ENGR 4421: Robotics II

URDF

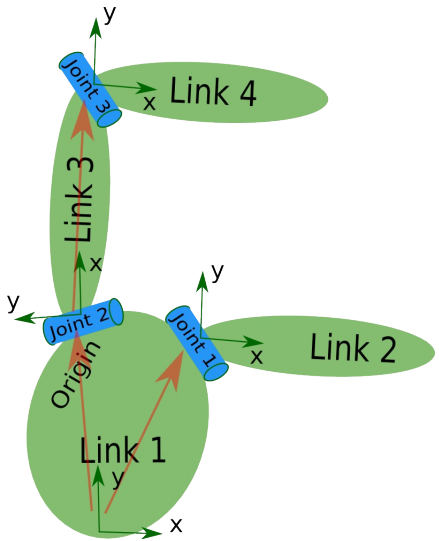
02/08/2022

Outline

- Introduction
- ROS Tutorials

What is URDF

- Unified Robot Description Format (URDF) specifies the geometry and organization of robots in ROS.
- URDF sets up transformations, extremely useful when robots get more complicated.
- URDF is useful for visualizing (via rviz), too.
- The robot model can be set up by describing its links and joints in XML language.



URDF Get Started

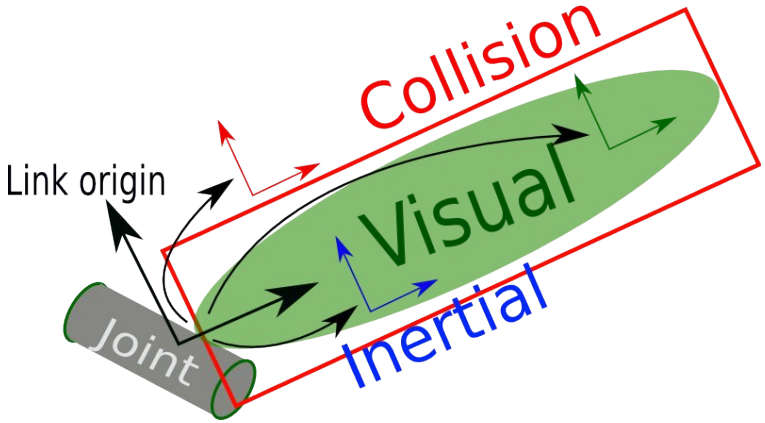
https://docs.ros.org/en/galactic/Tutorials/URDF/URDF-Main.html

Preparation

```
# Note: you can choose your own names in “< >”. Remember to get rid of the brackets: “<>”


cd ~/<ros workspace>/src  # go to `src/` in your ros workspace
ros2 pkg create --build-type ament_python <urdf_package>  # create a package
cd <urdf_package>  # go to your package
mkdir launch rviz urdf  # create useful directories
code .  # bring up VSCode and open the <urdf_package> directory \

# Now, you can create a new file, e.g. `urdf/robot.urdf`, to start modeling.
```

Create a Link

```
<?xml version="1.0"?>
<robot name="robot">

  <link name="base_link">
    <visual>
      <geometry>
        <box size="0.4 0.2 0.1" />
      </geometry>
    </visual>
  </link>

</robot>
```



Visualize in RVIZ

- Add data files

```
import os
from glob import glob
from setuptools import setup

package_name = 'diffbot_description'

setup(
    ...
    data_files=[
        ...
        ('share/' + package_name, ['package.xml']),
        (os.path.join('share', package_name, 'launch'), glob(os.path.join('launch', '*.launch.py'))),
        (os.path.join('share', package_name, 'urdf'), glob(os.path.join('urdf', '*.urdf'))),
        (os.path.join('share', package_name, 'rviz'), glob(os.path.join('rviz', '*.rviz'))),
    ],
    ...
```

Visualize in RVIZ

- Update package dependencies

```
<package format="3">
  ...
  <license>TODO: License declaration</license>

  <exec_depend>joint_state_publisher</exec_depend>
  <exec_depend>joint_state_publisher_gui</exec_depend>
  <exec_depend>robot_state_publisher</exec_depend>
  <exec_depend>rviz2</exec_depend>
  <exec_depend>xacro</exec_depend>
  <exec_depend>launch</exec_depend>
  <exec_depend>launch_ros</exec_depend>

  <test_depend>ament_copyright</test_depend>
  ...
```

Visualize in RVIZ

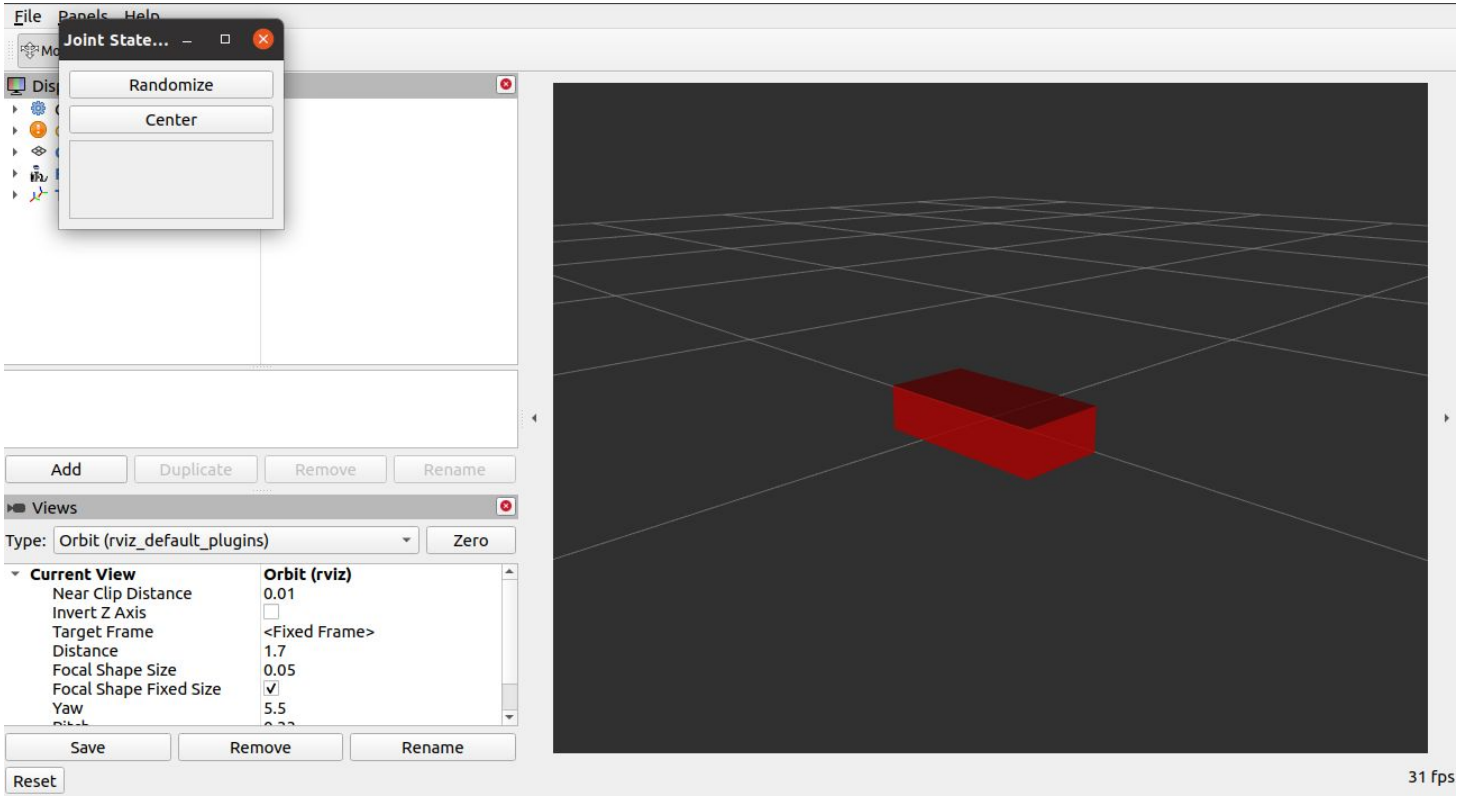
- Create a launch file.

```
cd <urdf package dir>/launch
wget https://raw.githubusercontent.com/ros/urdf_tutorial/ros2/launch/display.launch.py
```

- Build package and launch.

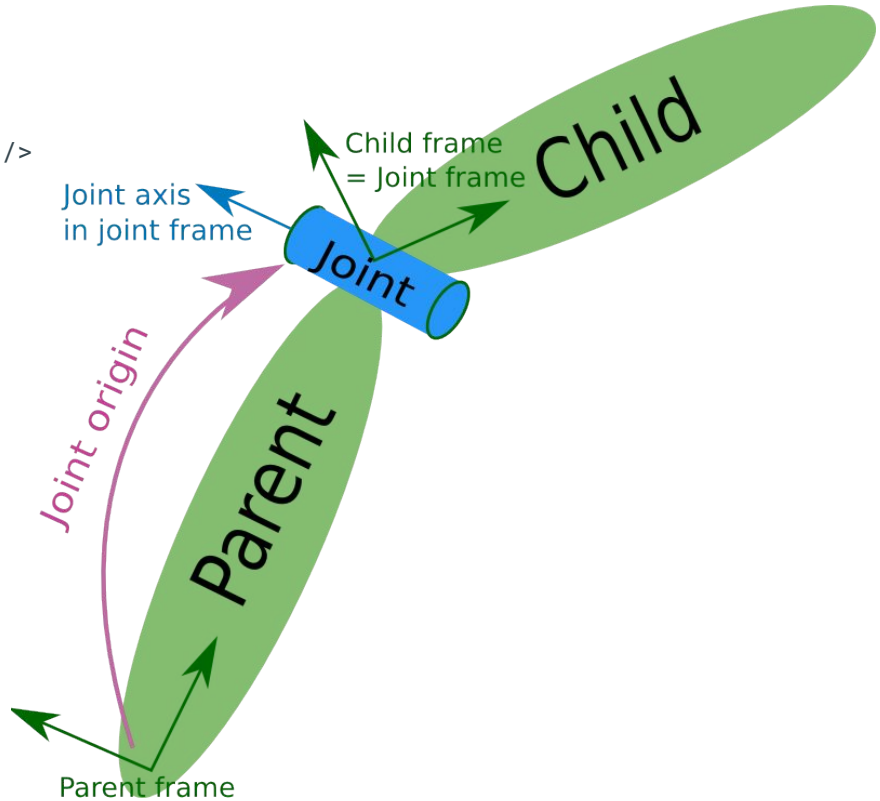
```
cd ~/<ros workspace>  # e.g. cd ~/tutorial_ws
rosdep install -i --from-path src --rosdistro galactic -y
colcon build
source install/setup.bash
ros2 launch <urdf package> display.launch.py
```

Visualize in RVIZ



Create a Joint

```
<joint name="base_to_left_wheel" type="continuous">
    <parent link="base_link" />
    <child link="left_wheel" />
    <origin rpy="1.5707963267948966 0 0" xyz="0.1 0.13 0" />
    <axis rpy="0 0 0" xyz="0 0 1" />
</joint>

<link name="left_wheel">
    <visual>
        <geometry>
            <cylinder length="0.05" radius="0.1" />
        </geometry>
        <material name="black" />
    </visual>
</link>
```



Color

```
<robot name="diffbot">
    <!-- define colors -->
    <material name="blue">
        <color rgba="0 0 0.8 1" />
    </material>
    <material name="black">
        <color rgba="0 0 0 1" />
    </material>
    <material name="white">
        <color rgba="1 1 1 1" />
    </material>
    <material name="purple">
        <color rgba="0.3098 0.1765 0.4980 1" />
    </material>
    ...
</robot>
```

Collision

```
<link name="base_link">
    <visual>
        ...
    </visual>
    <collision>
        <geometry>
            <box size="0.4 0.2 0.1" />
        </geometry>
    </collision>
</link>
```

Inertia

```
<link name="base_link">
    <visual>
        ...
    </visual>
    <collision>
        ...
    </collision>
    <inertial>
        <mass value="1" />
        <inertia ixx="0.0042" ixy="0.0" ixz="0.0" iyy="0.0142" iyz="0.0" izz="0.0167" />
    </inertial>
</link>
```