, due to the symmetry of the rotational inertia matrix, only needs 6 upper triangular elements ixx, ixy, ixz, iyy, iyz, izz as attributes.

- geometry

  The tag describes the shape; the main function of the `mesh` attribute is to load the texture file, and the `filename` attribute is the file address of the texture path. The label also includes other label descriptions:

  ```
  <box size="1 2 3"/>     #The box box, through the size attribute describes
  the length, width and height of the box.
  <cylinder length="1.6" radius="0.5"/>   #The cylinder is cylindrical, the
  height of the cylinder is described by the `length` property, and the radius
  of the cylinder is described by the `radius` property.
  <sphere radius="1"/>    #sphere is spherical, and the radius of the sphere
  is described by the `radius` property.
  ```

- material

  The tag describes the material; the `name` attribute is **required**, which can be empty or repeated. Red, green, blue, and transparency are described by the `rgba` attribute in the [color] tag, separated by spaces. The range of colors is [0-1].

6.1.4、joints

1）、Introduction

Describe the relationship between two joints, motion position and velocity limits, kinematic and dynamic properties.

Joint Type:

- fixed：Fixed joints. Movement is not allowed and acts as a connection.
- continuous：Rotate the joint. It can be rotated continuously, and there is no limit to the rotation angle.
- revolute：Rotate the joint. Similar to continuous, there is a limit to the rotation angle.
- prismatic：Sliding joints. Move along a certain axis, there is a position limit.
- floating：Suspended joints. With six degrees of freedom, 3T3R.
- planar：Planar joints. Allows translation or rotation above the plane orthogonal.

2）、Sample Code

```
<joint name="front_right_joint" type="continuous">
        <origin xyz="0.08 -0.0845 -0.0389" rpy="-1.5703 0 3.14159"/>
        <parent link="base_link"/>
        <child link="front_right_wheel"/>
        <axis xyz="0 0 1" rpy="0 0 0"/>
        <limit effort="100" velocity="1"/>
    </joint>
```

In the [joint] tag, the `name` attribute is **required**, describing the name of the joint, and it is unique.。

In the `type` attribute of the [joint] tag, fill in the six types of joints.

3）、Introduction to labels

- origin

  The child label refers to the relative position of the rotation joint in the coordinate system where the `parent` is located.

- parent，child

  The parent and child sub-labels represent two links to be connected; parent is the reference, and child rotates around the praent.

- axis

  The child label indicates which axis (xyz) the corresponding link of the child rotates around and the amount of rotation around the fixed axis.

- limit

  The child tag is mainly to limit the child. The `lower` property and the `upper` property limit the radian range of rotation, and the `effort` property limits the force range during the rotation. (positive or negative value, in cattle or N), the `velocity` property limits the speed of rotation, in m/s or m/s.

- mimic

  Describes the relationship of this joint to existing joints.

- safety_controller

  Describe the safety controller parameters. Protect the movement of the robot joints.

6.2、URDF visualization

6.2.1、Run

```
cd ~/driver_ws/src/yahboomcar_description/launch
roslaunch  display.launch
```

6.2.2、Sample Image

The red axis is the **X axis**; the green axis is the **Y axis**; the blue axis is the **Z axis**; the coordinate system formed by the three axes is called the **base coordinate system**. Adjusting the [joint_state_publisher_gui] component can control the rotation of the wheel.