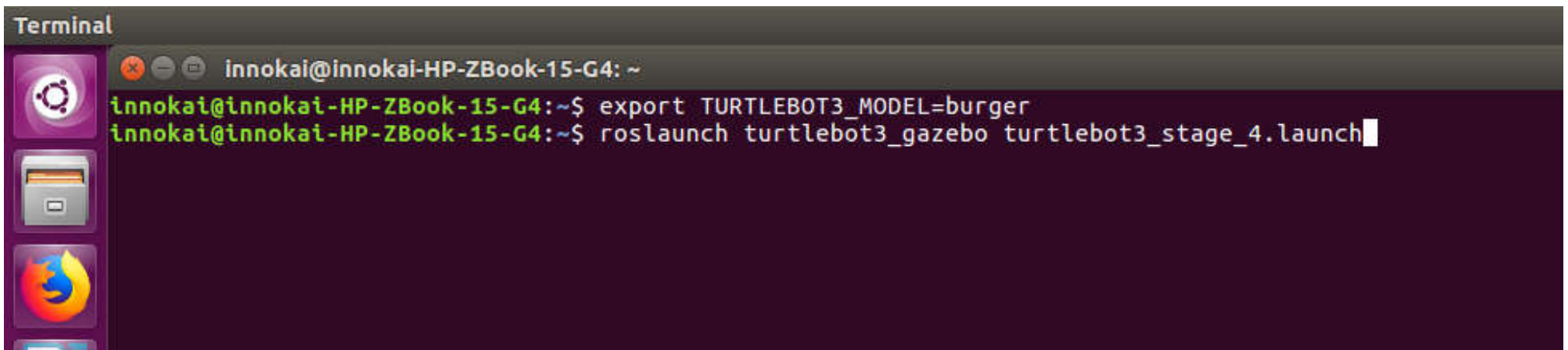


Mapping

USING SLAM TO DO THE MAPPING

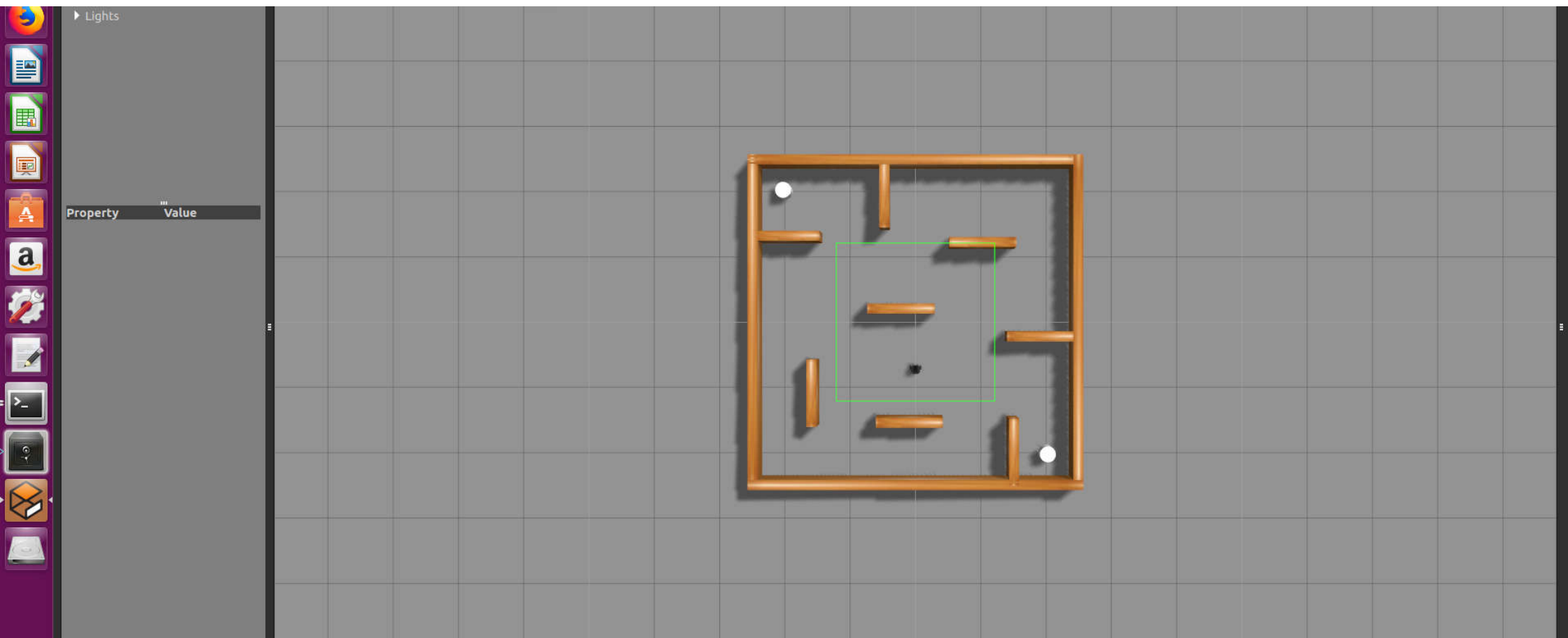




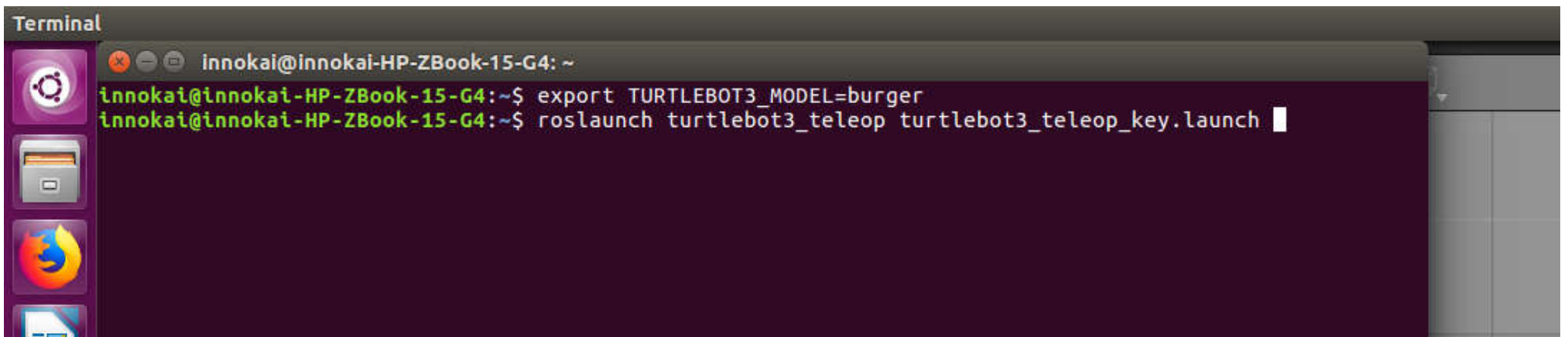
A terminal window titled "Terminal" with a dark background. The window shows the user "innokai" at the prompt "innokai@innokai-HP-ZBook-15-G4: ~". The user has entered two commands: "export TURTLEBOT3_MODEL=burger" and "roslaunch turtlebot3_gazebo turtlebot3_stage_4.launch". The terminal window has a sidebar on the left with icons for the Ubuntu logo, a file manager, and a web browser.

```
innokai@innokai-HP-ZBook-15-G4: ~  
innokai@innokai-HP-ZBook-15-G4:~$ export TURTLEBOT3_MODEL=burger  
innokai@innokai-HP-ZBook-15-G4:~$ roslaunch turtlebot3_gazebo turtlebot3_stage_4.launch
```

Try in simulation Gazebo



It will come out Gazebo model

A screenshot of a Linux terminal window titled "Terminal". The window shows the user "innokai" at the prompt "innokai@innokai-HP-ZBook-15-G4: ~". Two commands have been entered: "export TURTLEBOT3_MODEL=burger" and "roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch". The terminal has a dark purple background and a light gray border. On the left side of the terminal window, there is a vertical dock with icons for the Dash menu, Home folder, Firefox, and Files.

```
Terminal
innokai@innokai-HP-ZBook-15-G4: ~
innokai@innokai-HP-ZBook-15-G4:~$ export TURTLEBOT3_MODEL=burger
innokai@innokai-HP-ZBook-15-G4:~$ roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch
```

To control the turtlebot in the gazebo model, simply type:

```
Terminal
/opt/ros/kinetic/share/turtlebot3_teleop/launch/turtlebot3_teleop_key.launch http://localhost:11311
innokai@innokai-HP-ZBook-15-G4:~$ export TURTLEBOT3_MODEL=burger
innokai@innokai-HP-ZBook-15-G4:~$ roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch
... logging to /home/innokai/.ros/log/26092696-f0ec-11e9-930c-0024d6f63bff/roslaunch-innokai-HP-ZBook-15-G4-4462.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

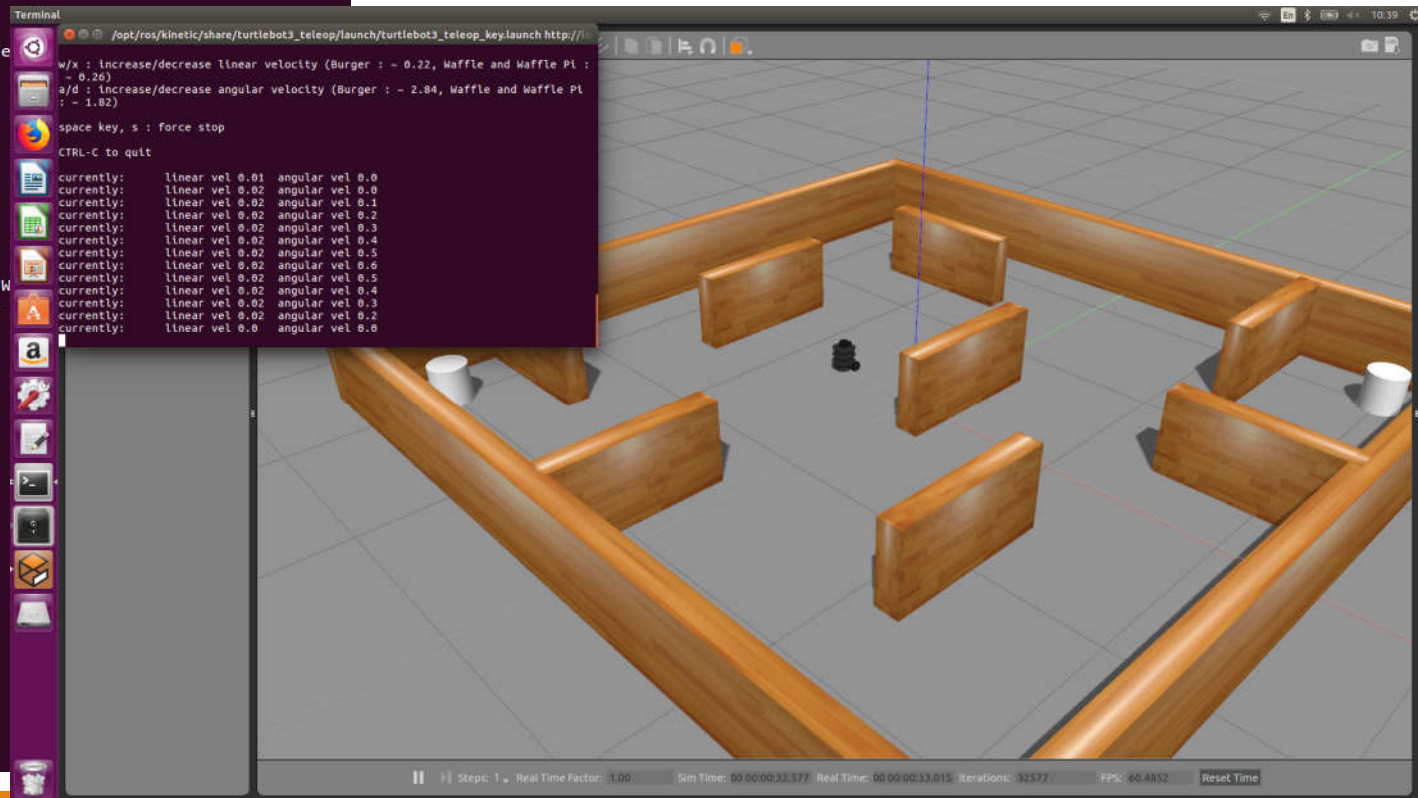
started roslaunch server http://localhost:38351/

SUMMARY
=====
PARAMETERS
* /model: burger
* /rostdistro: kinetic
* /rosversion: 1.12.14
NODES
/
  turtlebot3_teleop_keyboard (turtlebot3_teleop/turtlebot3_teleop_key)
ROS_MASTER_URI=http://localhost:11311
process[turtlebot3_teleop_keyboard-1]: started with pid [4479]
Control Your TurtleBot3!
-----
Moving around:
      w      a      s      d
      |      |      |      |
      v      v      v      v
      X      X      X      X

w/x : increase/decrease linear velocity (Burger : ~ 0.22, Waffle and Waffle Pi : ~ 0.26)
a/d : increase/decrease angular velocity (Burger : ~ 2.84, Waffle and Waffle Pi : ~ 1.82)

space key, s : force stop
CTRL-C to quit
```

Now you can control the turtlebot in the Gazebo model



```
innokai@innokai-HP-ZBook-15-G4: ~  
innokai@innokai-HP-ZBook-15-G4:~$ rosbag record -o data.bag /scan/tf/odom
```

```
innokai@innokai-HP-ZBook-15-G4: ~  
innokai@innokai-HP-ZBook-15-G4:~$ rosbag record -o data.bag /scan/tf/odom  
[ INFO] [1571375662.923784163]: Subscribing to /scan/tf/odom  
[ INFO] [1571375663.128316175, 536.315000000]: Recording to data_2019-10-18-13-14-23.bag.  
█
```

Next, we start to scan the environment by using the radar sensor.

RUN AROUND!!!!

Check the map

- Once you are satisfied you have visited the whole space
- Click ^c to stop saving topics to the bag and close the file
- Inspect the file and see if it looks reasonable

```
innokai@innokai-HP-ZBook-15-G4:~$ rosbag info data_2019-10-18-13-14-23.bag
path:      data_2019-10-18-13-14-23.bag
version: 2.0
size:      4.0 KB
innokai@innokai-HP-ZBook-15-G4:~$
```


TUNE THE MAP

We can improve mapping quality by setting some of the gmapping parameters to different values:

```
$ rosparam set /slam_gmapping/angularUpdate 0.1
```

```
$ rosparam set /slam_gmapping/linearUpdate 0.1
```

```
$ rosparam set /slam_gmapping/lskip 10
```

```
$ rosparam set /slam_gmapping/xmax 10
```

```
$ rosparam set /slam_gmapping/xmin -10
```

```
$ rosparam set /slam_gmapping/ymax 10
```

```
$ rosparam set /slam_gmapping/ymin -10
```


RUN THE MAP

```
$ roscore
```

```
$ rosparam set use_sim_time true
```

```
$ roslaunch turtlebot3_slam turtlebot3_slam.launch slam_methods:=gmapping
```

```
$ rosbag play --clock data.bag
```

A solid orange horizontal bar spanning the width of the slide at the bottom.

Try on the Turtlebot3

Change the Method

From the simulator to the real turtlebot3

Connect turtlebot3 via WIFI with remote PC



```
ROS_MASTER_URI = http://IP_OF_REMOTE_PC:11311  
ROS_HOSTNAME   = IP_OF_TURTLEBOT
```

```
ROS_MASTER_URI = http://IP_OF_REMOTE_PC:11311  
ROS_HOSTNAME   = IP_OF_REMOTE_PC
```

* Example when ROS Master is running on the Remote PC

* Uniform Resource Identifier

>> ifconfig

```
zimbot@zimbot-Aspire-E5-576G:~$ ifconfig
enp4s0f1  Link encap:Ethernet  HWaddr a8:1e:84:be:4d:34
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:812 errors:0 dropped:0 overruns:0 frame:0
          TX packets:812 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:119138 (119.1 KB)  TX bytes:119138 (119.1 KB)

wlp3s0    Link encap:Ethernet  HWaddr a0:af:bd:a4:0a:01
          inet addr:10.10.229.189 Bcast:10.10.231.255  Mask:255.255.248.0
          inet6 addr: fe80::3043:daf2:c65:9465/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:13128 errors:0 dropped:0 overruns:0 frame:0
          TX packets:5229 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:14699170 (14.6 MB)  TX bytes:631867 (631.8 KB)
```

Navigation

Run Navigation Nodes

Set the model and bring up the simulation of the map

```
$ export TURTLEBOT3_MODEL=burger
```

```
$ roslaunch turtlebot3_gazebo turtlebot3_stage_4.launch
```

In new terminal

```
$ export TURTLEBOT3_MODEL=burger
```

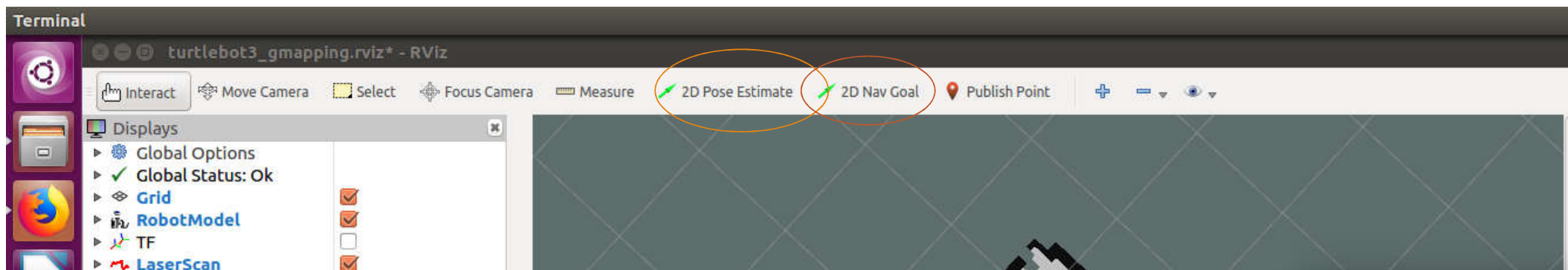
```
$ roslaunch turtlebot3_navigation turtlebot3_navigation.launch map_file:=$HOME/map.yaml
```

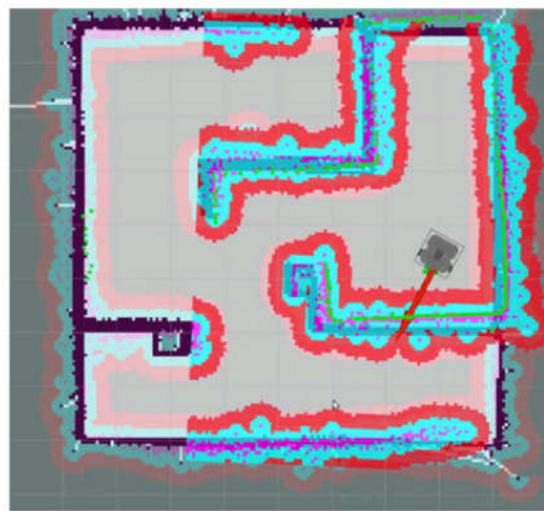
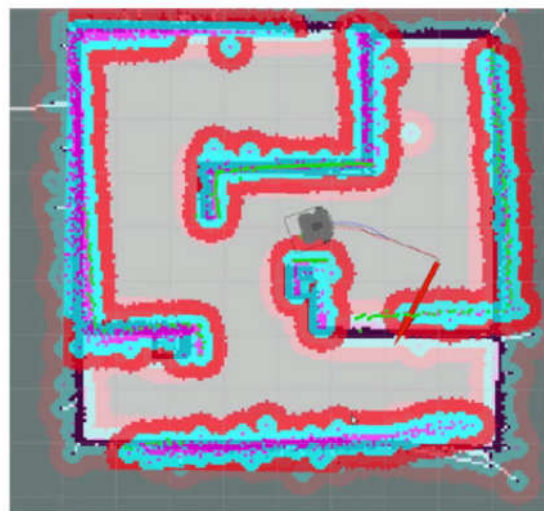
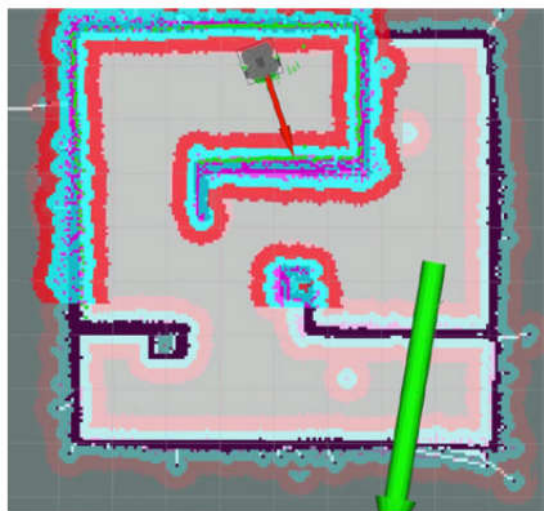
If you want to run RViz separately, use the following command.

```
$ rviz -d `rospack find turtlebot3_navigation`/rviz/turtlebot3_navigation.rviz
```


2D Pose Estimate
-Estimate Initial Pose

2D Nav Goal
Send Navigation Goal





Run Navigation Nodes

Run roscore.
\$ roscore

Bring up basic packages to start TurtleBot3 applications.
\$ roslaunch turtlebot3_bringup turtlebot3_robot.launch

export TURTLEBOT3_MODEL=burger
\$ roslaunch turtlebot3_navigation turtlebot3_navigation.launch map_file:=\$HOME/map.yaml

If you want to run RViz separately, use the following command.
\$ rviz -d `rospack find turtlebot3_navigation`/rviz/turtlebot3_navigation.rviz