Mobile Robot Navigation and Control, Lab3

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1 Setting up TurtleBot 3

Using the command "roslaunch turtlebot3_bringup turtlebot3_robot.launch" on turtlebot, "roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch" on my computer, I can control the robot.

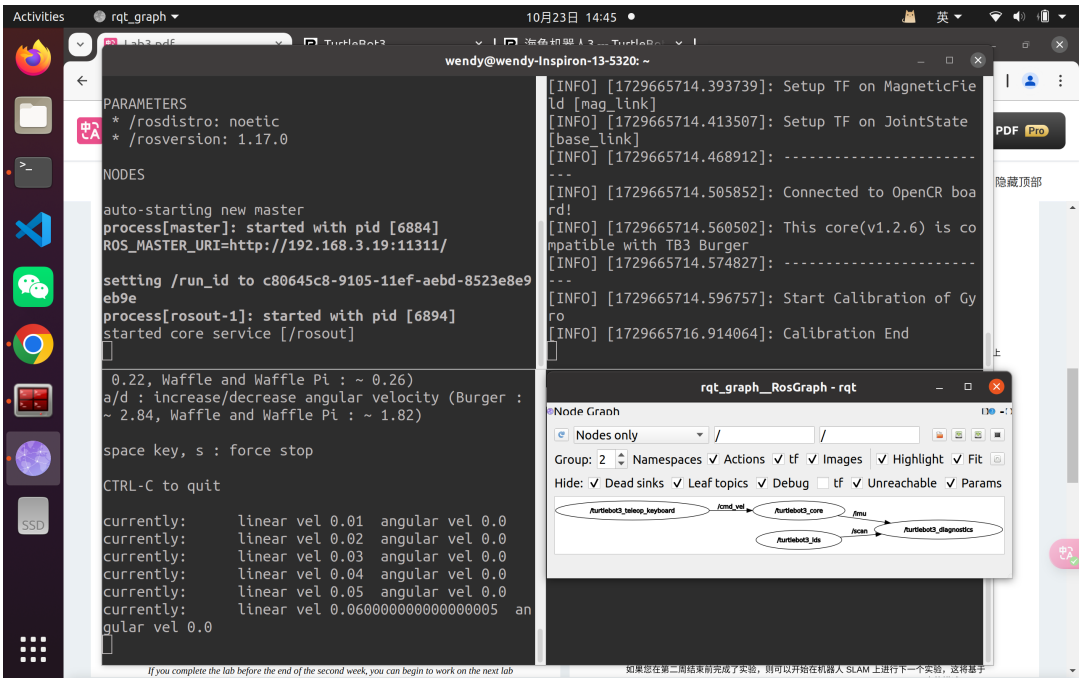


Fig. 1: rqt graph

2 HLS-LFCD2

The message /scan tells the information in the lidar. Using "rostopic echo /scan":

(a) The first page

(b) The second page

Fig. 2: The information in scan

Using the rviz, we can obeserve the pointcloud more clearly.

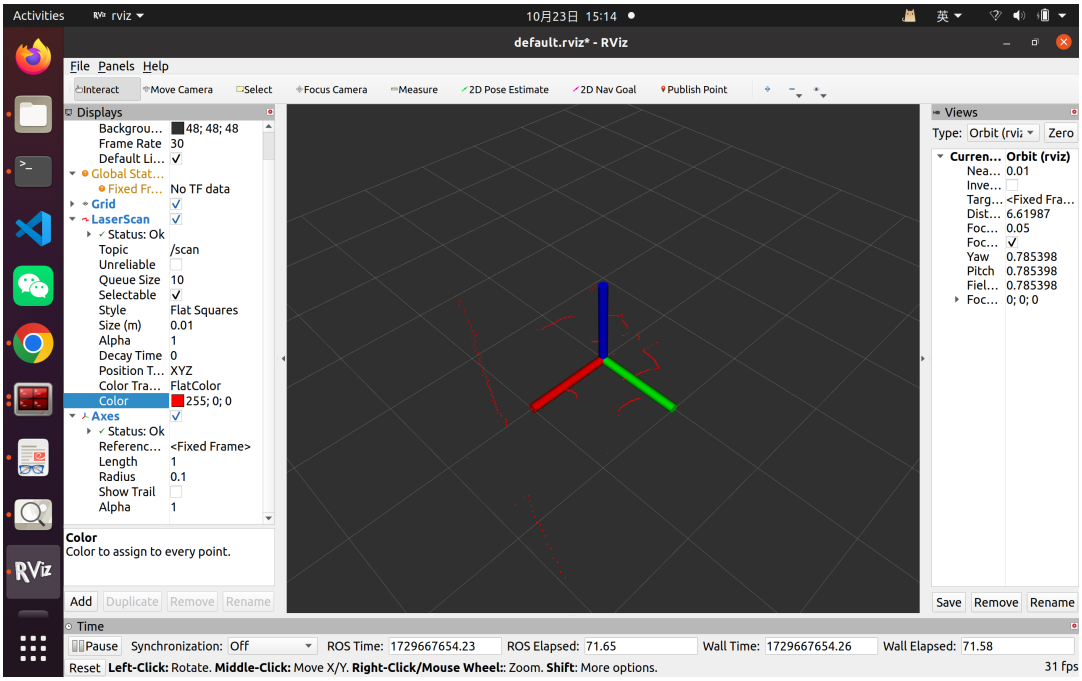


Fig. 3: rviz result

3 Verify the Performance of LiDAR

We put the robot beside a wall, the minimum distance (except 0) is the normal distance towards the wall. Like this:

Fig. 4: Experiment Scenario

```
def callback(scan):
  global dis

  dis_min = scan.range_max
  for i in range(0, 360):
    distance = scan.ranges[i]
    if distance < dis_min and distance != 0:
      dis_min = distance

  # the minimum distance represent the measured result normal to the wall
  dis.append(dis_min)
```

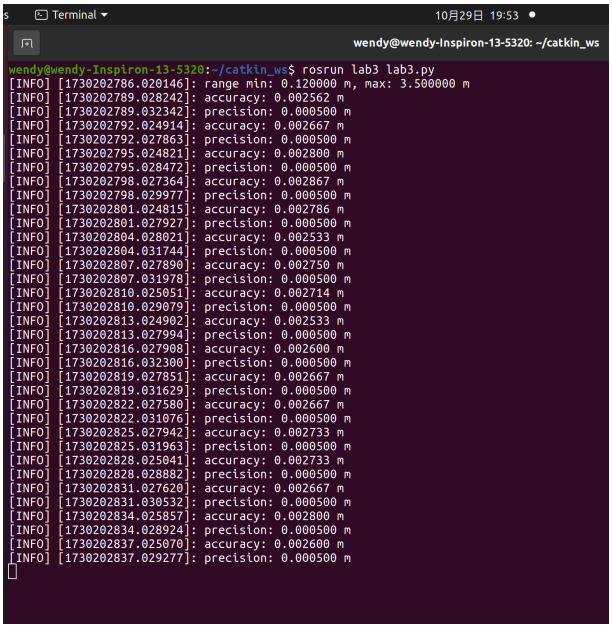
```python
def process_data(_):
  global dis

  if len(dis) > 0:
    dis_array = np.array(dis)
    rospy.loginfo("accuracy: %f m", abs(dis_array.mean() - dis_true))
    rospy.loginfo("precision: %f m", (dis_array.max() - dis_array.min()) / 2)
    dis.clear()
```

We can also read min and max in the scan, as follow:

```python
# range_min and range_max
scan = rospy.wait_for_message('/scan', LaserScan)
rospy.loginfo("range min: %f m, max: %f m", scan.range_min, scan.range_max)
```

When the true distance is 0.464m.
The result is:
range minimum: 0.120000m, range maximum: 3.500000m
accuracy: 0.002667m, precision: 0.0005m



(a) My result

Light source	Semiconductor Laser Diode(λ=785nm)
LASER safety	IEC60825-1 Class 1
Current consumption	400mA or less (Rush current 1A)
Detection distance	120mm ~ 3,500mm
Interface	3.3V USART (230,400 bps) 42bytes per 6 degrees, Full Duplex option
Ambient Light Resistance	10,000 lux or less
Sampling Rate	1.8kHz
Dimensions	69.5(W) X 95.5(D) X 39.5(H)mm
Mass	Under 125g

Measurement Performance Specifications

Items	Specifications
Distance Range	120 ~ 3,500mm
Distance Accuracy (120mm ~ 499mm)	±15mm
Distance Accuracy(500mm ~ 3,500mm)	±5.0%
Distance Precision(120mm ~ 499mm)	±10mm
Distance Precision(500mm ~ 3,500mm)	±3.5%
Scan Rate	300±10 rpm
Angular Range	360°

(b) Manual

Fig. 5: The information in scan

Our experimental results are in accordance with the instructions.
The range is the same as the manual, and the tolerances are within the limits specified in the manual.