Multi-robot navigation

Startup file path

（1）Virtual machine side:

~/transbot_ws/src/transbot_nav /transbot_map_server.launch

（2）Transbot robot：

~/transbot_ws/src/transbot_nav/ launch/transbot_navigation_multi.launch

~/transbot_ws/src/transbot_bringup/launch/laser_bringup_multi_robot.launch

Function package description:

Realize multiple roboot navigation and positioning in the same map.

Feature package path:

（1）VM(virtual machine) side: ~/transbot_ws/src/transbot_nav

（2）Transbot robot side：~/transbot_ws/src/transbot_nav

~/transbot_ws/src/transbot_bringup

Function realization conditions:

1) It is necessary to configure the network of multiple Transbot robot, make all Transbot robot and the virtual machine are in the same local area network, and the virtual machine must be used as the host (Master).

2) All robots must be on the same map, we need to put the map model on the virtual machine in advance;

Note: about network configuration, please refer to the previous lesson.

1. Start up this function

1.1 Steps

Take two Transbot robots as an example:

1. Input following commanding on VM(virtual machine)-side

```
roslaunch transbot_nav transbot_map_server.launch   #load map
```

```
yahboom@VM_Transbot:~$ ^C
yahboom@VM_Transbot:~$ roslaunch transbot_nav transbot_map_server.launch
... logging to /home/yahboom/.ros/log/91cb265c-5a5f-11ec-b469-000c29e9c080/roslaunch-VM_Transbot-10845.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://192.168.2.114:40655/

SUMMARY
========

PARAMETERS
 * /map_server/frame_id: map
 * /rosdistro: melodic
 * /rosversion: 1.14.12

NODES
  /
    map_server (map_server/map_server)

ROS_MASTER_URI=http://192.168.2.114:11311

process[map_server-1]: started with pid [10860]
```

2. Input following commanding on No.1 Transbot robot

```
    roslaunch transbot_nav laser_bringup_multi_robot.launch namespace:=robot1
#Open the drive control system of No.1 Transbot robot
    roslaunch transbot_nav transbot_navigation_multi.launch namespace:=robot1
#Open the navigation function of No.1 Transbot robot
```

```
/home/pi/transbot_ws/src/transbot_nav/launch/laser_base/laser_bringup_multi_robot.launch http://192.168.2.114:11311 94x44
ransbot:~$
ransbot:~$ roslaunch transbot_nav laser_bringup_multi_robot.launch namespace:=robot1
logging to /home/pi/.ros/log/10c58d32-5a59-11ec-b469-000c29e9c080/roslaunch-Transbot-17050

king log directory for disk usage. This may take a while.
s Ctrl-C to interrupt
 checking log file disk usage. Usage is <1GB.

o.py is deprecated; please use xacro instead
ted roslaunch server http://192.168.2.74:41293/

ARY
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METERS
robot1/apply_calib/calib_file: /home/pi/transbot...
robot1/apply_calib/calibrate_gyros: True
robot1/apply_calib/is_multi: True
robot1/apply_calib/is_namespace: robot1
robot1/base_node/is_multi_robot: True
robot1/base_node/is_namespace: robot1
robot1/base_node/linear_scale: 1.2
robot1/ekf_localization/base_link_frame: robot1/base_footp...
robot1/ekf_localization/frequency: 20
robot1/ekf_localization/imu0: /robot1/imu/data
robot1/ekf_localization/imu0_config: [False, False, Fa...
robot1/ekf_localization/imu0_differential: True
robot1/ekf_localization/imu0_relative: False
robot1/ekf_localization/odom0: /robot1/odom_raw
robot1/ekf_localization/odom0_config: [False, False, Fa...
robot1/ekf_localization/odom0_differential: True
robot1/ekf_localization/odom0_relative: False
robot1/ekf_localization/odom_frame: robot1/odom
robot1/ekf_localization/two_d_mode: True
robot1/ekf_localization/world_frame: robot1/odom
robot1/imu: /robot1/transbot/imu
robot1/imu_filter_madgwick/angular_scale: 1.08
robot1/imu_filter_madgwick/fixed_frame: robot1/base_link
robot1/imu_filter_madgwick/orientation_stddev: 0.05
robot1/imu_filter_madgwick/publish_tf: False
robot1/imu_filter_madgwick/use_mag: fasle
robot1/imu_filter_madgwick/use_magnetic_field_msg: fasle
```
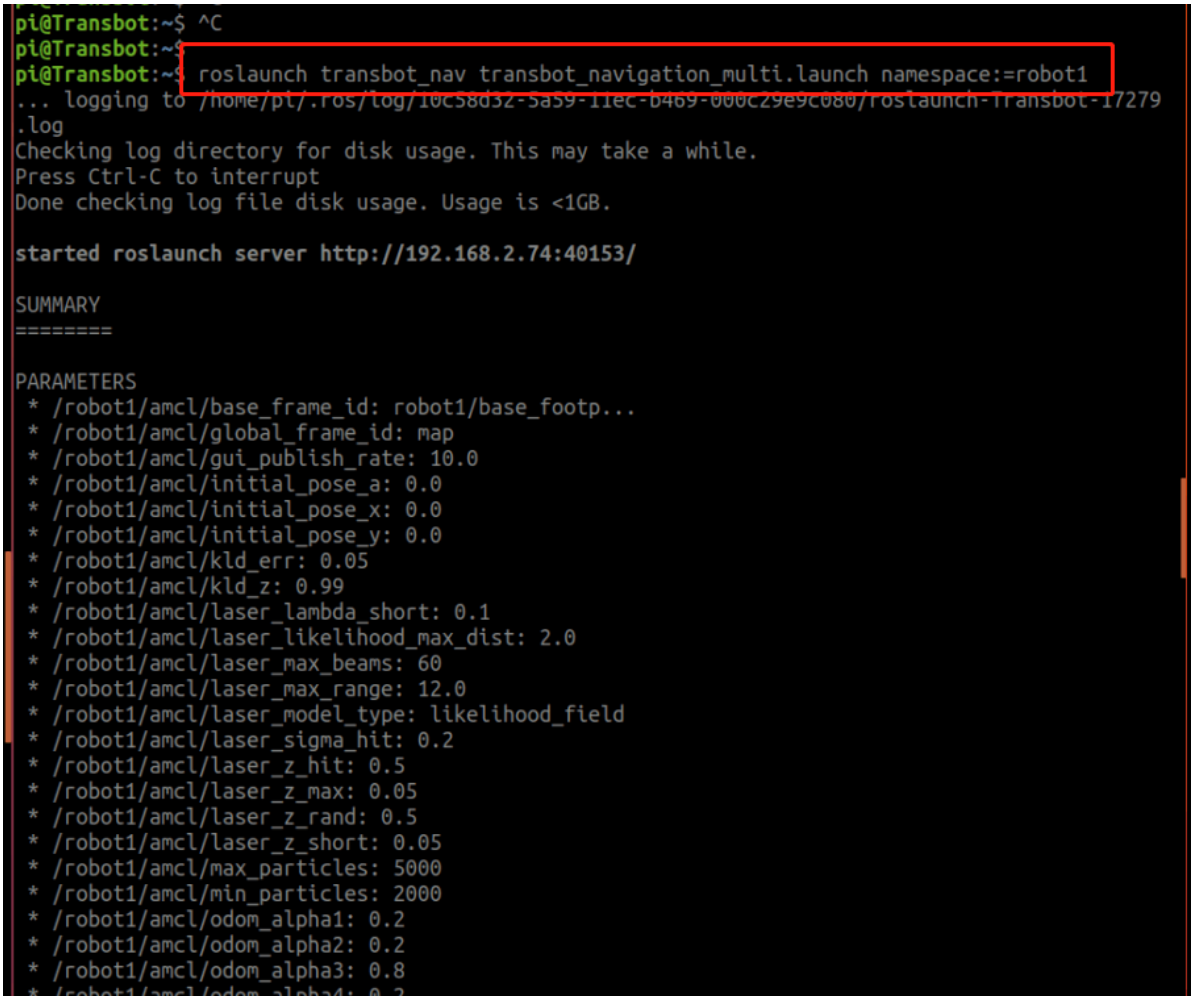



3. Input following commanding on No.2 Transbot robot

```
    roslaunch transbot_nav laser_bringup_multi_robot.launch namespace:=robot2
#Open the drive control system of No.2 Transbot robot
    roslaunch transbot_nav transbot_navigation_multi.launch namespace:=robot2
#Open the navigation function of No.2 Transbot robot
```

```
pi@Transbot:~$ AC
pi@Transbot:~$ roslaunch transbot_nav laser_bringup_multi_robot.launch namespace:=robot2
... logging to /home/pi/.ros/log/91cb265c-5a5f-11ec-b469-000c29e9c080/roslaunch-Transbot-20599
.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.

xacro.py is deprecated; please use xacro instead
started roslaunch server http://192.168.2.108:33483/

SUMMARY
========

PARAMETERS
 * /robot2/apply_calib/calib_file: /home/pi/transbot...
 * /robot2/apply_calib/calibrate_gyros: True
 * /robot2/apply_calib/is_multi: True
 * /robot2/apply_calib/is_namespace: robot2
 * /robot2/base_node/is_multi_robot: True
 * /robot2/base_node/is_namespace: robot2
 * /robot2/base_node/linear_scale: 1.2
 * /robot2/ekf_localization/base_link_frame: robot2/base_footp...
 * /robot2/ekf_localization/frequency: 20
 * /robot2/ekf_localization/imu0: /robot2/imu/data
 * /robot2/ekf_localization/imu0_config: [False, False, Fa...
 * /robot2/ekf_localization/imu0_differential: True
 * /robot2/ekf_localization/imu0_relative: False
 * /robot2/ekf_localization/odom0: /robot2/odom_raw
 * /robot2/ekf_localization/odom0_config: [False, False, Fa...
 * /robot2/ekf_localization/odom0_differential: True
 * /robot2/ekf_localization/odom0_relative: False
 * /robot2/ekf_localization/odom_frame: robot2/odom
 * /robot2/ekf_localization/two_d_mode: True
 * /robot2/ekf_localization/world_frame: robot2/odom
 * /robot2/imu: /robot2/transbot/imu
 * /robot2/imu_filter_madgwick/angular_scale: 1.08
 * /robot2/imu_filter_madgwick/fixed_frame: robot2/base_link
 * /robot2/imu_filter_madgwick/orientation_stddev: 0.05
 * /robot2/imu_filter_madgwick/publish_tf: False
 * /robot2/imu_filter_madgwick/use_mag: fasle
```

```
pi@Transbot:~$ roslaunch transbot_nav transbot_navigation_multi.launch namespace:=robot2
... logging to /home/pi/.ros/log/91cb265c-5a5f-11ec-b469-000c29e9c080/roslaunch-Transbot-20925
.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://192.168.2.108:36287/

SUMMARY
========

PARAMETERS
 * /robot2/amcl/base_frame_id: robot2/base_footp...
 * /robot2/amcl/global_frame_id: map
 * /robot2/amcl/gui_publish_rate: 10.0
 * /robot2/amcl/initial_pose_a: 0.0
 * /robot2/amcl/initial_pose_x: 0.0
 * /robot2/amcl/initial_pose_y: 0.0
 * /robot2/amcl/kld_err: 0.05
 * /robot2/amcl/kld_z: 0.99
 * /robot2/amcl/laser_lambda_short: 0.1
 * /robot2/amcl/laser_likelihood_max_dist: 2.0
 * /robot2/amcl/laser_max_beams: 60
 * /robot2/amcl/laser_max_range: 12.0
 * /robot2/amcl/laser_model_type: likelihood_field
 * /robot2/amcl/laser_sigma_hit: 0.2
 * /robot2/amcl/laser_z_hit: 0.5
 * /robot2/amcl/laser_z_max: 0.05
 * /robot2/amcl/laser_z_rand: 0.5
 * /robot2/amcl/laser_z_short: 0.05
 * /robot2/amcl/max_particles: 5000
 * /robot2/amcl/min_particles: 2000
 * /robot2/amcl/odom_alpha1: 0.2
 * /robot2/amcl/odom_alpha2: 0.2
 * /robot2/amcl/odom_alpha3: 0.8
 * /robot2/amcl/odom_alpha4: 0.2
 * /robot2/amcl/odom_alpha5: 0.1
 * /robot2/amcl/odom_frame_id: robot2/odom
 * /robot2/amcl/odom_model_type: diff
 * /robot2/amcl/recovery_alpha_fast: 0.0
```

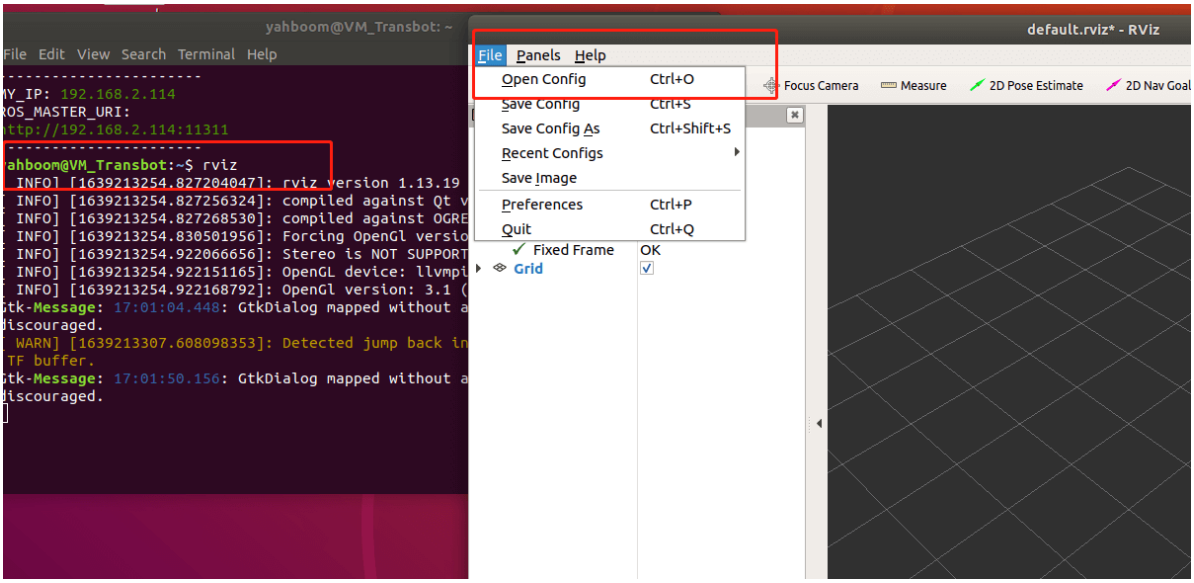
When the robot drive control system is turned on, if "First IMU message received." appears at the bottom of the terminal, it means the turn-on is successful.

When the robot navigation function is turned on, if "[INFO] [1639212777.429425928]: Recovery behavior will clear layer 'obstacle_layer'" appears at the bottom of the terminal, it means the activation is successful.

Then, you can go to the fourth step, open rviz, and load the rviz file.

4. Input following commanding on VM(virtual machine)-side

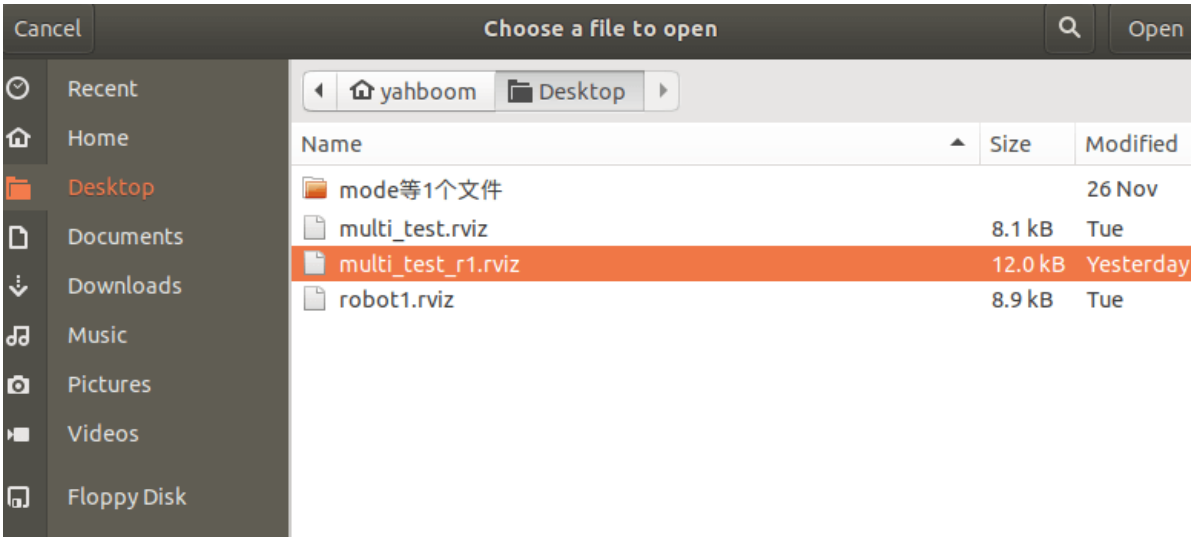
```
rviz
```

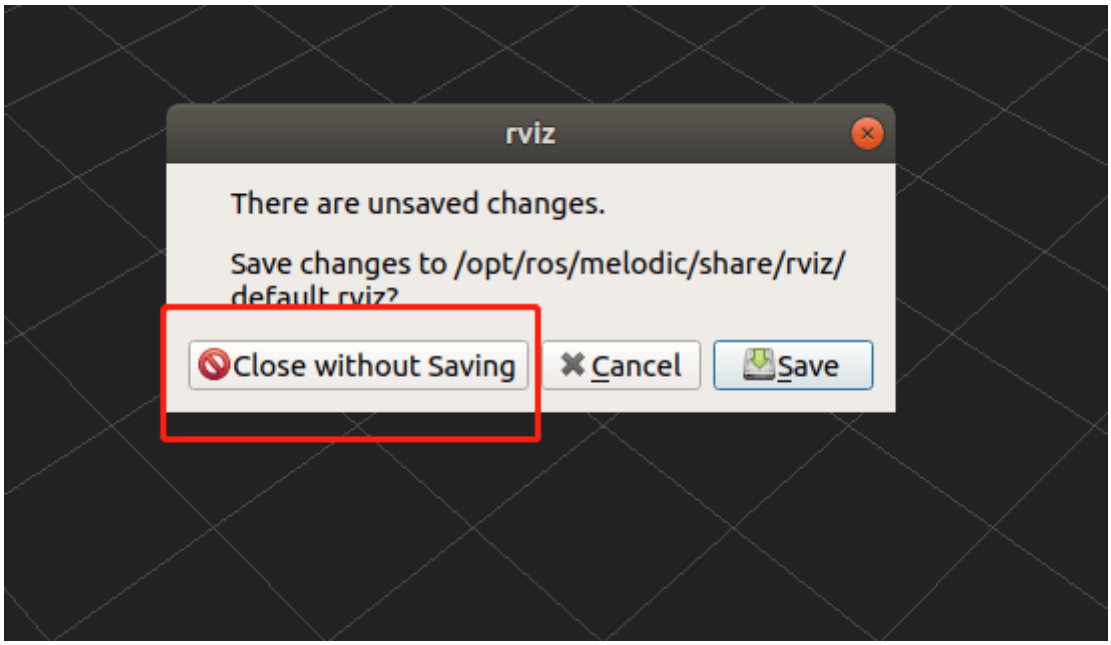


Then, click [File], select [Open Config[, select the [Desktop].

Double-click to select [multi_test_r1.rviz] (this file is placed in the Desktop directory by default).

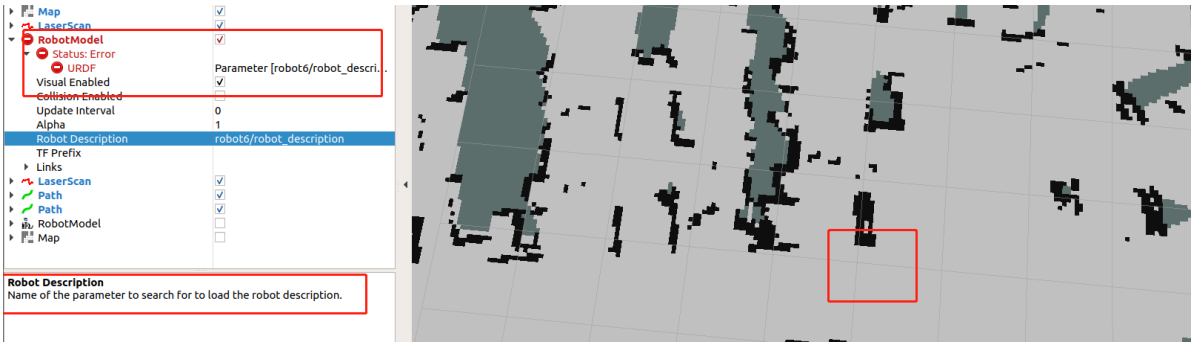
A dialog box will pop up, select [Close withoutSaving].





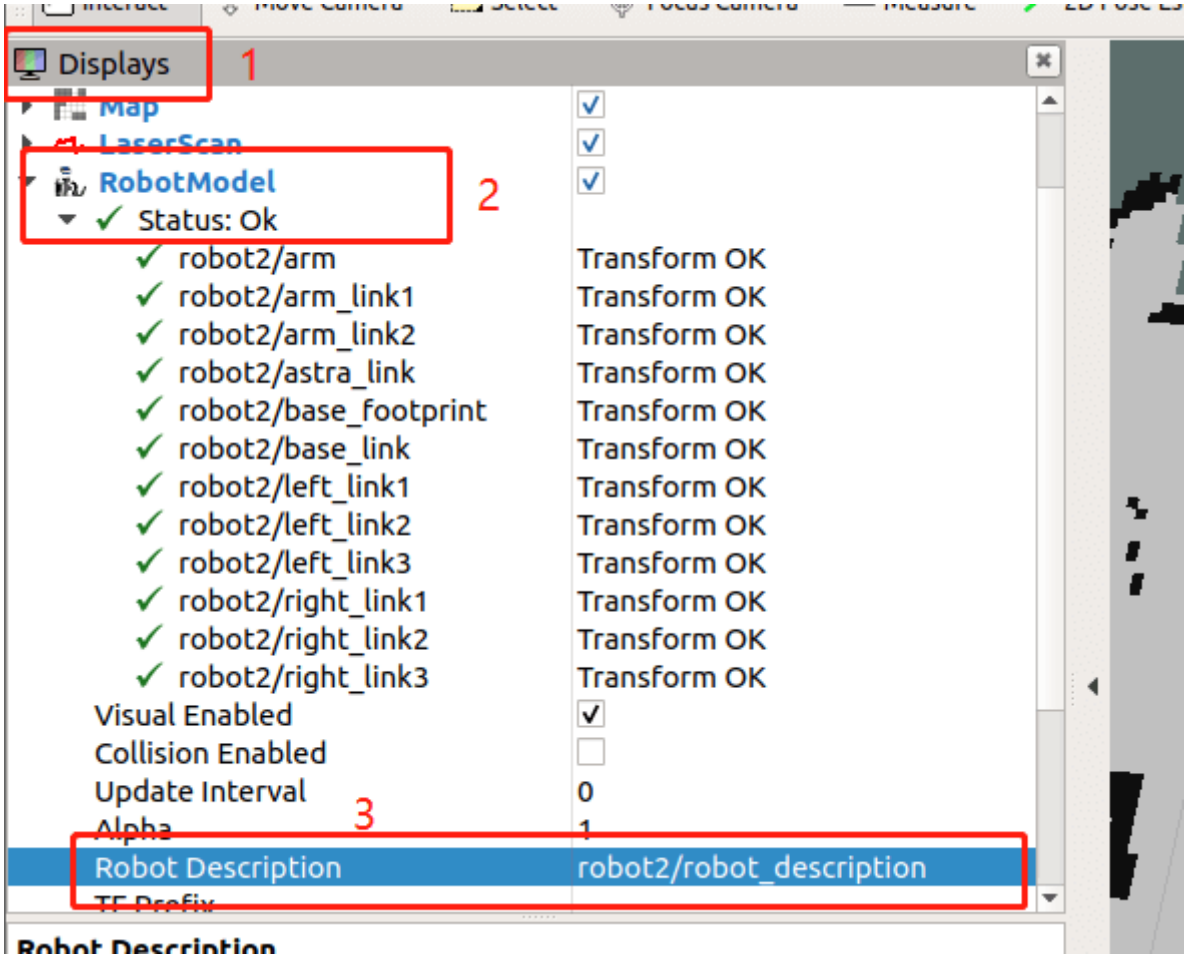
Modify the name of the robot model in rviz

The system will then load the map. But we will find that the robot model does not appear in the map.

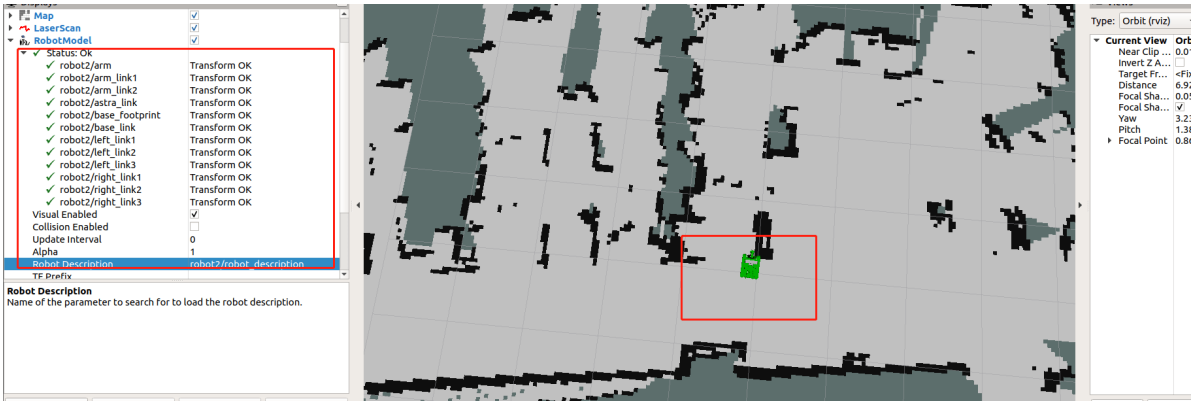


Because our default robot namespace is not robot1 and robot2.

We need to modify the name of the robot model in rviz (take modifying robot model 2 as an example), as shown below.



After the modification is completed, the system can load the transbot car model, as shown below.

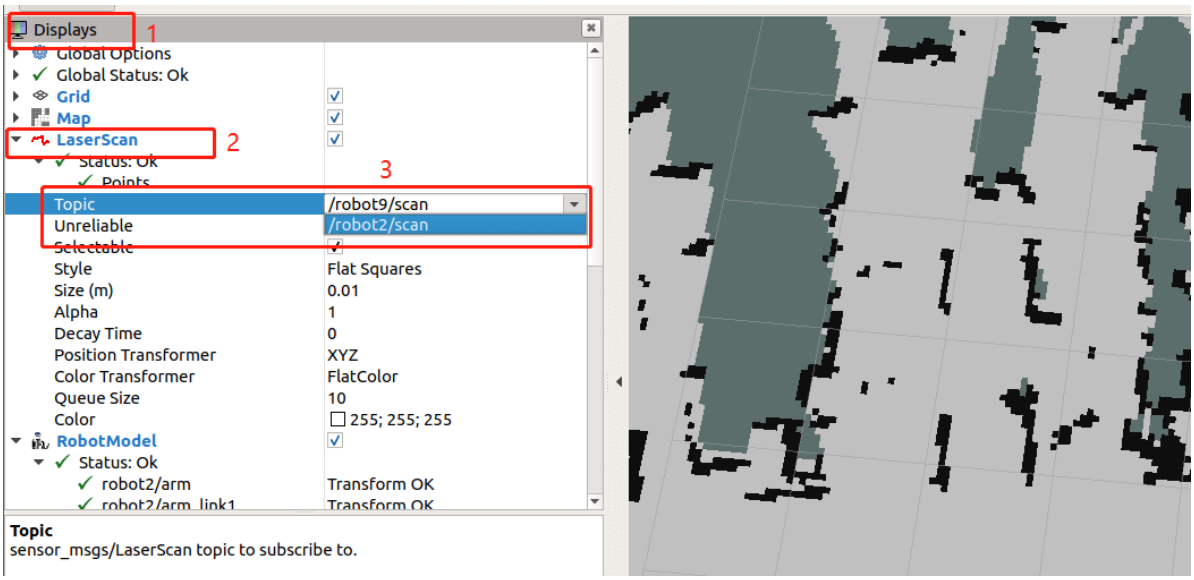


The No.1 Transbot robot 1 modifies the model in the same way as above.

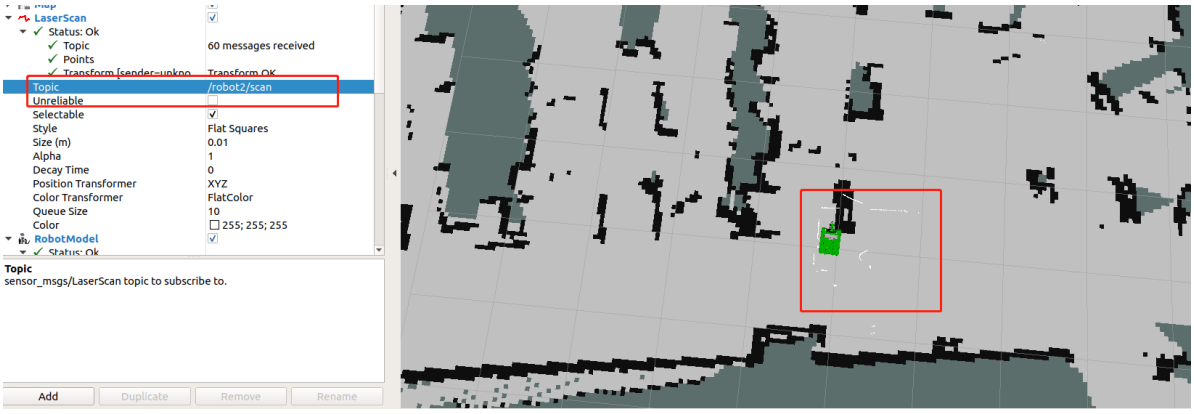
In addition, we also need to modify the topic of radar, the topic of Path, the topic of 2D Pose Estimate and the topic of 2D Naval Goal.

1.2 Modify the lidar topic in rviz

As shown below.



After selecting /robot2/scan, the point cloud information of the radar scan will be displayed in rviz.

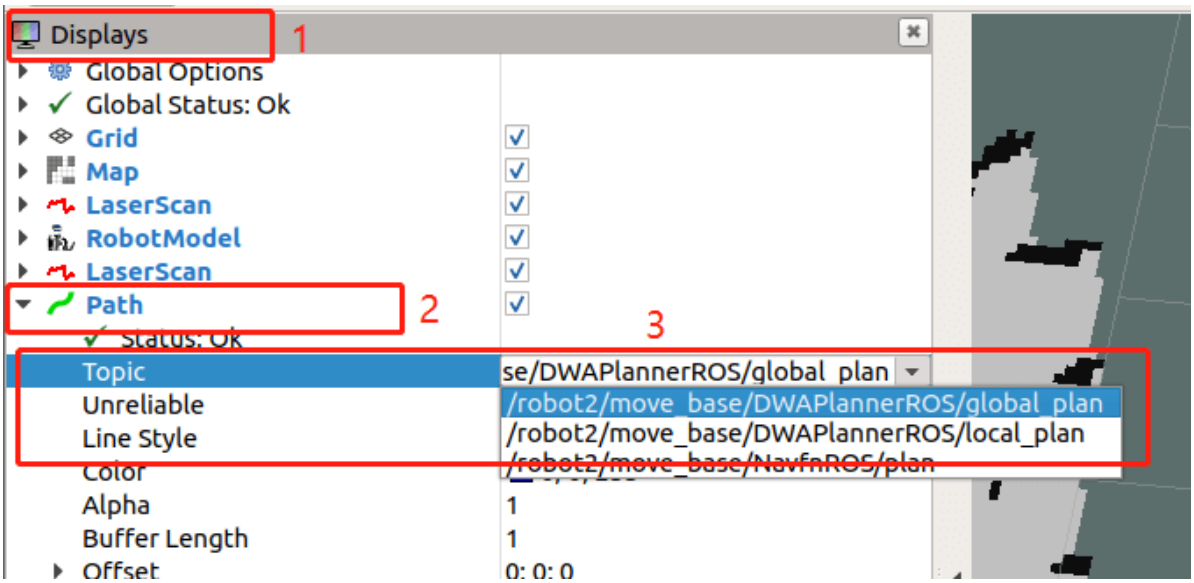


As shown in the figure above, the white part in the figure is the radar point cloud of No.2 Transbot robot.

1.3 Modify the path topic in rviz

The way of modifying the topic of Path is similar to the modification of the topic of lidar.

Display Path is mainly used to observe the movement route of the Transbot car.



Select /robot2/move_base/DWAPlannerROS/global_plan, you can see the global path planned during the navigation of the transbot car. To see the local planning path, select /robot2/move_base/DWAPlannerROS/local_plan.

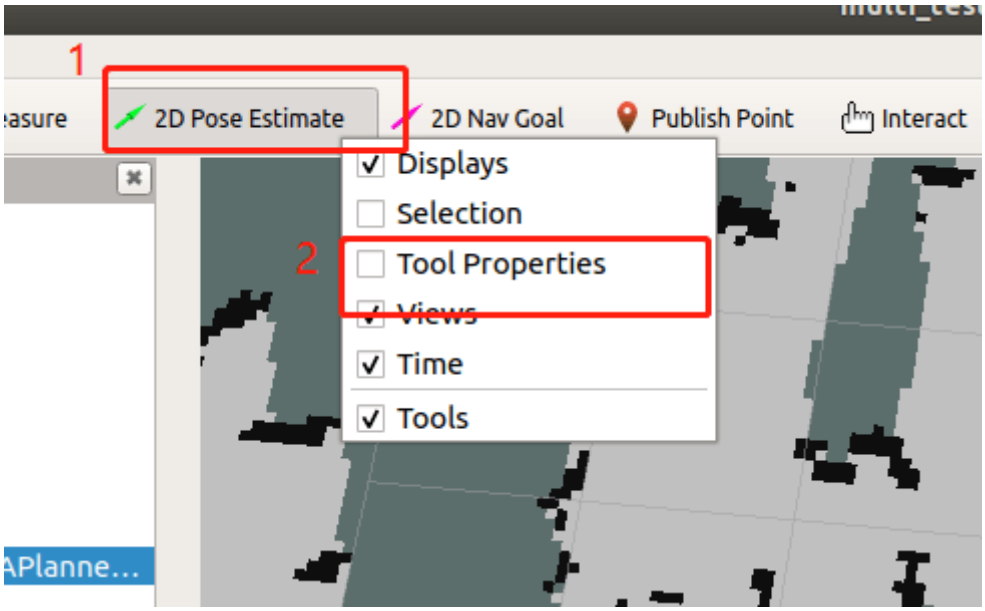
1.4 Modify the 2D Pose Estimate and 2D Naval Goal topic in rviz

2D Pose Estimate is used to manually position the transbot, and 2D Naval Goal is to give a target of the transbot and let it plan to this point autonomously.

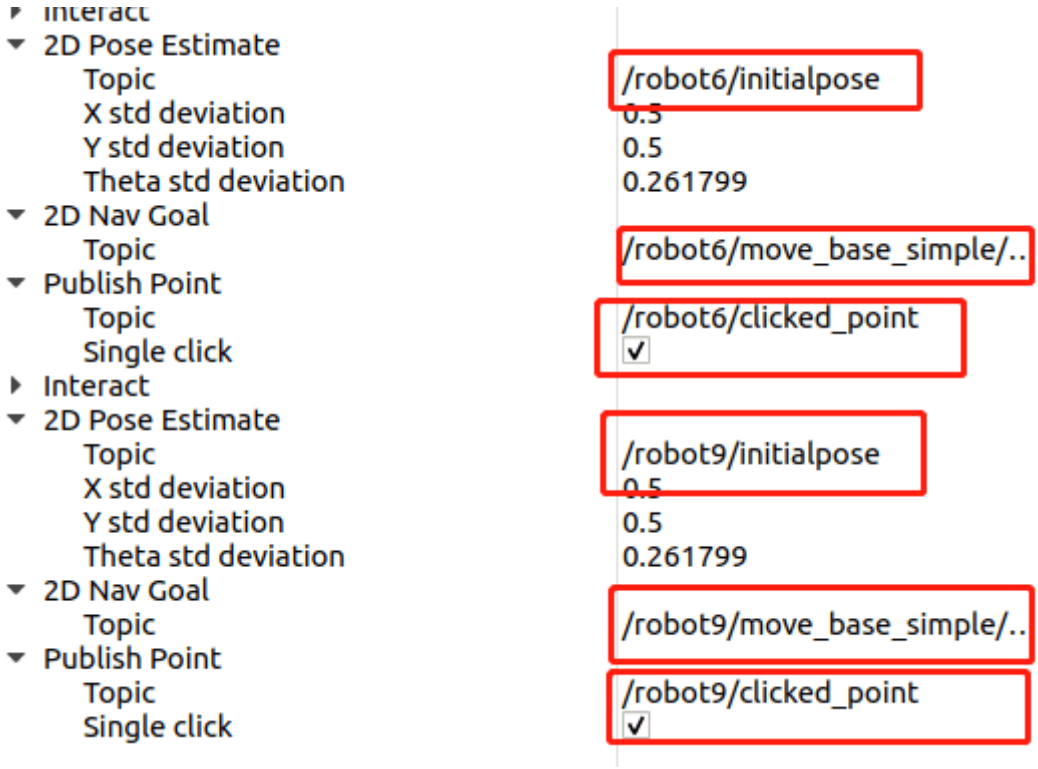
Since there are two Transbot robots, we will see two sets of 2D Pose Estimate and 2D Naval Goal,

We need to locate and target them separately.

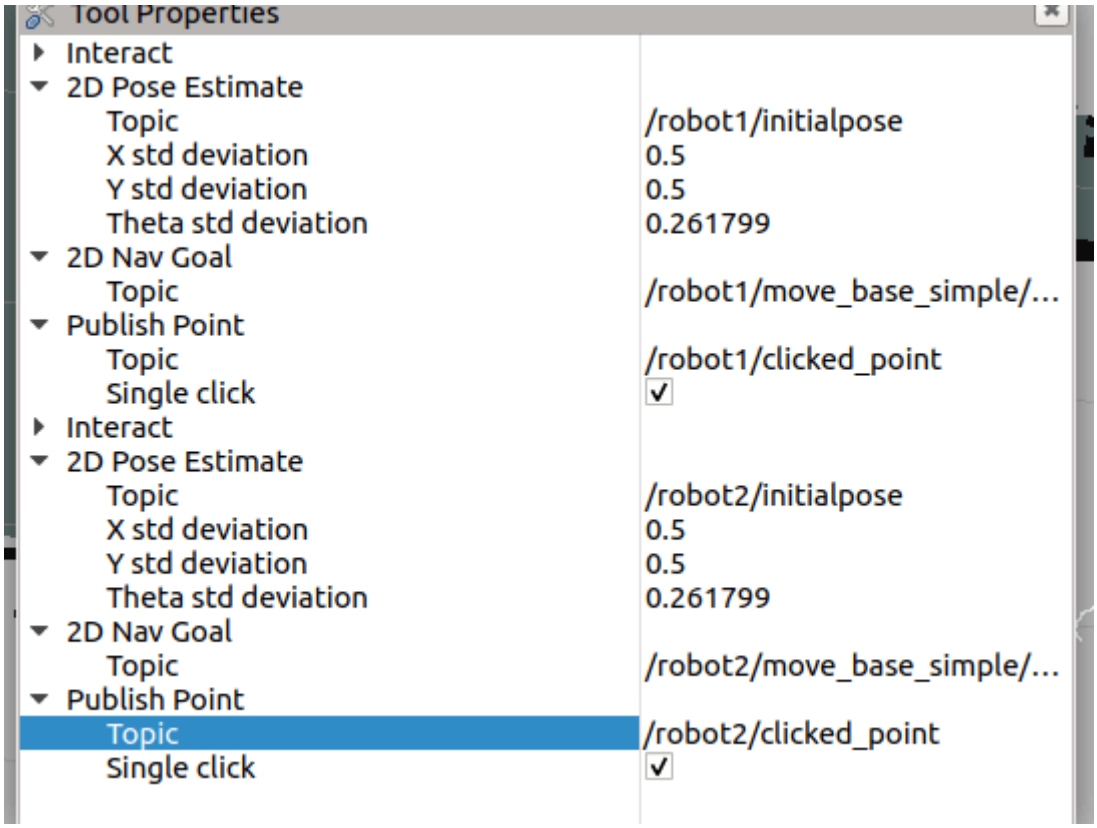
The two groups of topics are modified in the same way, and the steps are shown in the following figure.



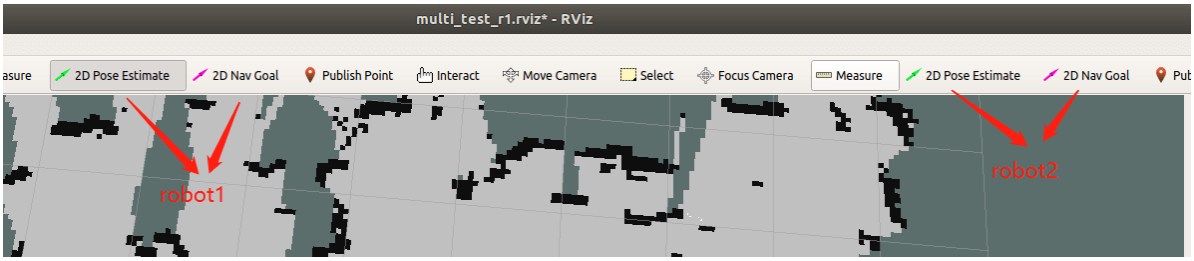
Right-click to select any 2D Pose Estimate, after the dialog box pops up, click to select Tool Properties, and then enter the modification interface.



We need to modify robot6 and robot9, change robot6 to robot1, and change robot9 to robot2. The effect after modification is as follows.



Finally, we can complete the positioning and navigation of the transbot car through 2D Pose Estimate and 2D Naval Goal in rviz.

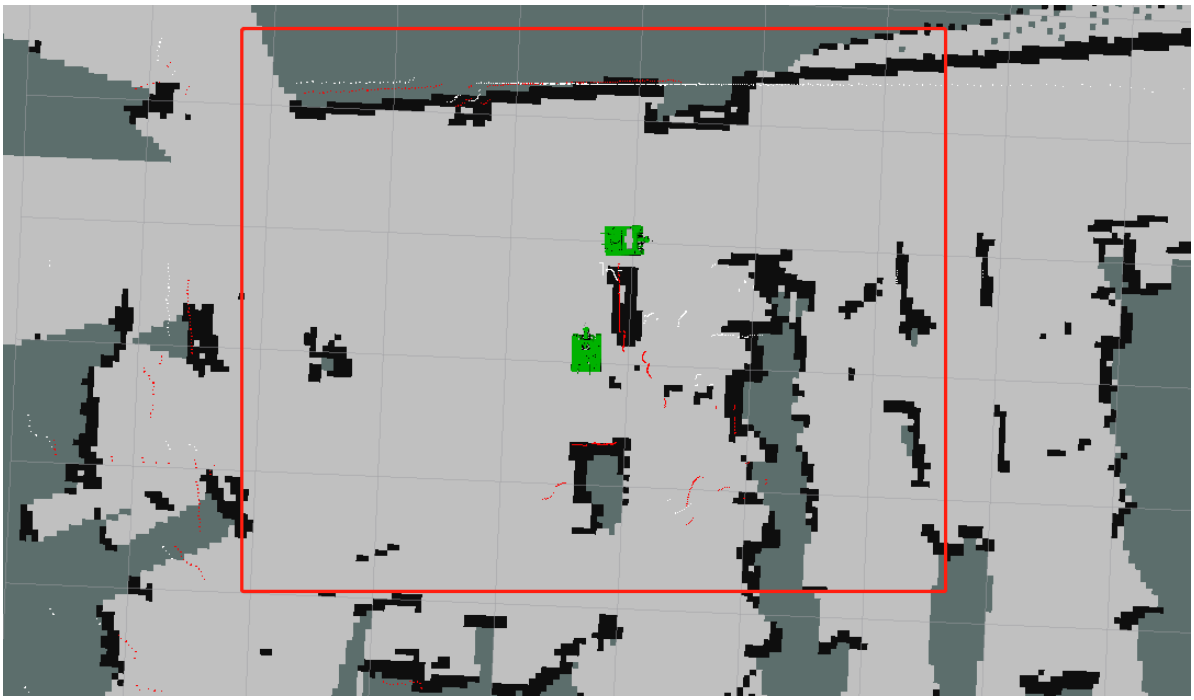


2. How to complete complete the positioning and navigation

2.1 After modifying the model transbot car name and topic name.

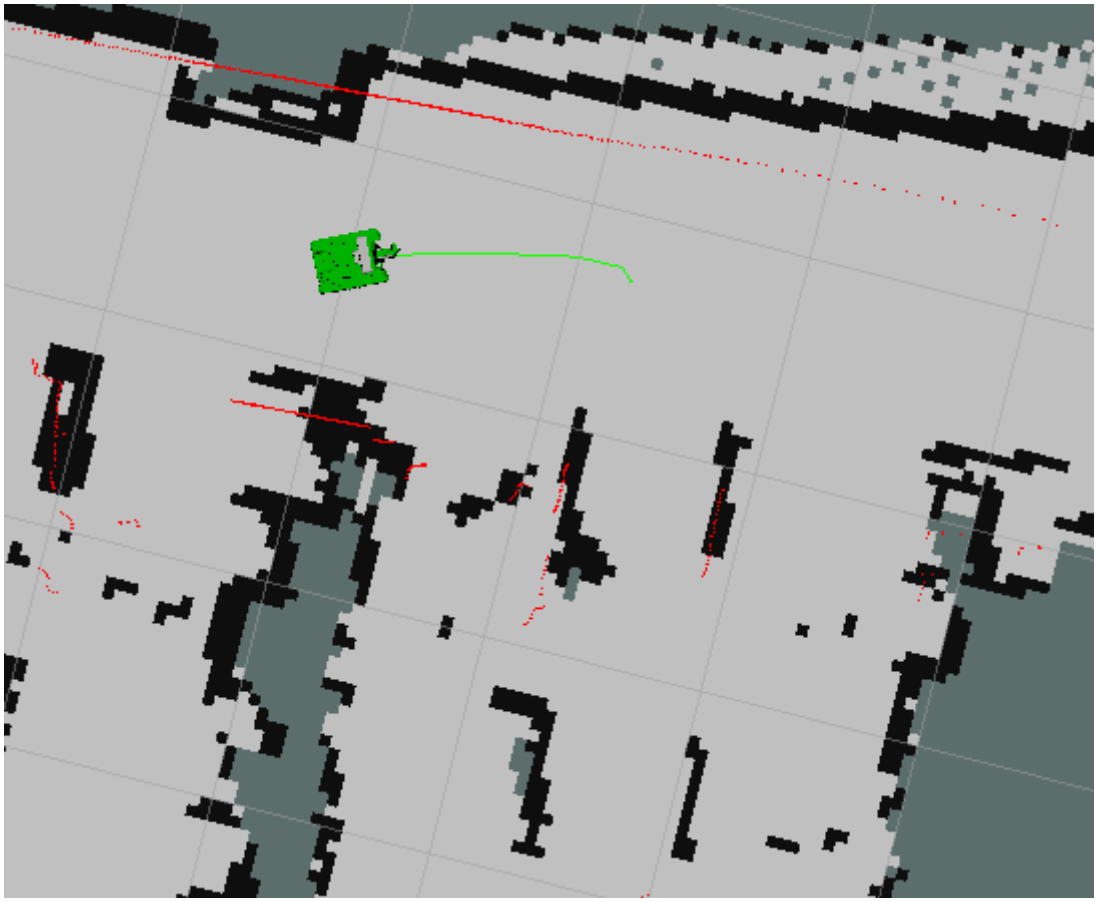
We can use the 2D Pose Estimate tool to locate the two transbot cars. After clicking 2D Pose Estimate, drag the mouse in the map to release it, and you will find that the robot model has changed.

Note: We need to adjust the car model to be consistent with the actual situation. That is, the position of the Transbot car in the actual map is the same as the position of the Transbot car in the simulated map.

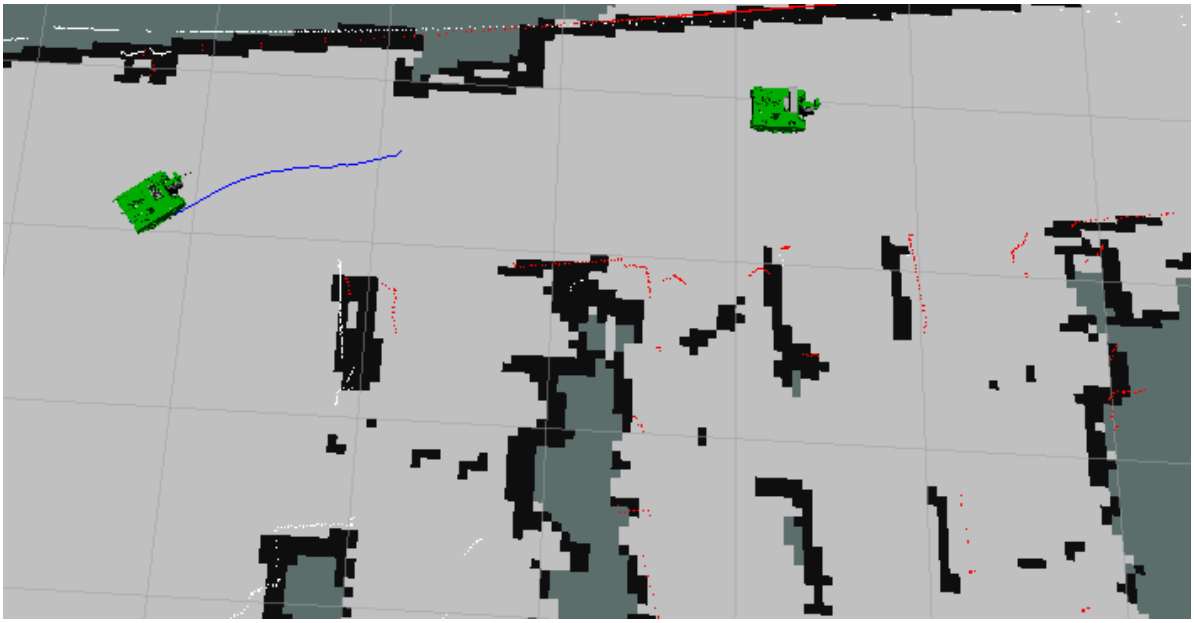


2.2 The adjusted approximate pose is shown in the figure above, that is, the point cloud scanned by the radar roughly overlaps with the map.

Next, use the 2D Naval Goal of No.1 Transbot and No.2 Transbot to give them a target point, and they will navigate autonomously to The target point, the effect is shown below.



The green line in the figure represents the path of the No.1 Transbot.



The blue line in the figure represents the path of the No.2 Transbot.