Simulation and Modelling

Lab 8: URDF, Gazebo and RVIZ

Meher Shrishti Nigam

20BRS1193

Instructions:

Design a User defined robot of your choice (or you can use the URDF file) and enable the LIDAR Scanner so that any obstacle placed on the path of the light scan will cut the light rays. Visualize the robot in Gazebo workspace, also show the demonstration in RViz.

(NB: Gain knowledge on wiring urdf file and .launch file for enabling any userdefined robot to get launched in the gazebo platform.)

Take the screenshot of the robot in Gazebo, the code (URDF) and rviz screenshot with all the features of rviz need to be uploaded.

explorer_bot.urdf

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

<robot name="custom_bot">

    <link name="base_link">

        <visual>

            <geometry>

                <box size="0.6 0.3 0.1"/>

            </geometry>

            <material name="red">

                <color rgba="1 0.0 0.0 1"/>

            </material>

        </visual>

        <collision>

            <geometry>

                <box size="0.6 0.3 0.1"/>

            </geometry>

        </collision>

        <inertial>

            <mass value="1.0"/>

            <inertia ixx="0.015" ixy="0" ixz="0" iyy="0.0375" iyz="0.0" izz="0.0375"/>

        </inertial>

    </link>

    <link name="front_caster_of_wheel">

        <visual>

            <geometry>

                <box size="0.1 0.1 0.1"/>

            </geometry>
```

```
        <material name="green">
            <color rgba="0.0 0.1 0.0 1"/>
        </material>
    </visual>
    <collision>
        <geometry>
            <box size="0.1 0.1 0.1"/>
        </geometry>
    </collision>
    <inertial>
        <mass value="0.1"/>
        <inertia ixx="0.00083" ixy="0" ixz="0" iyy="0.00083" iyz="0.0" izz="0.000167"/>
    </inertial>
</link>
<joint name="front_caster_of_wheel_joint" type="continuous">
   <axis xyz="0.0 0.0 1"/>
   <parent link="base_link"/>
   <child link="front_caster_of_wheel"/>
   <origin xyz="0.3 0.0 0.0" rpy="0.0 0.0 0.0"/>
</joint>
<link name="front_wheel">
    <visual>
        <geometry>
            <cylinder radius="0.035" length="0.05"/>
        </geometry>
        <material name="black">
        </material>
    </visual>
    <collision>
        <geometry>
            <cylinder radius="0.035" length="0.05"/>
        </geometry>
    </collision>
    <inertial>
        <mass value="0.1"/>
        <inertia ixx="5.1458e-5" ixy="0" ixz="0" iyy="5.1458e-5" iyz="0.0" izz="6.125e-5"/>
    </inertial>
</link>
<joint name="front_wheel_joint" type="continuous">
    <axis xyz="0.0 0.0 1"/>
    <parent link="front_caster_of_wheel"/>
```

```
        <child link="front_wheel"/>
        <origin xyz="0.05 0.0 -0.05" rpy="-1.5708 0.0 0.0"/>
    </joint>
<link name="right_wheel">
        <visual>
            <geometry>
                <cylinder radius="0.035" length="0.05"/>
            </geometry>
            <material name="black">
                <color rgba="0.0 0.0 0.0 1"/>
            </material>
        </visual>
        <collision>
            <geometry>
                <cylinder radius="0.035" length="0.05"/>
            </geometry>
        </collision>
        <inertial>
            <mass value="0.1"/>
            <inertia ixx="5.1458e-5" ixy="0" ixz="0" iyy="5.1458e-5" iyz="0.0" izz="6.125e-5"/>
</inertial>
    </link>
    <joint name="right_wheel_joint" type="continuous">
        <axis xyz="0.0 0.0 1"/>
        <parent link="base_link"/>
        <child link="right_wheel"/>
        <origin xyz="-0.2825 -0.125 -0.05" rpy="-1.5708 0.0 0.0"/>
    </joint>
    <link name="left_wheel">
        <visual>
            <geometry>
                <cylinder radius="0.035" length="0.05"/>
            </geometry>
            <material name="black">
                <color rgba="0.0 0.0 0.0 1"/>
            </material>
        </visual>
        <collision>
            <geometry>
                <cylinder radius="0.035" length="0.05"/>
            </geometry>
        </collision>
```

```
        <inertial>
            <mass value="0.1"/>
            <inertia ixx="5.1458e-5" ixy="0" ixz="0" iyy="5.1458e-5" iyz="0.0" izz="6.125e-5"/>
</inertial>
    </link>
    <joint name="left_wheel_joint" type="continuous">
        <axis xyz="0.0 0.0 1"/>
        <parent link="base_link"/>
        <child link="left_wheel"/>
        <origin xyz="-0.2825 0.125 -0.05" rpy="-1.5708 0.0 0.0"/>
    </joint>
    <link name="laser_scanner">
        <visual>
            <geometry>
                <box size="0.1 0.1 0.1"/>
            </geometry>
        </visual>
        <collision>
            <geometry>
                <box size="0.1 0.1 0.1"/>
            </geometry>
        </collision>
        <inertial>
            <mass value="1e-5"/>
            <inertia ixx="1e-6" ixy="0" ixz="0.0" iyy="1e-6" iyz="0.0" izz="1e-6"/>
        </inertial>
    </link>
    <joint name="laser_scanner_joint" type="fixed">
        <axis xyz="0.0 1 0.0"/>
        <parent link="base_link"/>
        <child link="laser_scanner"/>
        <origin xyz="0.0 0.0 0.08" rpy="0.0 0.0 0.0"/>
    </joint>
    <gazebo reference="laser_scanner">
        <sensor type="ray" name="laser">
            <pose>0 0 0 0 0 0</pose>
            <visualize>true</visualize>
            <update_rate>40</update_rate>
            <ray>
                <scan>
                    <horizontal>
                        <samples>720</samples>
```

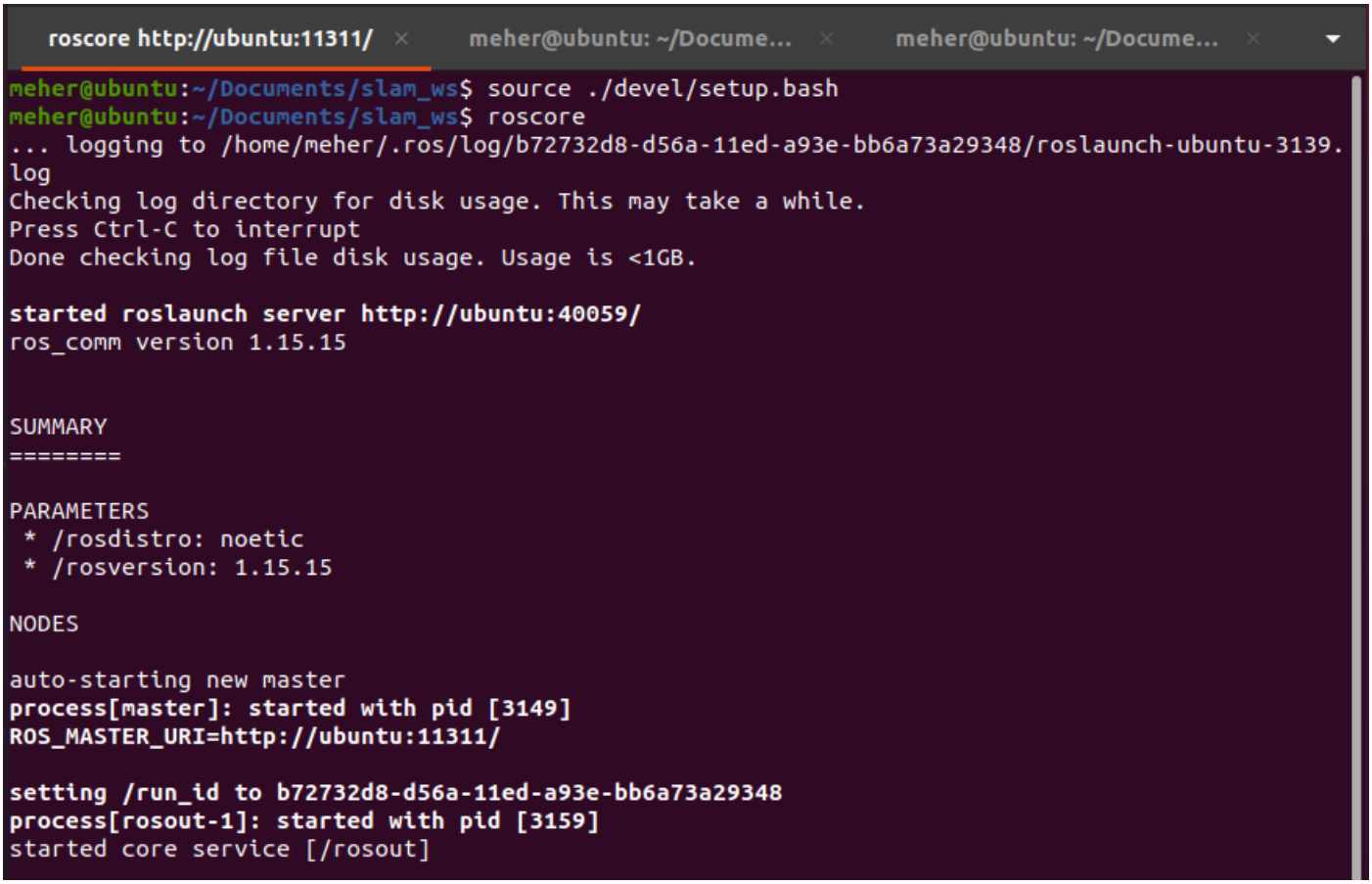
```
                    <resolution>1</resolution>
                    <min_angle>-1.578</min_angle>
                    <max_angle>1.578</max_angle>
                </horizontal>
            </scan>
            <range>
                <min>0.1</min>
                <max>10</max>
                <resolution>0.1</resolution>
            </range>
        </ray>
        <plugin name="Lidar" filename="libgazebo_ros_laser.so">
            <topicName>/scan</topicName>
            <frameName>laser_scanner</frameName>
        </plugin>
    </sensor>
</gazebo>
<gazebo>
    <plugin name="explorer_bot_controller"   filename="libgazebo_ros_diff_drive.so">
        <leftJoint>left_wheel_joint</leftJoint>
        <rightJoint>right_wheel_joint</rightJoint>
        <legacyMode>false</legacyMode>
        <robotBaseFrame>base_link</robotBaseFrame>
        <wheelSeparation>0.25</wheelSeparation>
        <wheelDiameter>0.07</wheelDiameter>
        <publishWheelJointState>true</publishWheelJointState>
    </plugin>
</gazebo>
   <gazebo>
    <plugin name="joint_state_publisher"
            filename="libgazebo_ros_joint_state_publisher.so">
        <jointName>front_caster_of_wheel_joint, front_wheel_joint</jointName>
    </plugin>
</gazebo>
<gazebo reference="base_link">
    <material>Gazebo/Orange</material>
</gazebo>
<gazebo reference="front_caster_of_wheel">
    <material>Gazebo/Red</material>
  </gazebo>
  <gazebo reference="front_wheel">
```

```
    <material>Gazebo/Black</material>
  </gazebo>
  <gazebo reference="left_wheel">
    <material>Gazebo/Black</material>
  </gazebo>
  <gazebo reference="right_wheel">
    <material>Gazebo/Black</material>
  </gazebo>
</robot>
```

gazebo_explorer_bot.launch

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

<launch>

    <param name="robot_description" textfile="$(find
explorer_bot)/urdf/explorer_bot.urdf" />


    <include file="$(find gazebo_ros)/launch/empty_world.launch"/>


    <node name="spawn_urdf" pkg="gazebo_ros" type="spawn_model"  args="-param
robot_description -urdf -model explorer_bot" />


    <node name="Rsp" pkg="robot_state_publisher" type="robot_state_publisher"
output="screen"/>

</launch>
```

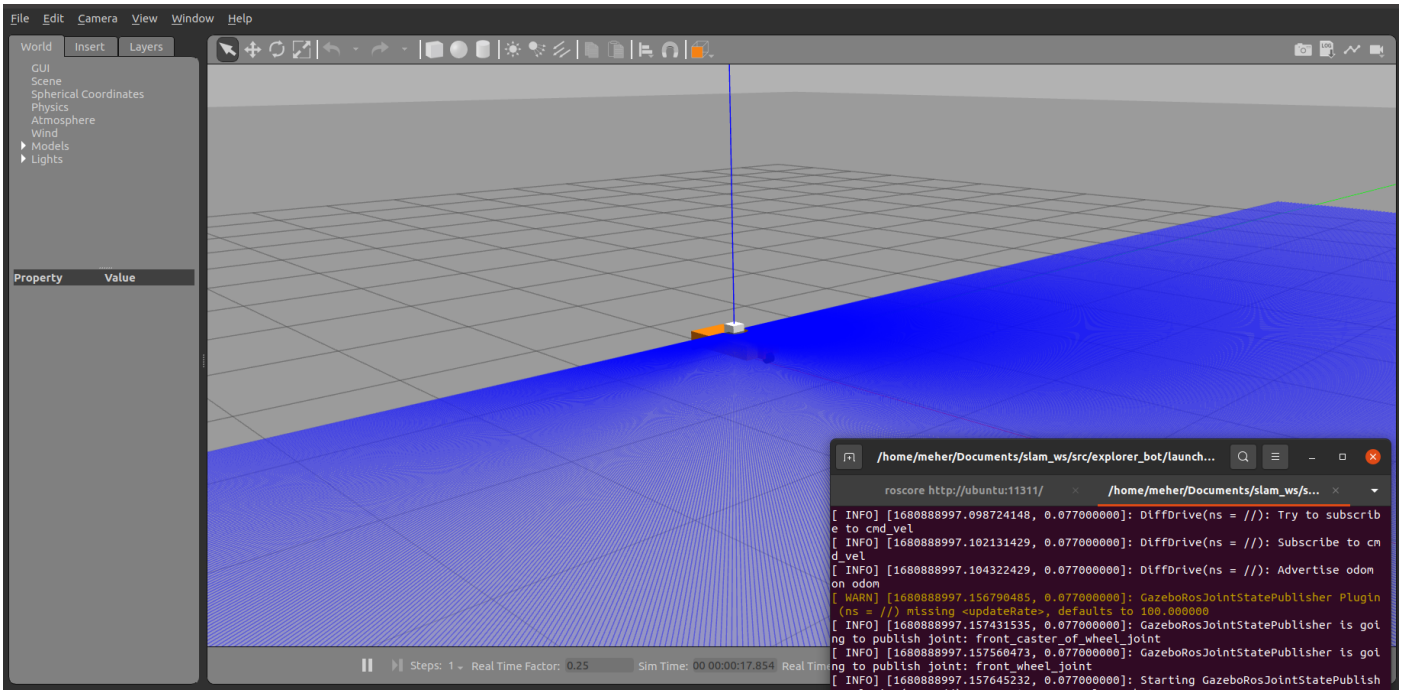
Terminals:


roscore http://ubuntu:11311/
meher@ubuntu: ~/Docume...
meher@ubuntu: ~/Docume...
meher@ubuntu:~/Documents/slam_ws$ source ./devel/setup.bash
meher@ubuntu:~/Documents/slam_ws$ roscore
... logging to /home/meher/.ros/log/b72732d8-d56a-11ed-a93e-bb6a73a29348/roslaunch-ubuntu-3139.
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://ubuntu:40059/
ros_comm version 1.15.15
SUMMARY
========
PARAMETERS
* /rosdistro: noetic
* /rosversion: 1.15.15
NODES
auto-starting new master
process[master]: started with pid [3149]
ROS_MASTER_URI=http://ubuntu:11311/
setting /run_id to b72732d8-d56a-11ed-a93e-bb6a73a29348
process[rosout-1]: started with pid [3159]
started core service [/rosout]

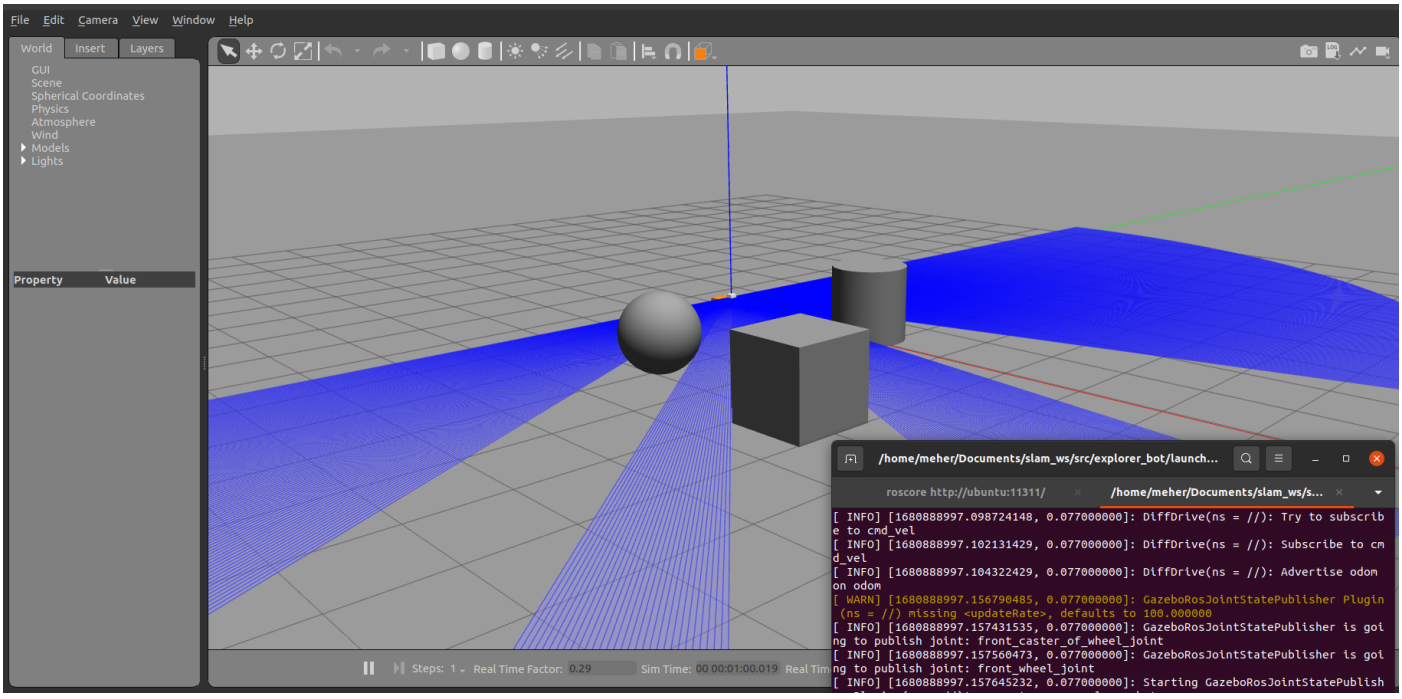
```
roscore http://ubuntu:11311/ × meher@ubuntu: ~/Docume... × meher@ubuntu: ~/Docume... ×
meher@ubuntu:~/Documents/slam_ws$ source ./devel/setup.bash
meher@ubuntu:~/Documents/slam_ws$ roslaunch explorer_bot gazebo_explorer_bot.launch
... logging to /home/meher/.ros/log/b72732d8-d56a-11ed-a93e-bb6a73a29348/roslaunch-ubuntu-3191.
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://ubuntu:33731/

SUMMARY
========

PARAMETERS
 * /gazebo/enable_ros_network: True
 * /robot_description: <?xml version="1....
 * /rosdistro: noetic
 * /rosversion: 1.15.15
 * /use_sim_time: True

NODES
  /
    Rsp (robot_state_publisher/robot_state_publisher)
    gazebo (gazebo_ros/gzserver)
    gazebo_gui (gazebo_ros/gzclient)
    spawn_urdf (gazebo_ros/spawn_model)

ROS_MASTER_URI=http://localhost:11311

process[gazebo-1]: started with pid [3205]
process[gazebo_gui-2]: started with pid [3209]
process[spawn_urdf-3]: started with pid [3215]
process[Rsp-4]: started with pid [3216]
[ WARN] [1680888993.342320983]: link 'front_wheel' material 'black' undefined.
[ WARN] [1680888993.342951281]: link 'front_wheel' material 'black' undefined.
[ WARN] [1680888993.344152440]: The root link base_link has an inertia specified in the URDF, b
ut KDL does not support a root link with an inertia.  As a workaround, you can add an extra dum
my link to your URDF.
[ INFO] [1680888995.068714086]: Finished loading Gazebo ROS API Plugin.
[ INFO] [1680888995.075090729]: waitForService: Service [/gazebo/set_physics_properties] has no
t been advertised, waiting...
[ INFO] [1680888995.271873329]: Finished loading Gazebo ROS API Plugin.
[ INFO] [1680888995.273342747]: waitForService: Service [/gazebo_gui/set_physics_properties] ha
s not been advertised, waiting...
[ INFO] [1680888996.534476639]: waitForService: Service [/gazebo/set_physics_properties] is now
 available.
[ INFO] [1680888996.579983168, 0.018000000]: Physics dynamic reconfigure ready.
```

```
roscore http://ubuntu:11311/ ×   meher@ubuntu: ~/Docume... ×   meher@ubuntu: ~/Docume... ×
meher@ubuntu:~/Documents/slam_ws$ source ./devel/setup.bash
meher@ubuntu:~/Documents/slam_ws$ rosrun rviz rviz
[ INFO] [1680889640.758181301]: rviz version 1.14.19
[ INFO] [1680889640.758263969]: compiled against Qt version 5.12.8
[ INFO] [1680889640.758374846]: compiled against OGRE version 1.9.0 (Ghadamon)
[ INFO] [1680889640.953326294]: Forcing OpenGl version 0.
[ INFO] [1680889644.505106178, 285.819000000]: Stereo is NOT SUPPORTED
[ INFO] [1680889644.508361396, 285.821000000]: OpenGL device: SVGA3D; build: RELEASE;  LLVM;
[ INFO] [1680889644.518198274, 285.821000000]: OpenGl version: 4.1 (GLSL 4.1) limited to GLSL 1
.4 on Mesa system.
[ WARN] [1680889656.421737541, 289.132000000]: TF_REPEATED_DATA ignoring data with redundant ti
mestamp for frame base_link at time 289.115000 according to authority unknown_publisher
[ WARN] [1680889667.384384903, 292.566000000]: link 'front_wheel' material 'black' undefined.
[ WARN] [1680889667.384563378, 292.566000000]: link 'front_wheel' material 'black' undefined.
[ WARN] [1680889674.482983998, 294.678000000]: TF_REPEATED_DATA ignoring data with redundant ti
mestamp for frame base_link at time 294.678000 according to authority unknown_publisher
[ WARN] [1680889681.954841350, 296.575000000]: TF_REPEATED_DATA ignoring data with redundant ti
mestamp for frame base_link at time 296.575000 according to authority unknown_publisher
[ WARN] [1680889683.263575087, 297.036000000]: TF_REPEATED_DATA ignoring data with redundant ti
mestamp for frame base_link at time 297.016000 according to authority unknown_publisher
[ WARN] [1680889683.264805932, 297.036000000]: TF_REPEATED_DATA ignoring data with redundant ti
mestamp for frame base_link at time 297.036000 according to authority unknown_publisher
[ WARN] [1680889687.789269986, 297.830000000]: TF_REPEATED_DATA ignoring data with redundant ti
mestamp for frame base_link at time 297.808000 according to authority unknown_publisher
[ WARN] [1680889689.075677006, 298.020000000]: TF_REPEATED_DATA ignoring data with redundant ti
mestamp for frame base_link at time 298.005000 according to authority unknown_publisher
[ WARN] [1680889689.734131668, 298.133000000]: TF_REPEATED_DATA ignoring data with redundant ti
mestamp for frame base_link at time 298.023000 according to authority unknown_publisher
[ WARN] [1680889689.734518252, 298.133000000]: TF_REPEATED_DATA ignoring data with redundant ti
mestamp for frame base_link at time 298.023000 according to authority unknown_publisher
[ WARN] [1680889689.737119644, 298.133000000]: TF_REPEATED_DATA ignoring data with redundant ti
```

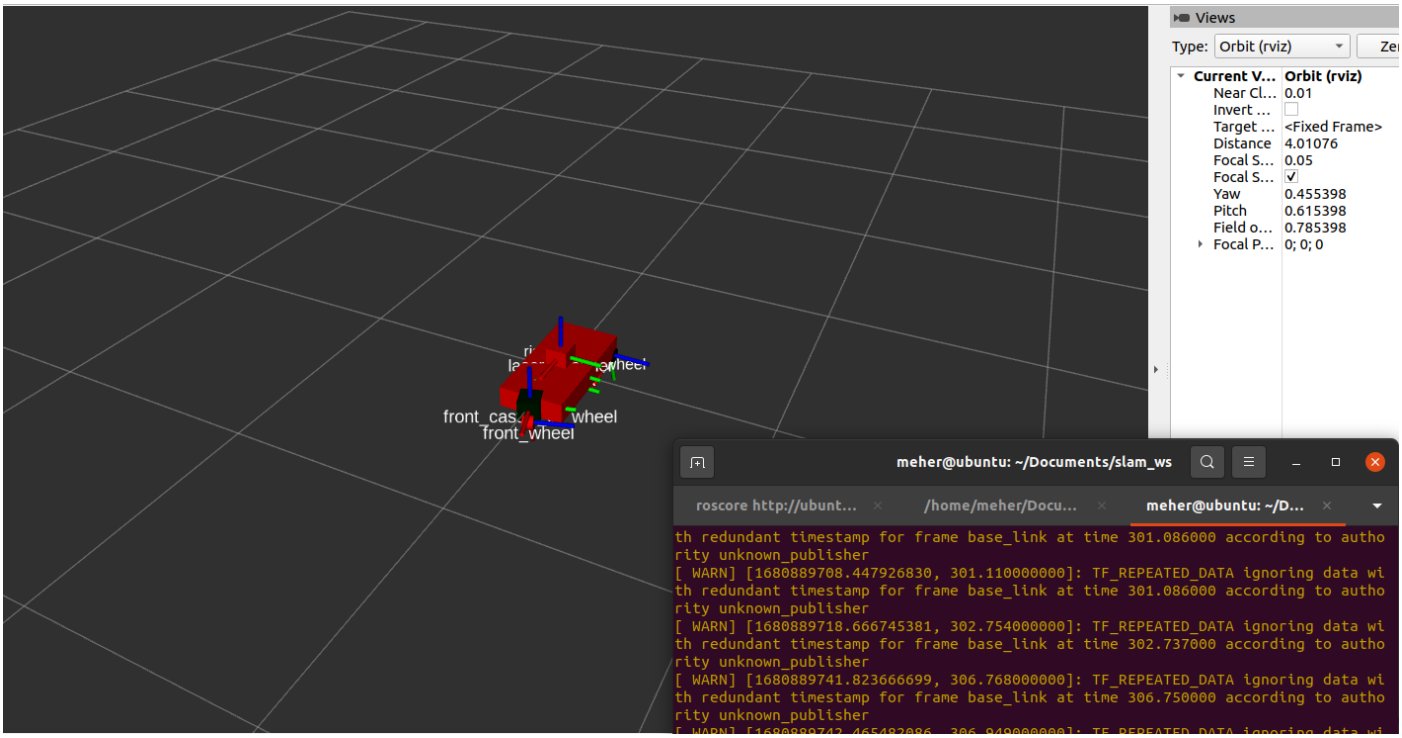
Gazebo (Without Obstacles):



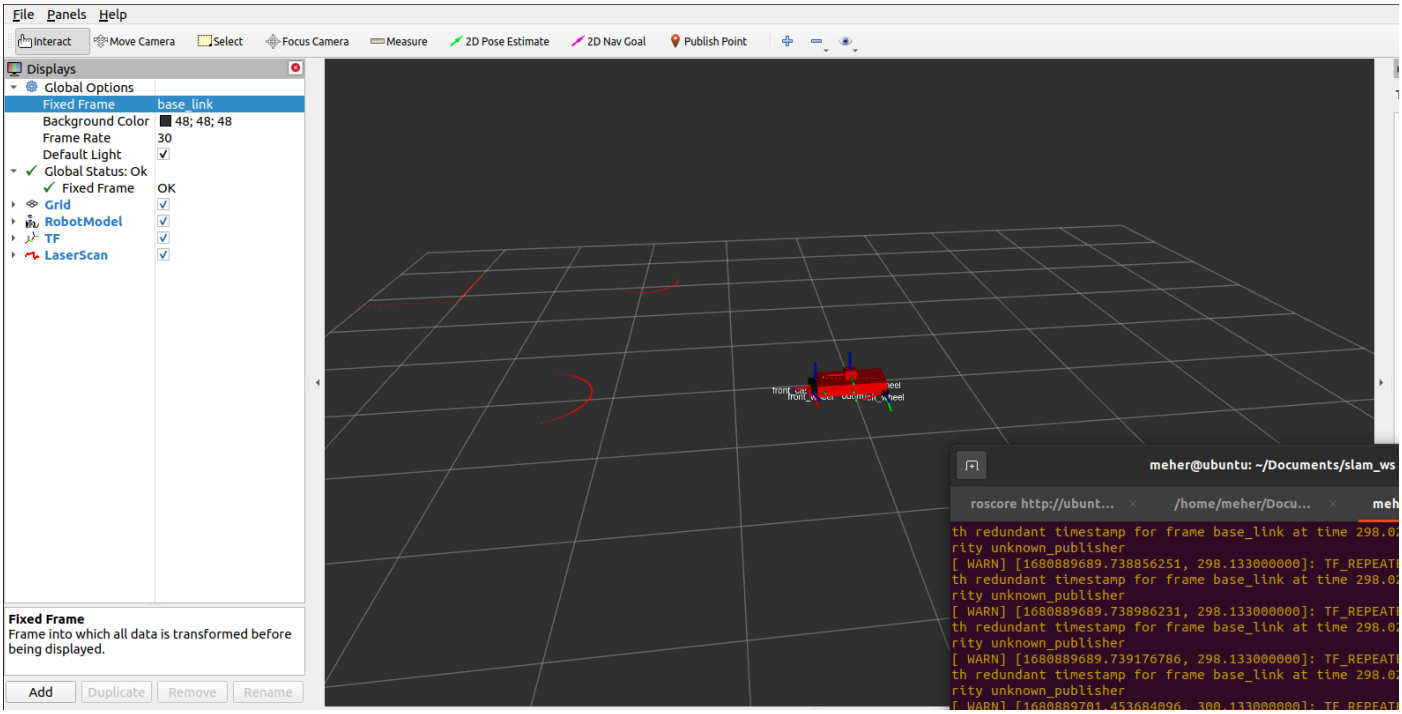
Gazebo (With Obstacles):



Rviz (Without Obstacles)



Rviz (With Obstacles)


File Panels Help
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Displays
Global Options
Fixed Frame base_link
Background Color 48; 48; 48
Frame Rate 30
Default Light
Global Status: Ok
Fixed Frame OK
Grid
RobotModel
TF
LaserScan
Fixed Frame
Frame into which all data is transformed before being displayed.
Add
Duplicate
Remove
Rename
meher@ubuntu: ~/Documents/slam_ws
roscore http://ubunt...
/home/meher/Docu...
th redundant timestamp for frame base_link at time 298.02
rity unknown_publisher
[WARN] [1680889689.738856251, 298.133000000]: TF_REPEAT
th redundant timestamp for frame base_link at time 298.02
rity unknown_publisher
[WARN] [1680889689.738986231, 298.133000000]: TF_REPEAT
th redundant timestamp for frame base_link at time 298.02
rity unknown_publisher
[WARN] [1680889689.739176786, 298.133000000]: TF_REPEAT
th redundant timestamp for frame base_link at time 298.02
rity unknown_publisher