RVIZ AND URDF

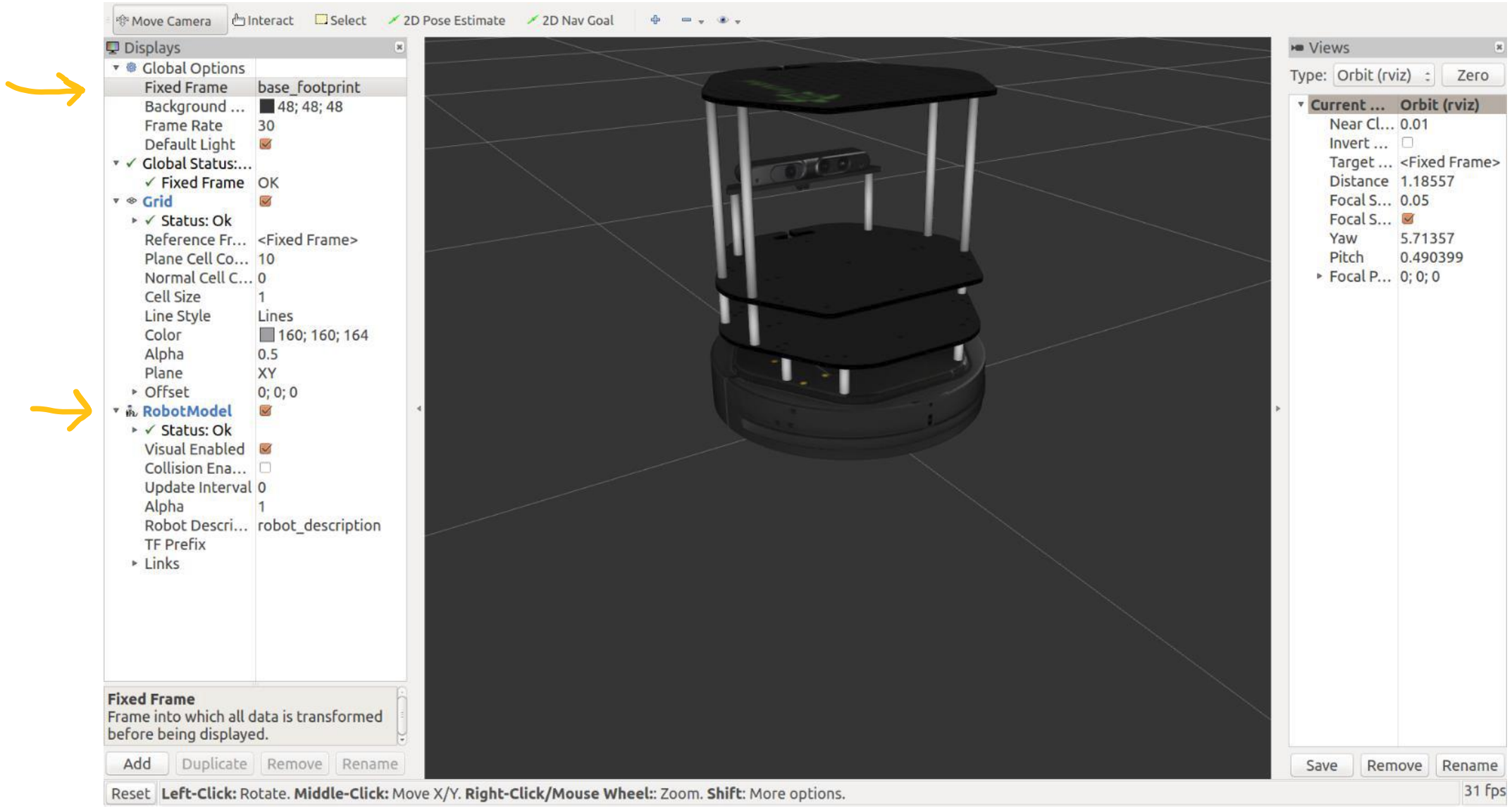
CHAPTER 2 IN TEXTBOOK- ROS1 KINETIC

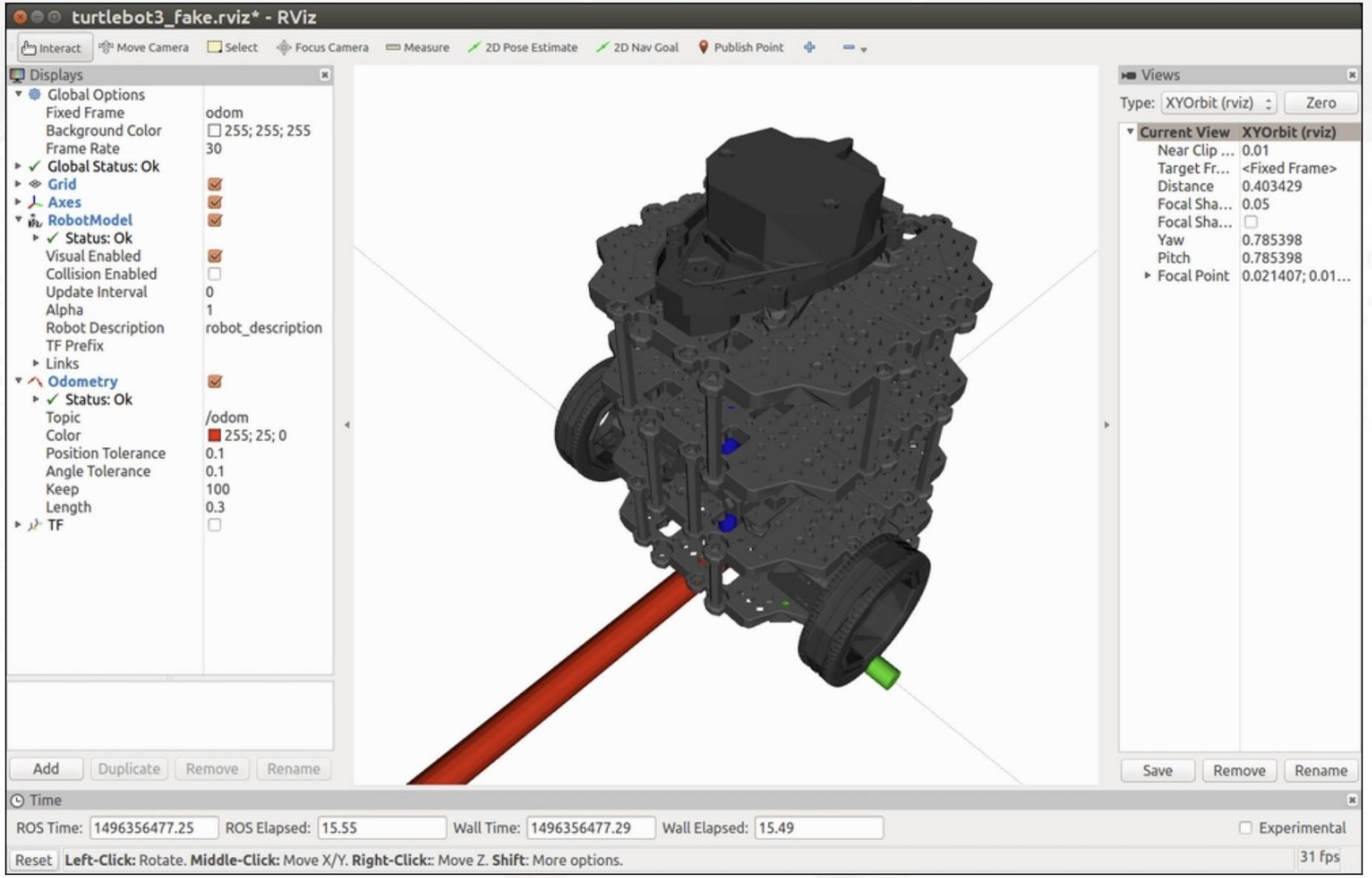
RVIZ PAGES 36-41

URDF PAGES 42-59

ROS1 RVIZ NOETIC AND ROS2 FOXY

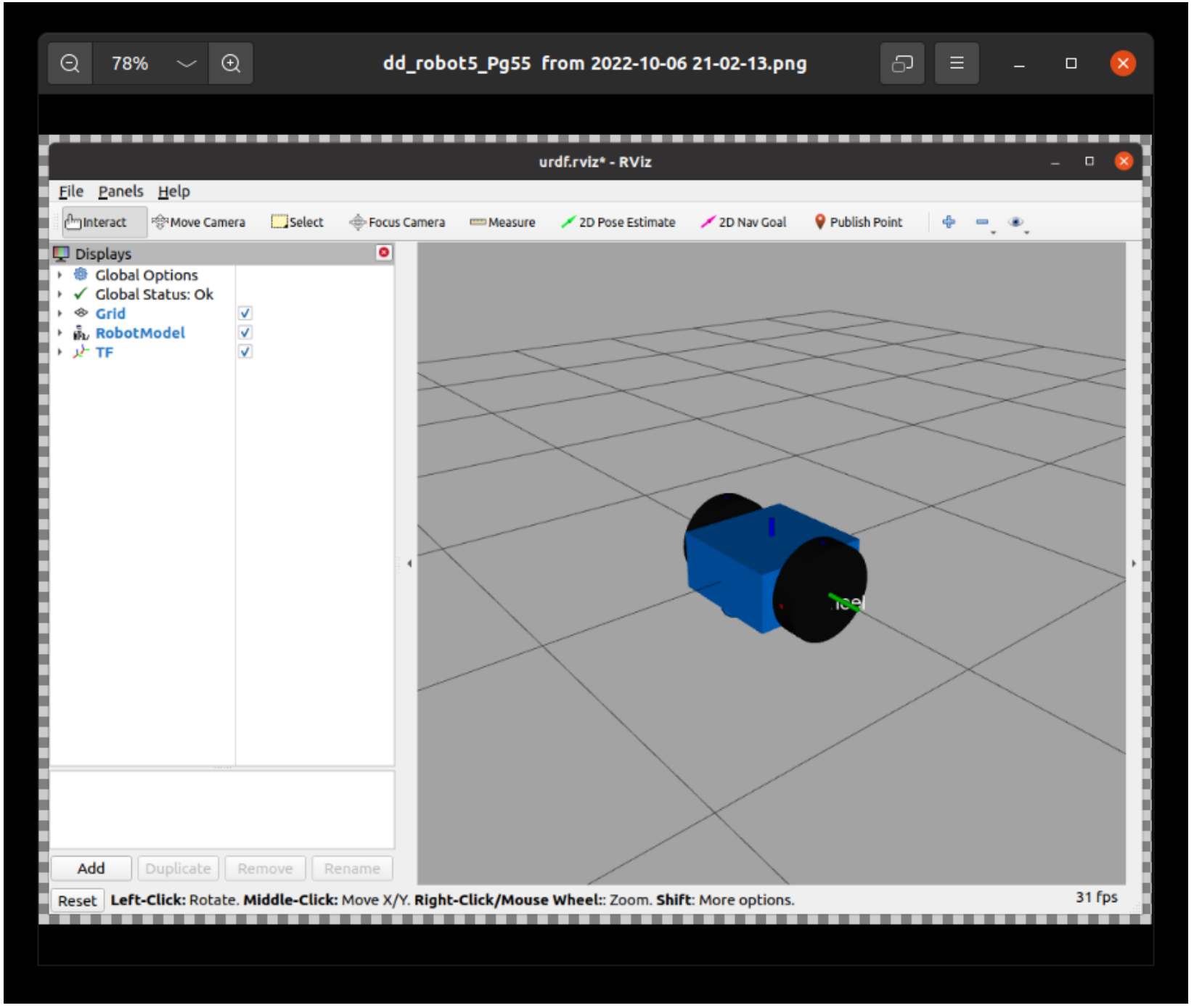
RVIZ for Visualization





TURTLEBOT3 BURGER

dd_robot
In Noetic



In this chapter 2, *ROS Robotics By Example*, we will cover the following topics:

- An introduction to rviz, installation instructions, and instructions for use
- How to create and build a ROS package
- An incremental approach to develop a URDF file and visualizing it in rviz
- ROS tools to verify the URDF file
- An introduction to Gazebo, installation instructions, and instructions for use
- Modifications necessary to visualize the URDF file in Gazebo
- Tools to verify your Gazebo URDF/**Simulation Description Format** (**SDF**) file

A simple way to control a robot in Gazebo

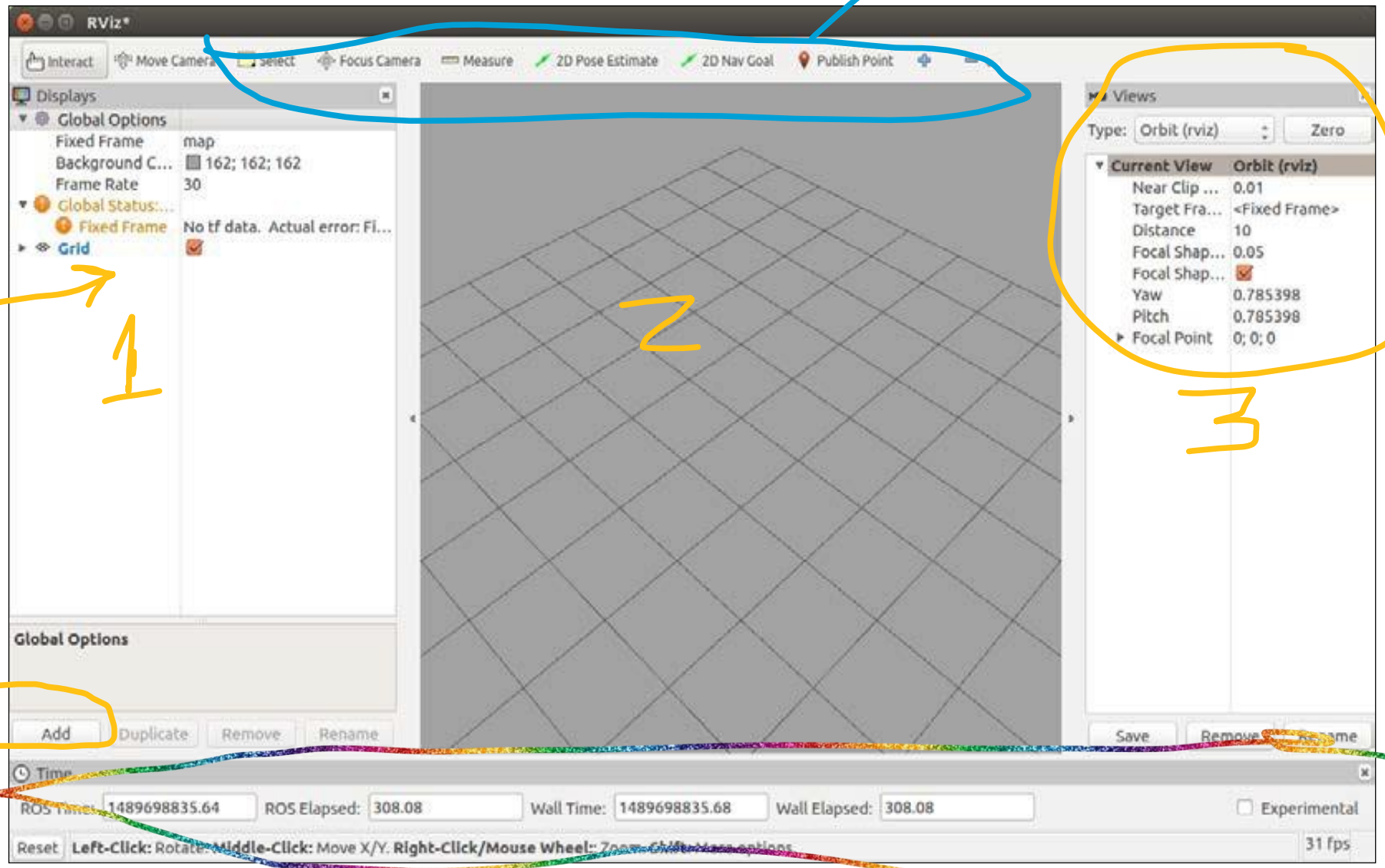
RVIZ1 AND GAZEBO 7 AND ROS1 KINETIC HERE

RVIZ for Visualization

4

CAMERA, NAVIGATION

Frames
Model



1

2

3

VIEWS

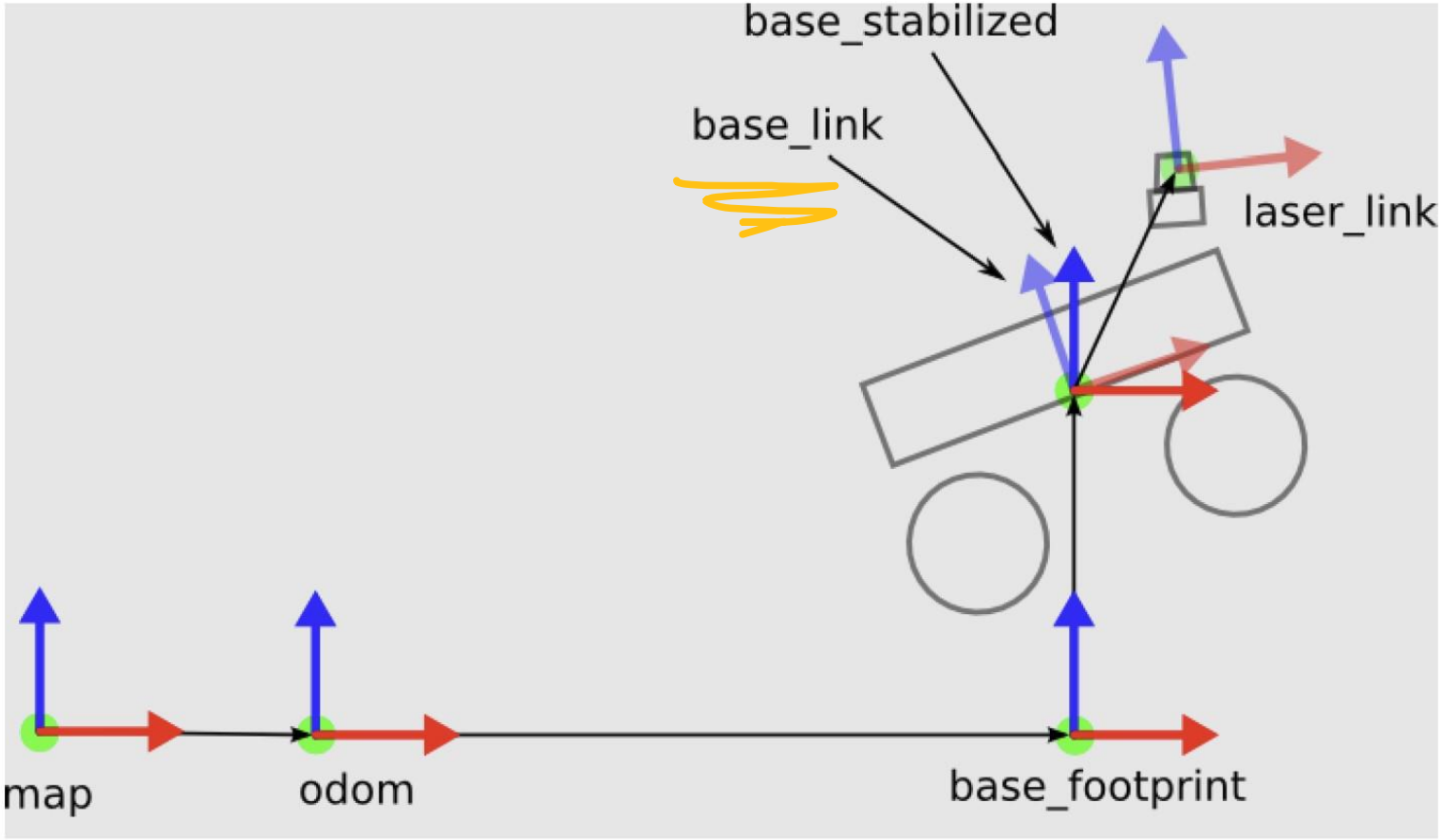
Display
Panel

5

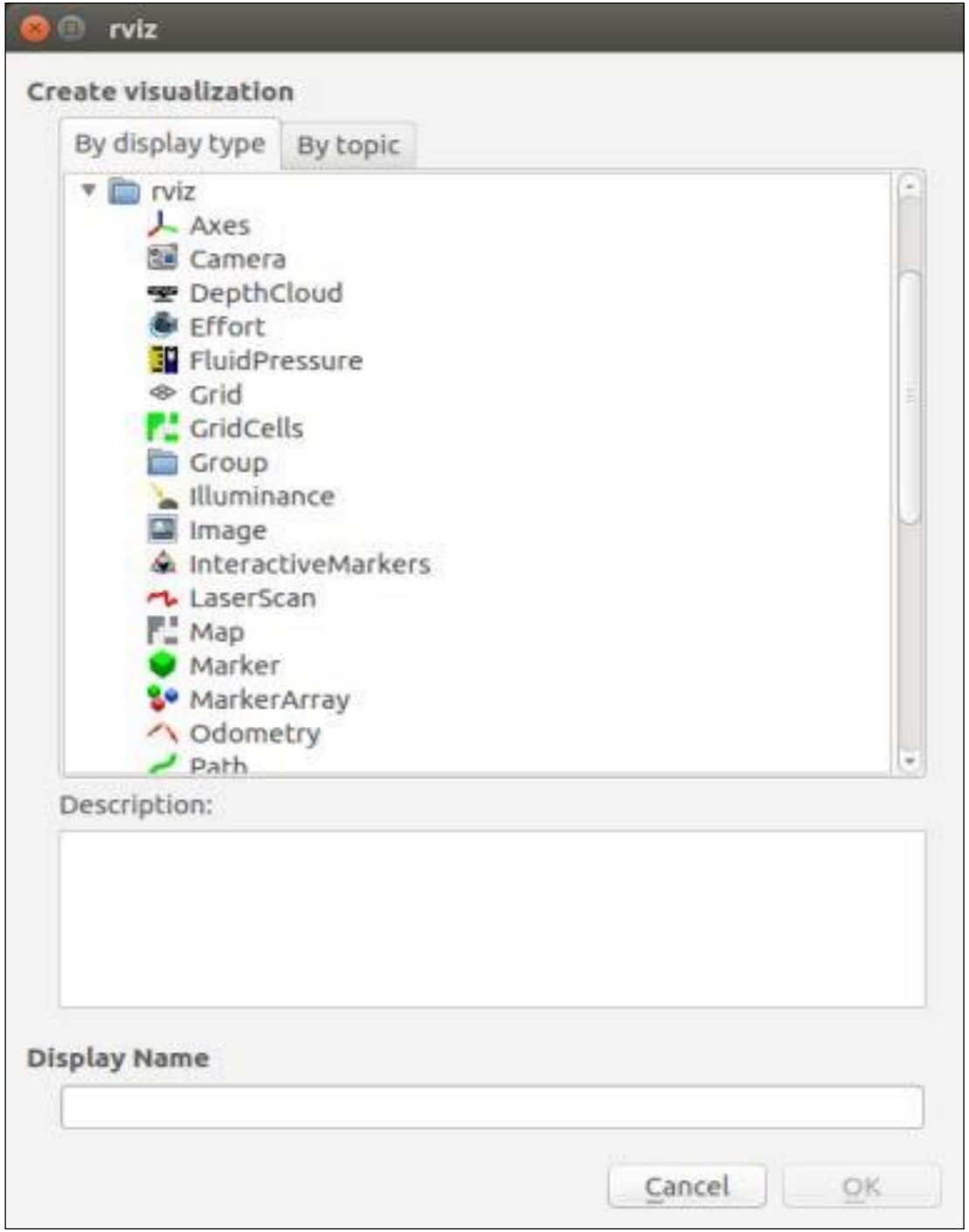
TIME

Frames in RVIZ FOR TF

http://wiki.ros.org/hector_slam/Tutorials/SettingUpForYourRobot?action=AttachFile&do=get&target=coordsystems_img.png



DISPLAY PANEL



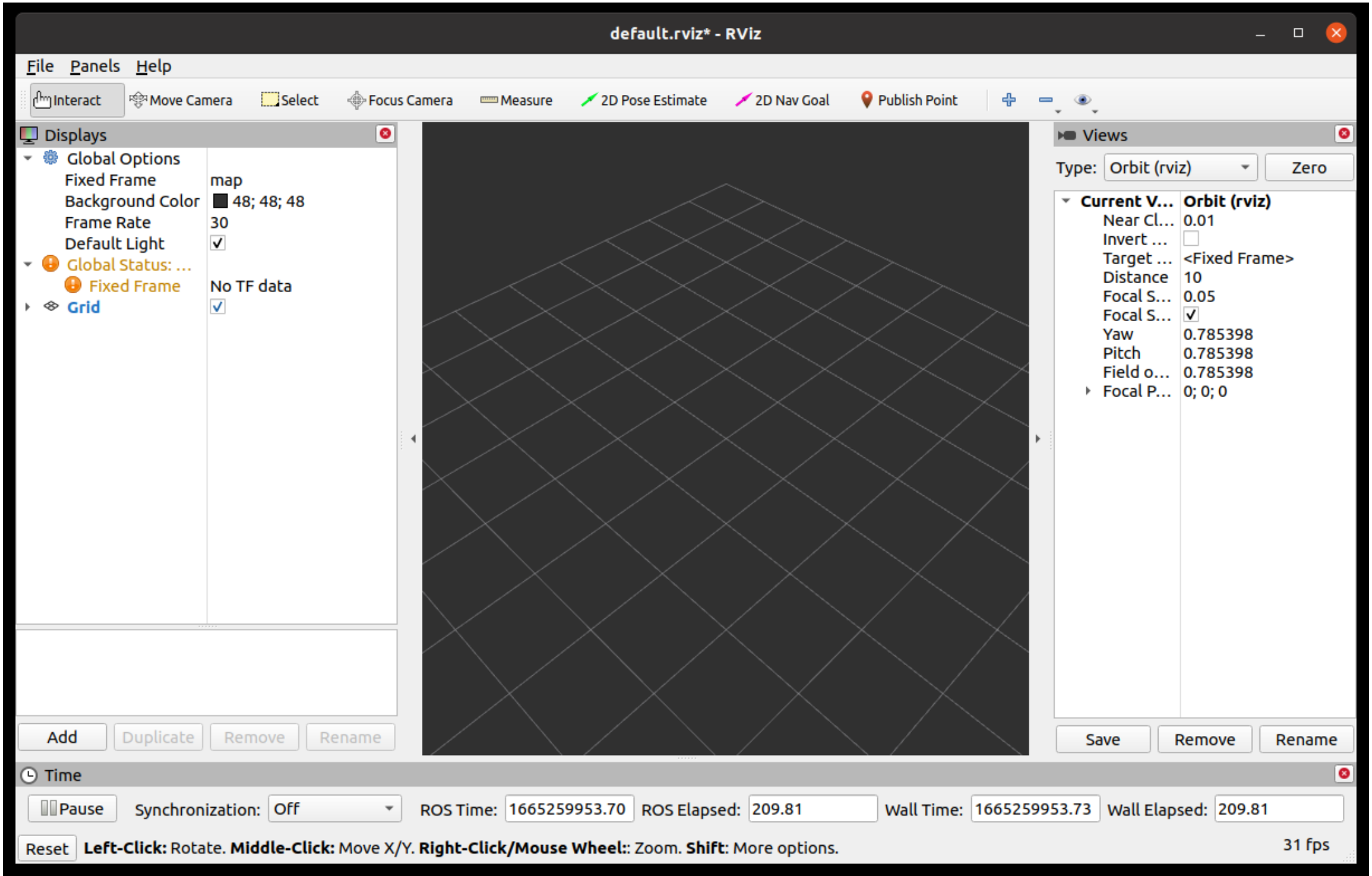
Alias foxy or noetic
harman@harman-VirtualBox:~$ **noetic**

ROS_DISTRO was set to 'foxy' before. harman@harman-VirtualBox:~$ **roscore**
* /rosdistro: noetic

NEW TERMINAL

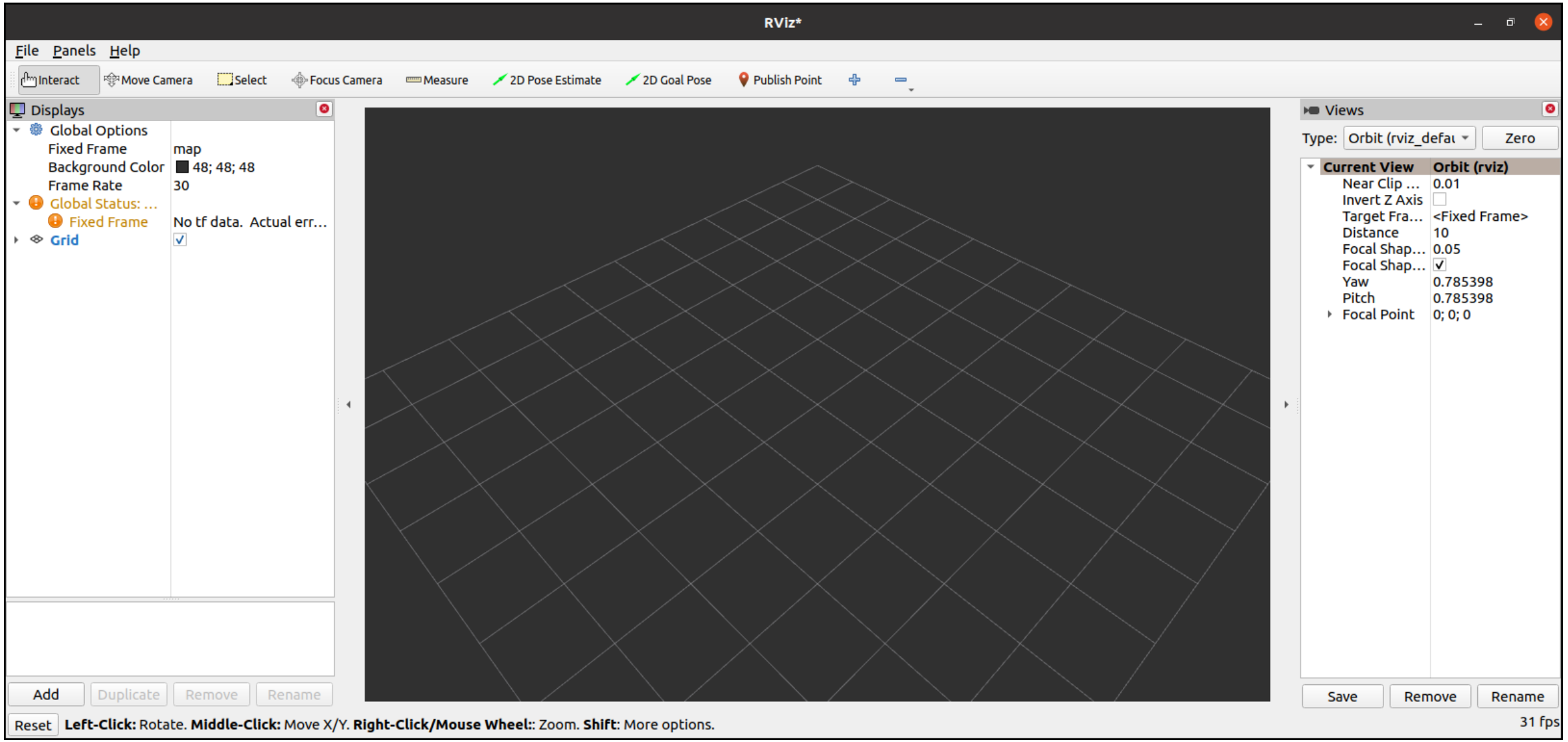
Alias foxy or noetic
harman@harman-VirtualBox:~$ **noetic**

ROS_DISTRO was set to 'foxy' before. harman@harman-VirtualBox:~$ **rosrun rviz rviz**
[INFO] [1665259743.423426356]: rviz version 1.14.19


default.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 map
Background Color 48; 48; 48
Frame Rate 30
Default Light
Global Status: ...
Fixed Frame No TF data
Grid
Add
Duplicate
Remove
Rename
Views
Type: Orbit (rviz)
Zero
Current V... Orbit (rviz)
Near Cl... 0.01
Invert ...
Target ... <Fixed Frame>
Distance 10
Focal S... 0.05
Focal S...
Yaw 0.785398
Pitch 0.785398
Field o... 0.785398
Focal P... 0; 0; 0
Save
Remove
Rename
Time
Pause
Synchronization: Off
ROS Time: 1665259953.70
ROS Elapsed: 209.81
Wall Time: 1665259953.73
Wall Elapsed: 209.81
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel:: Zoom. Shift: More options.
31 fps

harman@harman-VirtualBox:~$ **ros2 run rviz2 rviz2**
[INFO] [1665259284.306074601] [rviz2]: Stereo is NOT SUPPORTED
[INFO] [1665259284.306159948] [rviz2]: OpenGl version: 3.1 (GLSL 1.4)
[INFO] [1665259284.380477455] [rviz2]: Stereo is NOT SUPPORTED

RVIZ2


RViz*
File
Panels
Help
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Goal Pose
Publish Point
Displays
Global Options
Fixed Frame
map
Background Color
48; 48; 48
Frame Rate
30
Global Status: ...
Fixed Frame
No tf data. Actual err...
Grid
Views
Type:
Orbit (rviz_defa
Zero
Current View
Orbit (rviz)
Near Clip ...
0.01
Invert Z Axis
Target Fra...
<Fixed Frame>
Distance
10
Focal Shap...
0.05
Focal Shap...
Yaw
0.785398
Pitch
0.785398
Focal Point
0; 0; 0
Add
Duplicate
Remove
Rename
Save
Remove
Rename
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel:: Zoom. Shift: More options.
31 fps

Creating and building a ROS package

```
catkin_ws/      -- WORKSPACE
build/          -- BUILD SPACE
devel/          -- DEVEL SPACE
src/            -- SOURCE SPACE
CMakeLists.txt   -- 'Toplevel' CMake
file, provided by catkin
```

Make sure that you have `source ~/catkin_ws/devel/ setup.bash` in your **`.bashrc`** file, or this command is entered at the terminal window prompt

TEXT PAGES 41-41

NO SOURCE – NO DICE !!

Alias foxy or noetic

harman@harman-VirtualBox:~$ **env | grep ROS** **NO distro or source**

ROS_VERSION=2

ROS_PYTHON_VERSION=3

ROS_DOMAIN_ID=231

ROS_LOCALHOST_ONLY=0

ROS_DISTRO=foxy

harman@harman-VirtualBox:~$ **echo $ROS_PACKAGE_PATH** **?????????? HELP! Where is ROS?**

harman@harman-VirtualBox:~$ **noetic** **Choose a distro**

ROS_DISTRO was set to 'foxy' before. Please make sure that the environment does not mix paths from different distributions.

harman@harman-VirtualBox:~$ **echo $ROS_PACKAGE_PATH** **OK – Just to ROS Noetic NOT to Workspace**

/opt/ros/noetic/share

harman@harman-VirtualBox:~$ **source ~/catkin_ws/devel/setup.bash**

harman@harman-VirtualBox:~$ **echo $ROS_PACKAGE_PATH**

/home/harman/catkin_ws/src:/opt/ros/noetic/share **ROS and Work Space are in PATH**

We begin by moving to your catkin workspace source directory:

```
$ cd ~/catkin_ws/src
```

Now, let's create our first ROS package, **`ros_robotics`**:

```
$ catkin_create_pkg ros_robotics
```

Next, build the packages in the catkin workspace:

```
$ cd ~/catkin_ws
$ catkin_make
```

After the workspace has been built to include the `ros_robotics` package, the

`~/catkin_ws/devel` subdirectory will have a structure similar to the structure under the `/opt/ros/<distro>` `(kinetic or Noetic)` directory.

harman@harman-VirtualBox:~/catkin_ws$ cd ~/catkin_ws/src
harman@harman-VirtualBox:~/catkin_ws/src$ ls
CMakeLists.txt ros_robotics

harman@harman-VirtualBox:~/catkin_ws/src/ros_robotics$ **tree -L 1**

```
.
├── CMakeLists.txt
├── launch
├── package.xml
├── urdf
├── urdf.rviz
└── worlds

3 directories, 3 files
```

harman@harman-VirtualBox:~/catkin_ws/src/ros_robotics$ **tree -L 2**

```
.
├── CMakeLists.txt
├── launch
│   ├── ddrobot_gazebo.launch
│   ├── ddrobot_rviz.launch
│   └── ddrobot_rviz_launch_bak
├── package.xml
├── urdf
│   ├── dd_robot2.urdf
│   ├── dd_robot3.urdf
│   ├── dd_robot4.urdf
│   ├── dd_robot5.urdf
│   ├── dd_robot6.urdf
│   ├── dd_robot.gazebo
│   ├── dd_robot.gv
│   ├── dd_robot.pdf
│   └── dd_robot.urdf
├── urdf.rviz
└── worlds
    ├── ddrobot.world
    └── ddrobot_world_bak

3 directories, 17 files
```

CHAPTER 2 IN TEXT

URDF - XACRO files (XML)

The Universal Robotic Description Format (URDF) is an XML file format used in ROS to describe all elements of a robot.

To use a URDF file in Gazebo, some additional simulation-specific tags must be added to work properly with Gazebo.

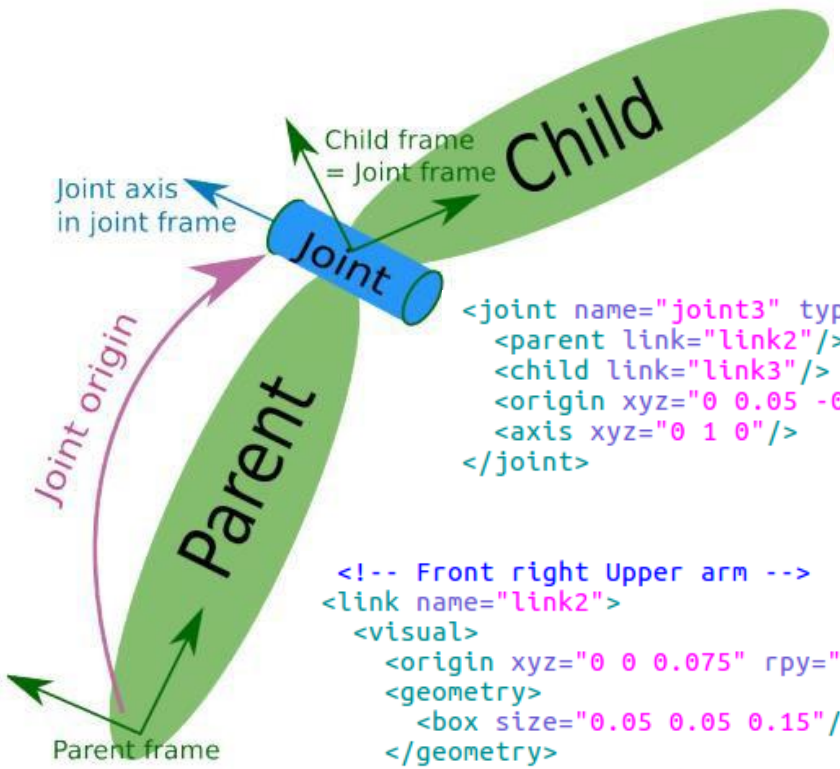
URDF

- Specify the kinematic and dynamic properties
- Tags: link, joint, transmission
- Order in the file does not matter

XACRO (Covered in Chapter 5 of the Textbook)

- XML Macro Language used for URDF simplification
- Reduce redundancy and increase modularity
- Use parametrization (Use parameters for lengths and links and math for origin and inertia calculation)

Link and joint representation




```
 <!-- Front right End arm-->
<link name="link3">
  <visual>
    <origin xyz="0 0 -0.1" rpy="0 0 0"/>
    <geometry>
      <box size="0.025 0.025 0.025"/>
    </geometry>
    <material name="orange"/>
  </visual>
</link>
```

```
<joint name="joint3" type="continuous">
  <parent link="link2"/>
  <child link="link3"/>
  <origin xyz="0 0.05 -0.07" rpy="0 0 0"/>
  <axis xyz="0 1 0"/>
</joint>
```

```
 <!-- Front right Upper arm -->
<link name="link2">
  <visual>
    <origin xyz="0 0 0.075" rpy="0 0 0"/>
    <geometry>
      <box size="0.05 0.05 0.15"/>
    </geometry>
    <material name="red"/>
  </visual>
</link>
```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LAUNCH RVIZ AND THE ROBOT MODEL Kinetic

```
$ roslaunch ros_robotics
ddrobot_rviz.launch model:=dd_robot.urdf
```

```
<launch>
  <!-- values passed by command line input -->
  <arg name="model" />
  <arg name="gui" default="False" />

  <!-- set these parameters on Parameter Server -->
  <param name="robot_description" textfile="$(find
ros_robotics)/urdf/$(arg model)" />
  <param name="use_gui" value="$(arg gui)"/>
```

ROS1 Kinetic Launch Continued:

```
<!-- Start 3 nodes: joint_state_publisher, robot_state_publisher and rviz -->
  <node name="joint_state_publisher" pkg="joint_state_publisher"
type="joint_state_publisher" />

  <node name="robot_state_publisher" pkg="robot_state_publisher"
type="state_publisher" />      (X for Noetic)

  <node name="rviz" pkg="rviz" type="rviz" args="-d $(find
ros_robotics)/urdf.rviz" required="true" />
  <!-- (required = "true") if rviz dies, entire roslaunch will be killed -->
</launch>
```

LAUNCH RVIZ AND THE ROBOT MODEL NOETIC

```
<launch>
  <!-- values passed by command line input The model i.e. dd_robotx.urdf-->
  <arg name="model" />
    <!-- <arg name="gui" default="False" /> 7/30/21 Put gui:=True on Command Line-->

  <!-- set these parameters on Parameter Server -->
  <param name="robot_description" textfile="$(find ros_robotics)/urdf/$(arg model)" />
  <param name="use_gui" value="$(arg gui)"/>


  <!-- Start 3 nodes: joint_state_publisher_gui, robot_state_publisher and rviz -->
  <node name="joint_state_publisher_gui" pkg="joint_state_publisher_gui" type="joint_state_publisher_gui" />

  <node name="robot_state_publisher" pkg="robot_state_publisher"
   type="robot_state_publisher" />
  <!-- state_publisher changed to robot_state_publisher -->

  <node name="rviz" pkg="rviz" type="rviz" args="-d $(find ros_robotics)/urdf.rviz" required="true" />
  <!-- (required = "true") if rviz dies, entire roslaunch will be killed -->
</launch>
```

Noetic

As of early 2020, the GUI functionality has been split out of the main `joint_state_publisher` package into its own package called `joint_state_publisher_gui`.

The old `use_gui` parameter to `joint_state_publisher` is still honored, but launches `joint_state_publisher_gui` if installed and available.

For packages transitioning before this change, `joint_state_publisher_gui` should be added as an `<exec_depend>` to package.xml and launch files should be updated to launch `joint_state_publisher_gui` instead of using `joint_state_publisher` with `use_gui` parameter.

harman@harman-VirtualBox:~/catkin_ws/src/ros_robotics$ **cd launch;ls**

ddrobot_gazebo.launch **ddrobot_rviz.launch** ddrobot_rviz_launch_bak

harman@harman-VirtualBox:~/catkin_ws/src/ros_robotics/urdf$ **ls -la**

```
total 36
drwxrwxr-x 2 harman harman 4096 Sep 24 18:47 .
drwxrwxr-x 3 harman harman 4096 Sep 24 18:44 ..
-rw-rw-r-- 1 harman harman 1083 Feb 21  2018 dd_robot2.urdf
-rw-rw-r-- 1 harman harman 1265 Feb 21  2018 dd_robot3.urdf
-rw-rw-r-- 1 harman harman 1466 Feb 21  2018 dd_robot4.urdf
-rw-rw-r-- 1 harman harman 2273 Feb 21  2018 dd_robot5.urdf
-rw-rw-r-- 1 harman harman 2955 Feb 21  2018 dd_robot6.urdf
-rw-rw-r-- 1 harman harman 2993 Feb 21  2018 dd_robot.gazebo
-rw-rw-r-- 1 harman harman  254 Feb 21  2018 dd_robot.urdf
```

dd_robot Page 45-47 The Red Box – For Noetic

Alias foxy or noetic

harman@harman-VirtualBox:~$ **noetic**

ROS_DISTRO was set to 'foxy' before. Please make sure that the environment does not mix paths from different distributions.

harman@harman-VirtualBox:~$ **roslaunch ros_robotics ddrobot_rviz.launch**

model:=dd_robot.urdf gui:=True

RLException: [ddrobot_rviz.launch] is neither a launch file in package [ros_robotics] nor is [ros_robotics] a launch file name

The traceback for the exception was written to the log file

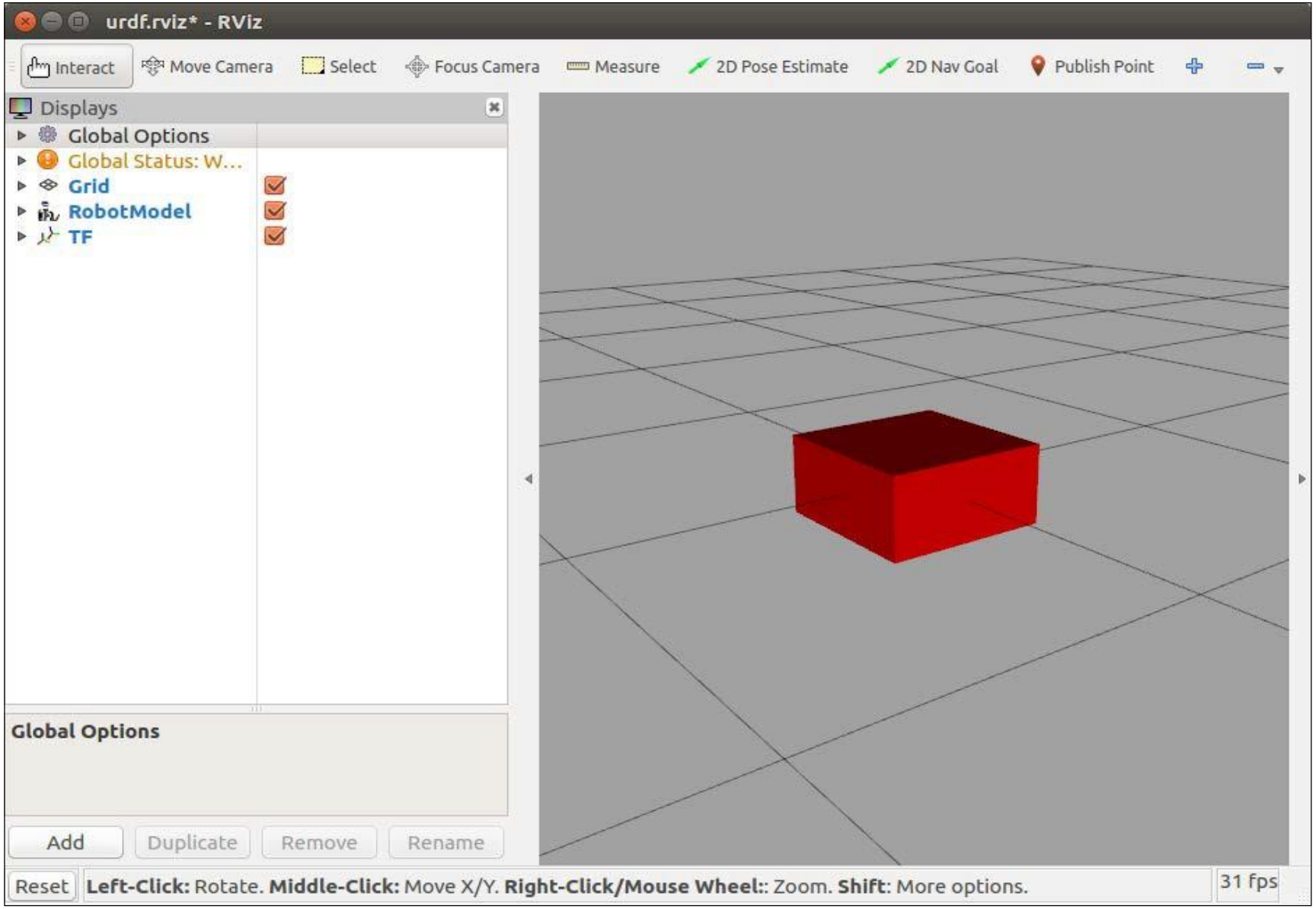
harman@harman-VirtualBox:~/catkin_ws/src/ros_robotics/urdf$ **cat dd_robot.urdf**

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

  <!-- Base Link -->
  <link name="base_link">
    <visual>
      <origin xyz="0 0 0" rpy="0 0 0" />
      <geometry>
         <box size="0.5 0.5 0.25"/>
      </geometry>
    </visual>
  </link>

</robot>
```

SUCCESS


urdf.rviz* - RViz
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Displays
Global Options
Global Status: W...
Grid
RobotModel
TF
Global Options
Add
Duplicate
Remove
Rename
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel:: Zoom. Shift: More options.
31 fps

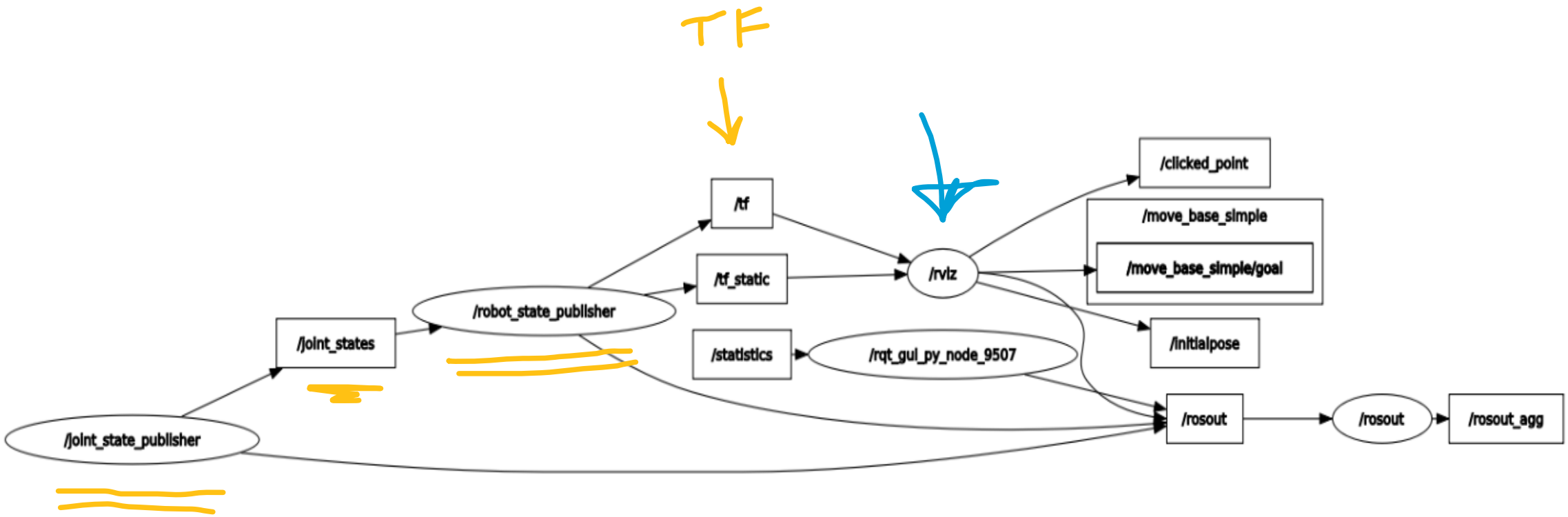
rqt_graph__RosGraph - rqt

Node Graph

Nodes/Topics (all)

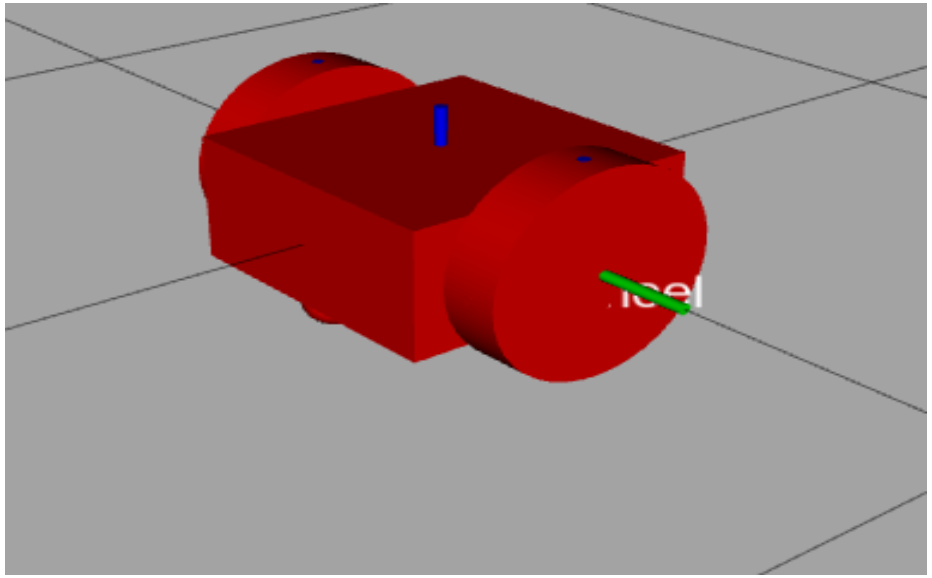
Group: 3 Namespaces Actions tf Images Highlight Fit

Hide: Dead sinks Leaf topics Debug tf Unreachable Params



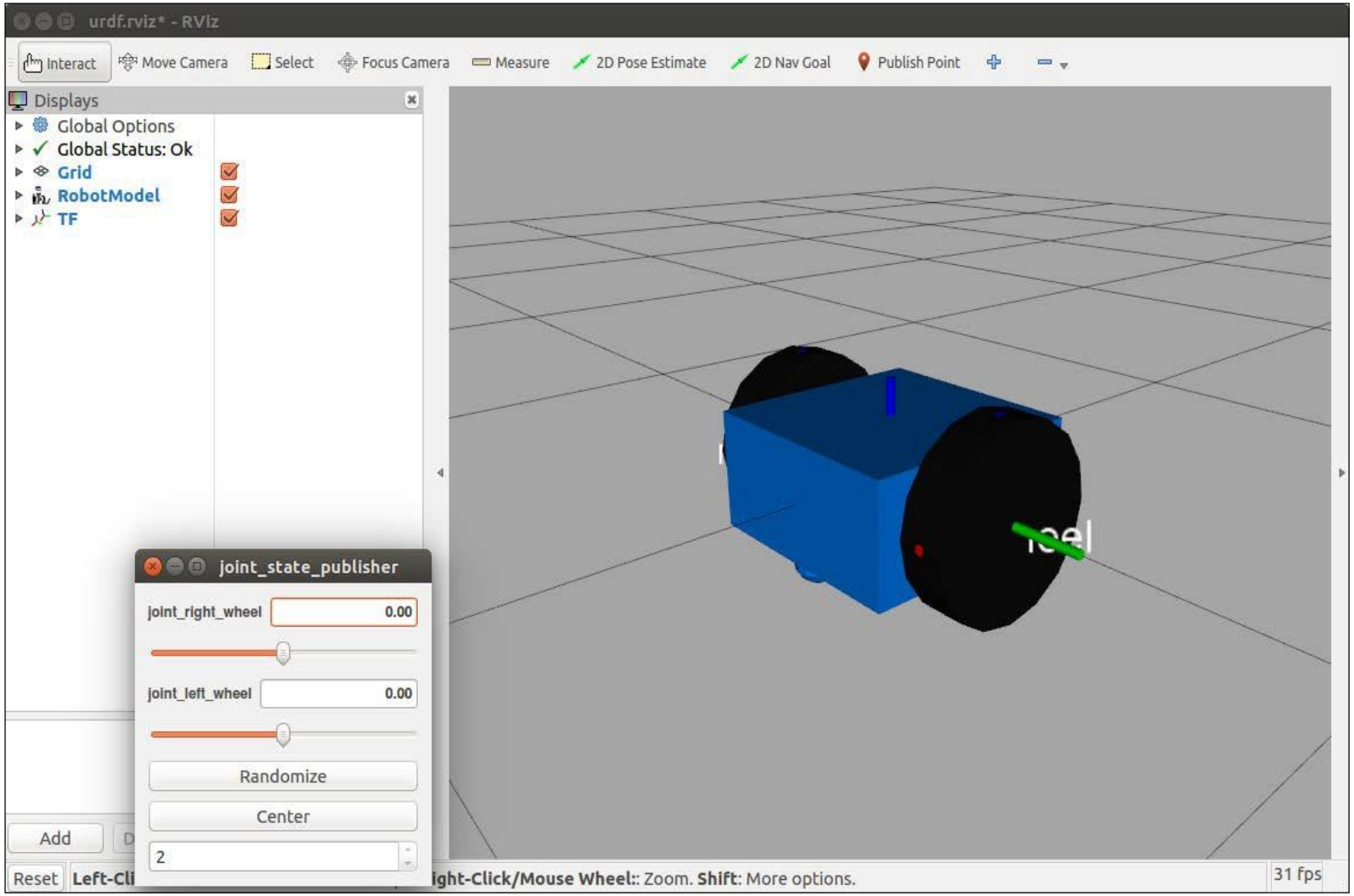
dd_robot3 Caster Pg 51-52

harman@harman-VirtualBox:~$ **roslaunch ros_robotics ddrobot_rviz.launch model:=dd_robot3.urdf gui:=True**



dd_robot4 Pg 52-54 Add Color

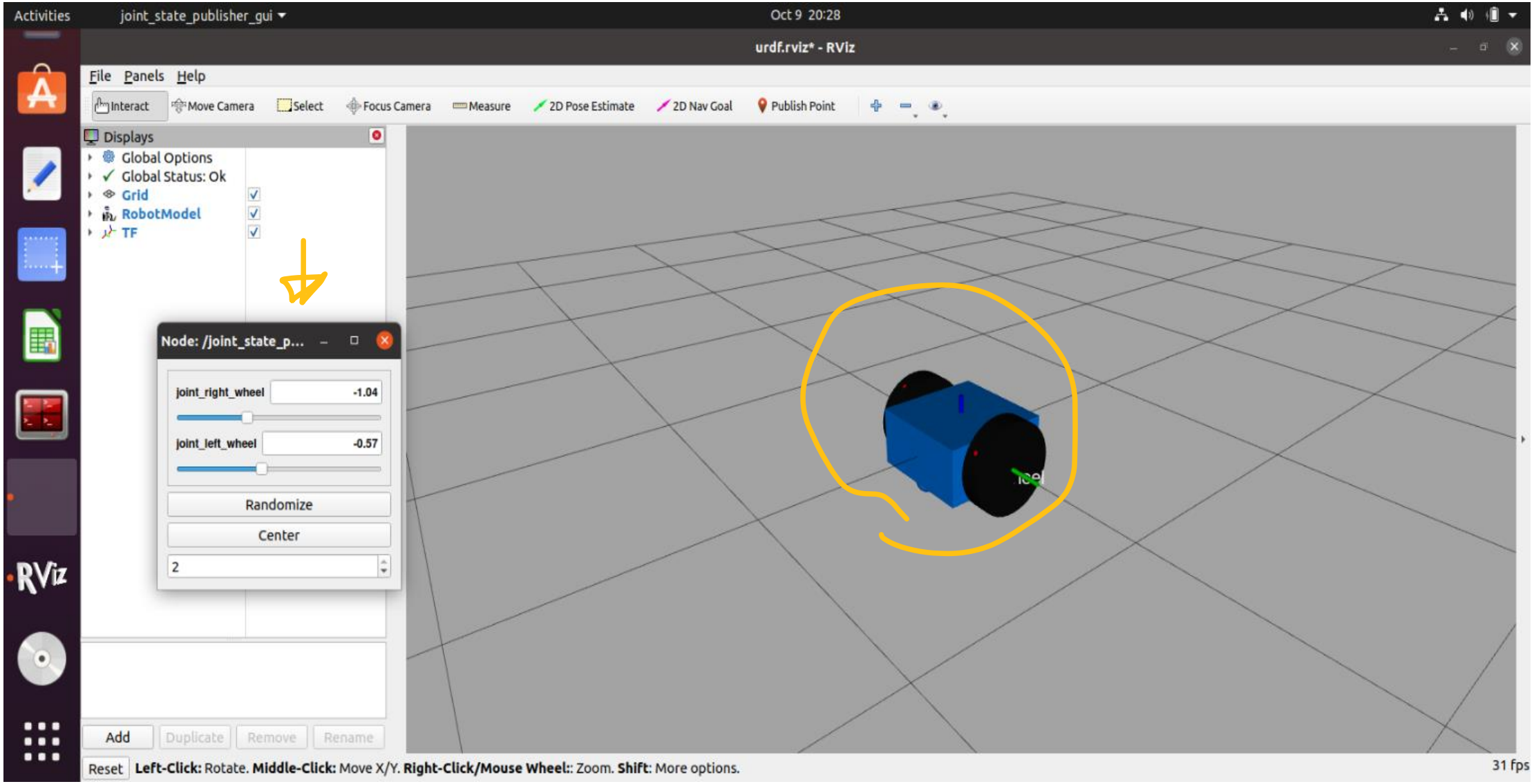
harman@harman-VirtualBox:~$ **roslaunch ros_robotics ddrobot_rviz.launch model:=dd_robot4.urdf gui:=True**



dd_robot4.urdf in rviz

dd_robot5_urdf Pg 55 10_6_2022 Collisions & Moving Wheels

harman@harman-VirtualBox:~$ roslaunch ros_robotics ddrobot_rviz.launch model:=dd_robot5.urdf gui:=True



MISTAKE 1 No Source

Alias foxy or noetic
harman@harman-VirtualBox:~$ noetic
ROS_DISTRO was set to 'foxy' before. Please make sure that the environment does not mix paths from different distributions.
harman@harman-VirtualBox:~$ roslaunch ros_robotics ddrobot_rviz.launch model:=dd_robot6.urdf
RLException: [ddrobot_rviz.launch] is neither a **launch file in package [ros_robotics**] nor is [ros_robotics] a launch file name
The traceback for the exception was written to the log file

MISTAKE 2 DID NOT ADD gui:=True

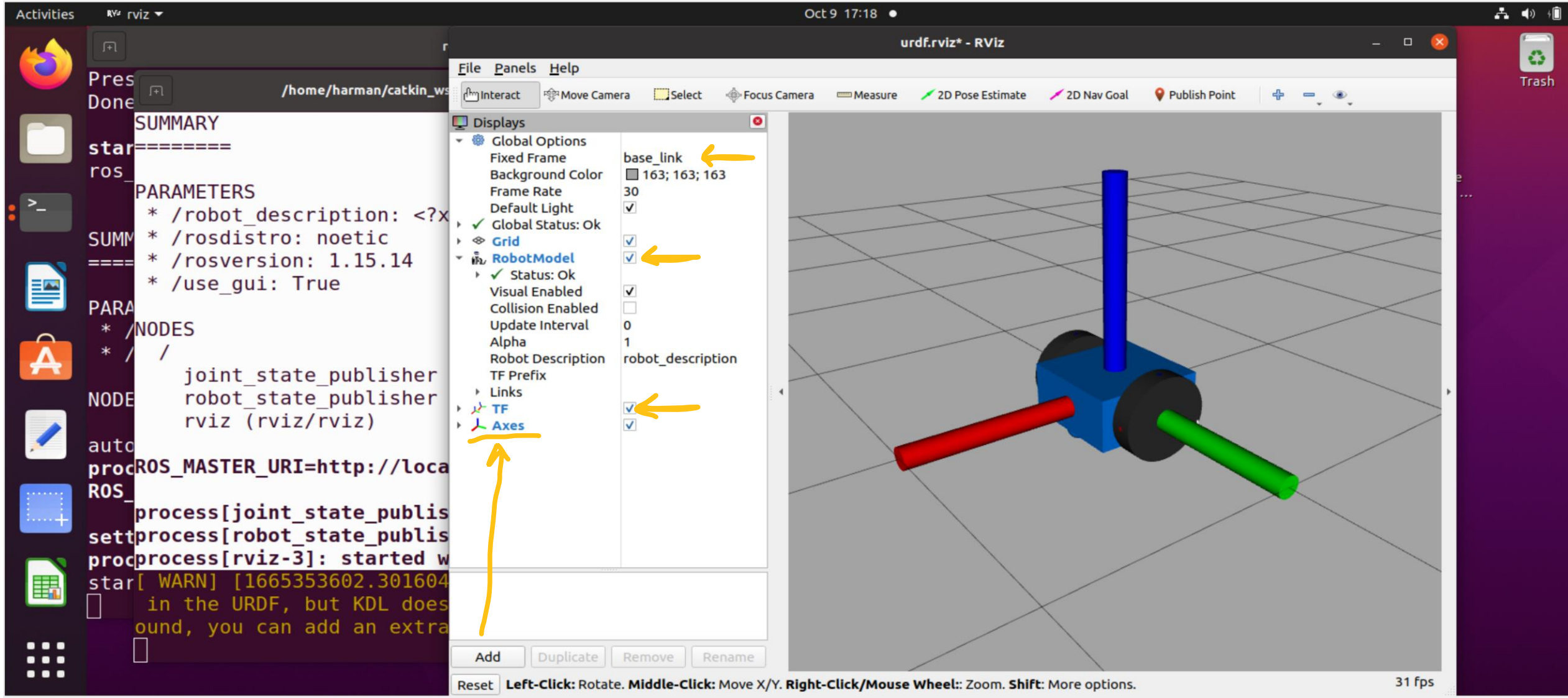
harman@harman-VirtualBox:~$ **source ~/catkin_ws/devel/setup.bash**
harman@harman-VirtualBox:~$ **roslaunch ros_robotics ddrobot_rviz.launch model:=dd_robot6.urdf**
... logging to /home/harman/.ros/log/d927fe1e-481e-11ed-af99-ddab8464af72/roslaunch-harman-VirtualBox-5086.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

RLException: [/home/harman/catkin_ws/src/ros_robotics/launch/ddrobot_rviz.launch] requires the 'gui' arg to be set
The traceback for the exception was written to the log file

harman@harman-VirtualBox:~$ **roslaunch ros_robotics ddrobot_rviz.launch model:=dd_robot6.urdf gui:=True**

Ubuntu 20.04 6_21 (Snapshot 2) [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help



Type here to search

81°F 5:18 PM 10/9/2022

harman@harman-VirtualBox:~$ **roslaunch ros_robotics ddrobot_rviz.launch model:=dd_robot6.urdf gui:=True**
... logging to /home/harman/.ros/log/d927fe1e-481e-11ed-af99-ddab8464af72/roslaunch-harman-VirtualBox-5092.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://harman-VirtualBox:39271/

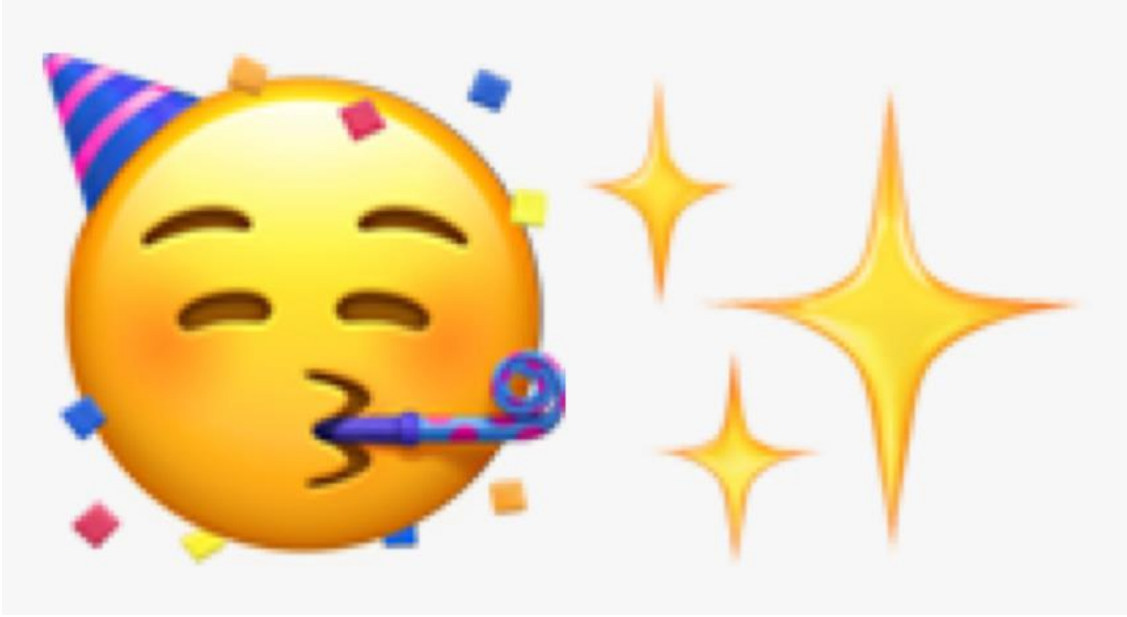
SUMMARY
========

PARAMETERS
 * /robot_description: <?xml version='1....
 * /rosdistro: noetic
 * /rosversion: 1.15.14
 * /use_gui: True

NODES
  /
    joint_state_publisher (joint_state_publisher/joint_state_publisher)
    robot_state_publisher (robot_state_publisher/robot_state_publisher)
    rviz (rviz/rviz)

ROS_MASTER_URI=http://localhost:11311

process[joint_state_publisher-1]: started with pid [5106]
process[robot_state_publisher-2]: started with pid [5107]



NOETIC SOURCED, WORKSPACE SOURCED, LAUNCH UPDATED FOR NOETIC, gui:=True

```
harman@harman-VirtualBox:~$ rostopic list
/clicked_point
/initialpose
/joint_states
/move_base_simple/goal
/rosout
/rosout_agg
/tf
/tf_static
```

```
harman@harman-VirtualBox:~$ rostopic type /joint_states
sensor_msgs/JointState
harman@harman-VirtualBox:~$ rosmsg show
sensor_msgs/JointState
std_msgs/Header header
  uint32 seq
  time stamp
  string frame_id
string[] name
float64[] position
float64[] velocity
float64[] effort
```

```
harman@harman-VirtualBox:~$ rostopic echo /joint_states -n1
header:
  seq: 8800
  stamp:
    secs: 1665354482
    nsecs: 922858476
  frame_id: ''
name:
  - joint_right_wheel
  - joint_left_wheel
position: [0.0, 0.0]
velocity: []
effort: []
```

```
harman@harman-VirtualBox:~$ rosnode list
/joint_state_publisher
/robot_state_publisher
/rosout
/rviz
```

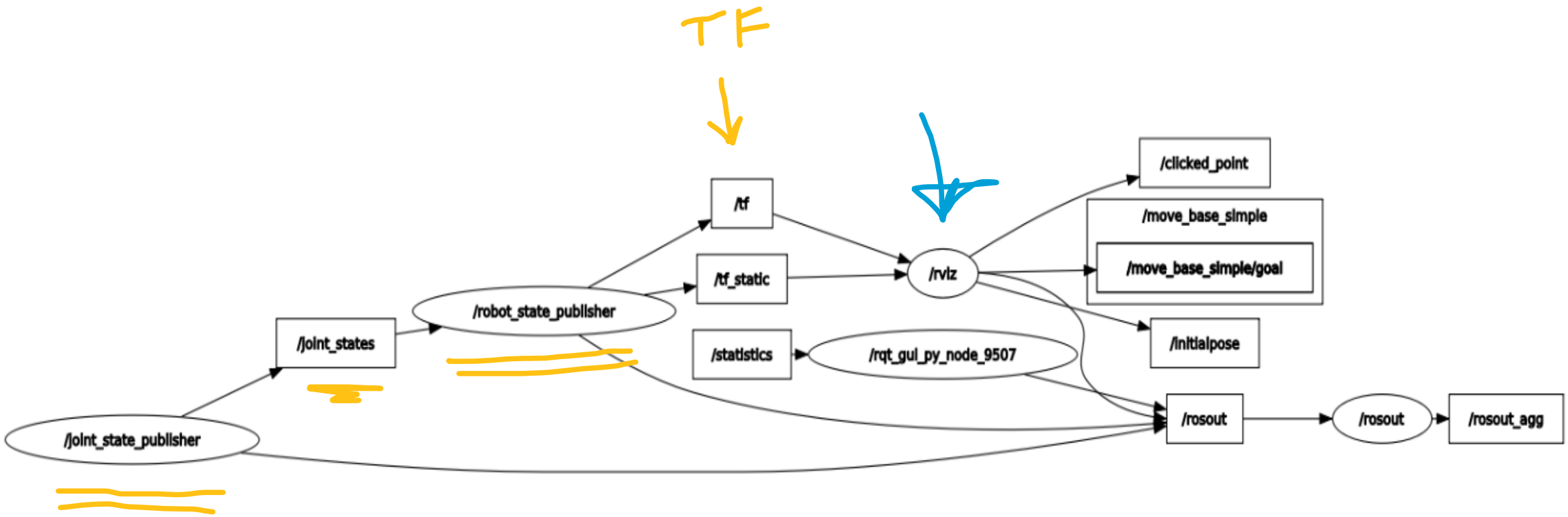
rqt_graph__RosGraph - rqt

Node Graph

Nodes/Topics (all)

Group: 3 Namespaces Actions tf Images Highlight Fit

Hide: Dead sinks Leaf topics Debug tf Unreachable Params



CHECK URDF PAGE 59

harman@harman-VirtualBox:~$ **locate liburdfdom-tools**
/usr/share/doc/liburdfdom-tools
/usr/share/doc/liburdfdom-tools/changelog.Debian.gz
/usr/share/doc/liburdfdom-tools/copyright
/var/lib/dpkg/info/liburdfdom-tools.list
/var/lib/dpkg/info/liburdfdom-tools.md5sums

```
harman@harman-VirtualBox:~$ roscd ros_robotics
harman@harman-VirtualBox:~/catkin_ws/src/ros_robotics$ ls
 CMakeLists.txt  launch  package.xml  urdf  urdf.rviz  worlds
harman@harman-VirtualBox:~/catkin_ws/src/ros_robotics$ cd urdf;ls
 dd_robot2.urdf  dd_robot4.urdf  dd_robot6.urdf   dd_robot.gv   dd_robot.urdf
 dd_robot3.urdf  dd_robot5.urdf  dd_robot.gazebo  dd_robot.pdf
```

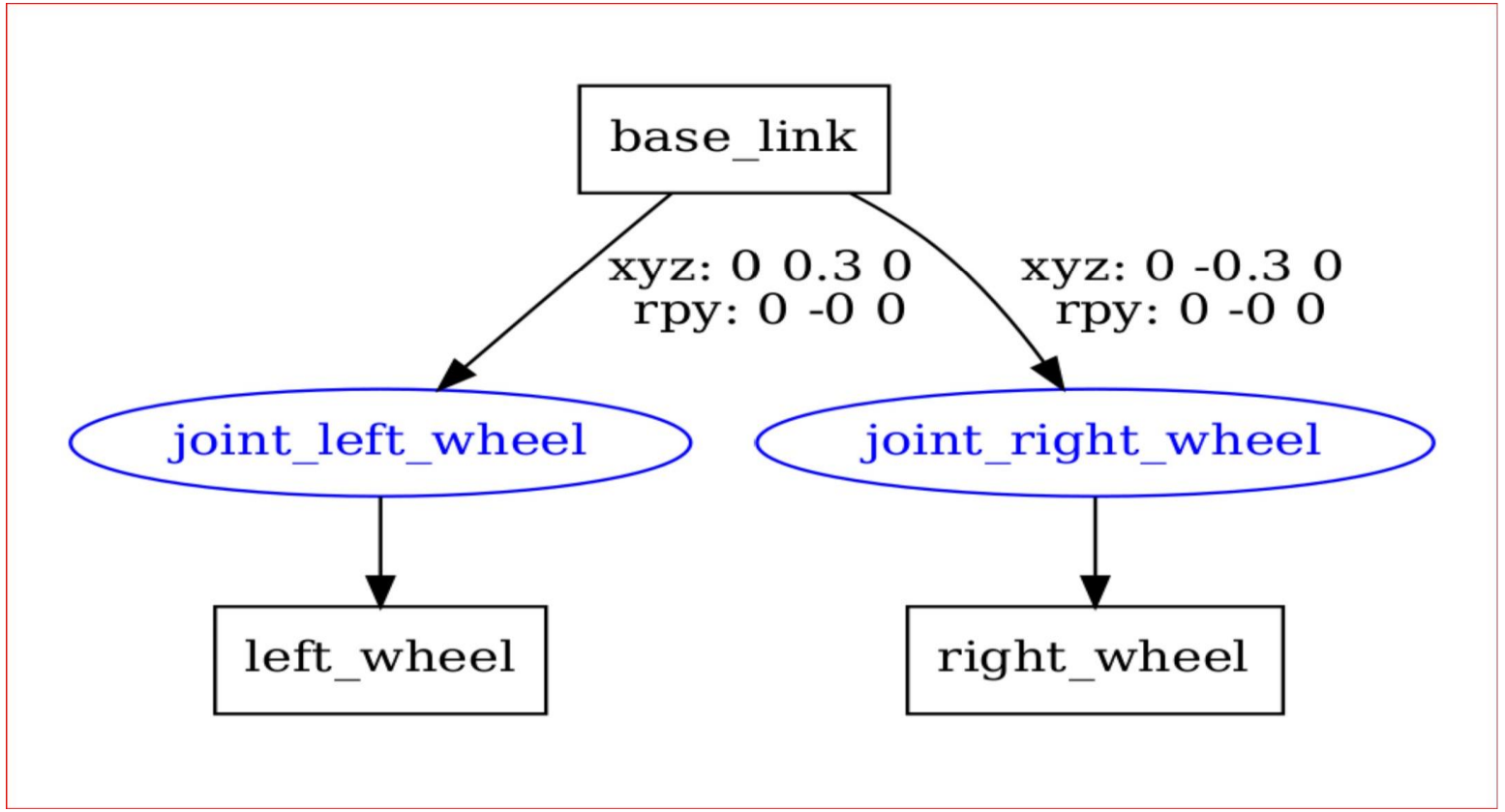
(Be sure to run this command from the directory containing the `dd_robot6.urdf` file.)

```
harman@harman-VirtualBox:~/catkin_ws/src/ros_robotics/urdf$ check_urdf dd_robot6.urdf
 robot name is: dd_robot
---------- Successfully Parsed XML ---------------
 Root Link: base_link has 2 child(ren)
   child(1):  left_wheel
   child(2):  right_wheel
```

X

```
harman@harman-VirtualBox:~$ check_urdf dd_robot6.urdf
Error:   Error document empty.
        at line 71 in /tmp/binarydeb/ros-foxy-urdfdom-
2.3.3/urdf_parser/src/model.cpp
ERROR: Model Parsing the xml failed
```

harman@harman-VirtualBox:~/catkin_ws/src/ros_robotics/urdf$ urdf_to_graphiz dd_robot6.urdf
Created file dd_robot.gv
Created file dd_robot.pdf



LET’S TRY IT