1.About lidar

1. Program function description

After the program runs, drive the lidar, turn on the radar scanning data, and visualize the lidar scanning data in rviz.

2. Program code reference path

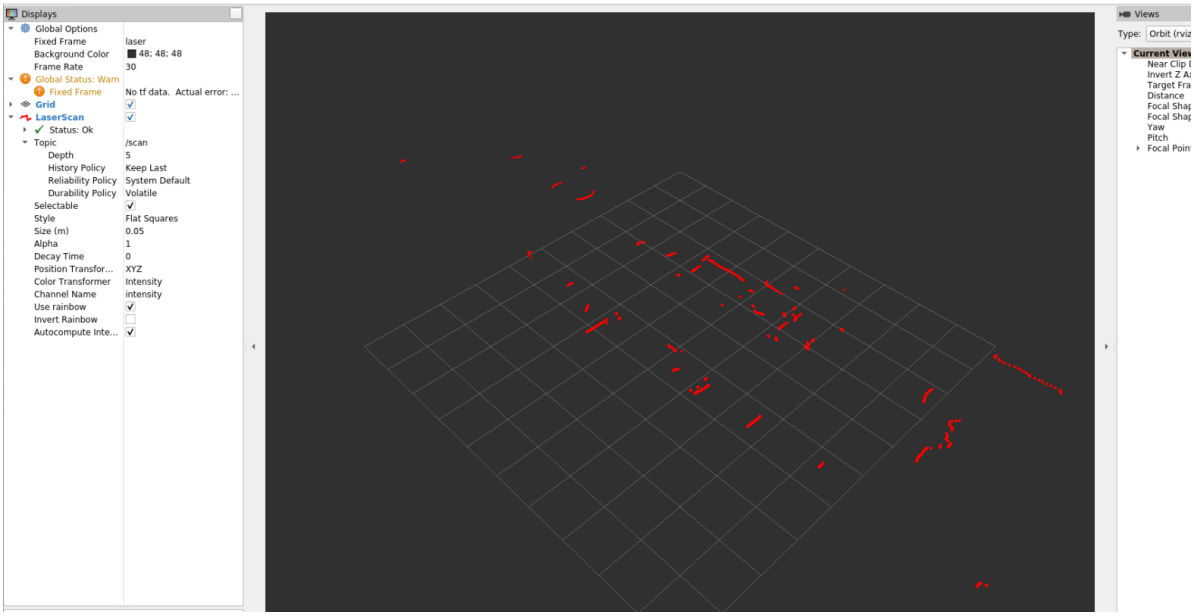
After entering the docker container, the location of the source code of this function is:

```
#A1 lidar
/root/yahboomcar_ros2_ws/software/library_ws/src/sllidar_ros2/launch/sllidar_launch.py
#4ROS lidar
/root/yahboomcar_ros2_ws/software/library_ws/src/ydlidar_ros2_driver-master/launch/ydlidar_raw_launch.py
#A1 lidar visualization
/root/yahboomcar_ros2_ws/software/library_ws/src/sllidar_ros2/launch/view_sllidar_launch.py
#4ROS lidar visualization
/root/yahboomcar_ros2_ws/software/library_ws/src/ydlidar_ros2_driver-master/launch/ydlidar_view_launch.py
```

3. Program startup

```
#Start A1 lidar
ros2 launch sllidar_ros2 sllidar_launch.py
#Start A1 lidar+rviz to visualize data
ros2 launch sllidar_ros2 view_sllidar_launch.py
#Start 4ROS lidar
ros2 launch ydlidar_ros2_driver ydlidar_raw_launch.py
#Start 4ROS lidar+rviz to visualize data
ros2 launch ydlidar_ros2_driver ydlidar_view_launch.py
```

Run screenshot, take starting "A1 lidar+visualization" as an example,



You can print the data scanned by lidar through the following command:

```
ros2 topic echo /scan
```

```
header:
  stamp:
    sec: 1681983563
    nanosec: 123403675
  frame_id: laser
angle_min: -3.1241390705108643
angle_max: 3.1415927410125732
angle_increment: 0.005806980188935995
time_increment: 0.00011245403584325686
scan_time: 0.1213379055261612
range_min: 0.15000000596046448
range_max: 12.0
ranges:
- 3.0320000648498535
- 3.0399999618530273
- 3.055999994277954
- 2.559999942779541
- 2.559999942779541
- 2.559999942779541
- 2.5480000972747803
- 2.5480000972747803
- 2.5399999618530273
```

4. Introduction to SLAM lidar

4.1. Overview

Single-line lidar refers to a radar whose line beam emitted by the laser source is a single line. It is divided into triangular ranging and TOF lidar. It is mainly used for robots.

Most field applications. It has fast scanning speed, strong resolution and high reliability. Compared with multi-line lidar, single-line lidar has better scanning speed at angular frequency and

The response is faster in terms of sensitivity, so the distance and accuracy of measuring obstacles are also more accurate.

4.2. Principle of ranging

The A1 lidar uses the triangulation ranging method, and the S2 lidar uses the tree TOF ranging method.

- Trigonometric distance measurement

  The laser triangulation ranging method mainly uses a beam of laser to illuminate the measured target at a certain incident angle. The laser is reflected and scattered on the target surface, and a lens is used to focus the reflected laser light at another angle.The light spot is imaged on the CCD (Charge-coupled Device, photosensitive coupling component) position sensor.When the measured object moves along the direction of the laser, the light spot on the position sensor will move, and its displacement corresponds to the movement distance of the measured object.Therefore, the distance value between the measured object and the baseline can be calculated from the light spot displacement distance through algorithm design. Since the incident light and reflected light form a triangle, the geometric triangle theorem is used to calculate the spot displacement, so this measurement method is called laser

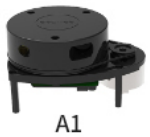
- TOF ranging method

  TOF lidar is based on measuring the flight time of light to obtain the distance of the target. Its working principle is mainly as follows: a modulated laser signal is emitted through a laser transmitter. The modulated light is received by the laser detector after being reflected by the object being measured. The distance to the target can be calculated by measuring the phase difference between the emitted laser and the received laser. .

4.3. Baud rate used

The baud rate of A1 lidar is 115200, and the baud rate of S2 lidar is 1000000.

4.4. Differences in various lidar models

Lidar	Measure method Measure radius	Measure frequency	Scanning frequency	Usage scenes	Application field
 A1	Triangular Ranging 12m	8000 times/s	10Hz	indoor	Open source hardware, educational robot, sweeping robot, service robot navigation obstacle avoidance, mapping, environment modeling.
 A2	Triangular Ranging 12m	8000 times/s	15Hz	indoor	Robot simultaneous localization and map construction (SLAM), environment scanning and 3D reconstruction, obstacle detection, multi-touch and human-machine interaction.
 A3	Triangular Ranging 25m	16000 times/s	20Hz	indoor /outdoor	Robot simultaneous localization and map construction (SLAM), environment scanning and 3D reconstruction, obstacle detection, multi-touch and human-machine interaction.
 S1	TOF ranging 40m	9200 times/s	15Hz	indoor /outdoor	Outdoor robot users, industrial users (positioning, mapping), stable ranging and high-precision mapping of outdoor scenes, large-screen interactive fields.
 S2	TOF ranging 30m	32000 times/s	15Hz	indoor /outdoor	Service robot navigation and obstacle avoidance, AGV vehicle obstacle detection and avoidance, parking space detection, multi-touch and large screen interaction, environmental scanning and 3D reconstruction, Drone mapping and obstacle avoidance.
 M2	TOF ranging 40m	9200 times/s	15Hz	indoor /outdoor	It satisfies the above-mentioned fields, and has built-in mapping and positioning functions at the same time, without external dependence, and mapping can be performed after power-on. It is more suitable for users who need instant mapping.