1. Introduction and use of SLAM lidar

1. Program function description

After the program is run, it drives the LiDAR of SLAM, turns on the lidar scanning data, and visualizes the data scanned by the LiDAR in rviz.

2. Program code reference path

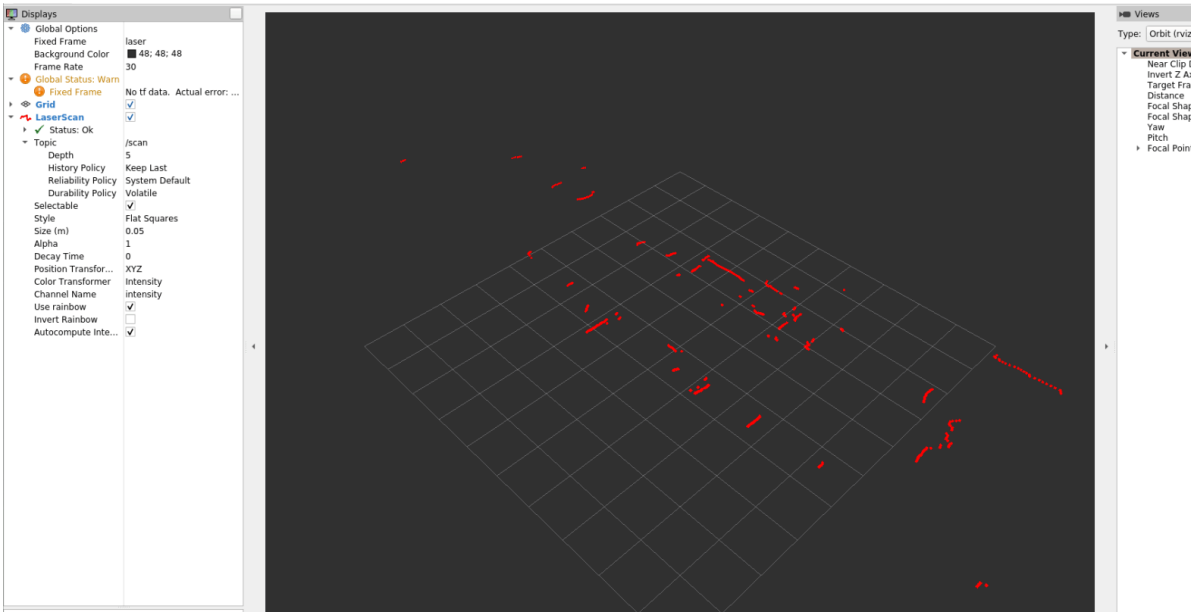
After entering the docker container, the location of the source code for this function is located at.

```
#A1雷达 #A1 lidar
/root/yahboomcar_ros2_ws/software/library_ws/src/sllidar_ros2/launch/sllidar_launch.py
#S2雷达 #S2 lidar
/root/yahboomcar_ros2_ws/software/library_ws/src/sllidar_ros2/launch/sllidar_s2_launch.py
#A1雷达可视化 #A1 lidar visualization
/root/yahboomcar_ros2_ws/software/library_ws/src/sllidar_ros2/launch/view_sllidar_launch.py
#S2雷达可视化 #S2 lidar visualization
/root/yahboomcar_ros2_ws/software/library_ws/src/sllidar_ros2/launch/view_sllidar_s2_launch.py
```

3. Program startup

```
#启动A1雷达 #Start A1 lidar
ros2 launch sllidar_ros2 sllidar_launch.py
#启动A1雷达+rviz可视化数据
#Start A1 lidar + rviz visualization data
ros2 launch sllidar_ros2 view_sllidar_launch.py
#启动S2雷达 #Start S2 lidar
ros2 launch sllidar_ros2 sllidar_s2_launch.py
#启动S2雷达+rviz可视化数据
#Start S2 lidar + rviz visualization data
ros2 launch sllidar_ros2 view_sllidar_s2_launch.py
```

Screenshot of the run, for example, launching "A1 lidar + Visualization".



The data from the lidar scan can be printed with the following command, the

```
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 Silan lidar

4.1 Overview

Single-line Lidar refers to the lidar where the beam from the laser source is a single line, which is divided into triangulation and TOF Lidar, and is mainly used in the robotic

It is mainly used in the field of robotics. Its scanning speed is fast, strong resolution, high reliability, compared with multi-line Lidar, single-line Lidar in the angular frequency and

Compared with multi-line LIDAR, single-line LIDAR has faster response in terms of angular frequency and sensitivity, so it is also more accurate in terms of distance and accuracy of obstacle ranging.

4.2 Ranging Principle

A1 lidar uses triangulation method and S2 lidar uses TOF method.

- Triangulation

  The laser triangulation method mainly involves irradiating the target with a laser beam at a certain angle of incidence, which is reflected and scattered on the surface of the target.

  Laser reflection and scattering on the surface of the target, the use of lenses at another angle on the reflected laser convergence imaging, spot imaging in the CCD (Charge-coupled Device, photocoupled) position sensor.

  The spot is imaged on the CCD (Charge-coupled Device) position sensor. When the object under test moves along the laser direction, the spot on the position sensor will move, and its displacement will correspond to the distance moved by the object.

  The displacement of the spot corresponds to the distance of the object, so the distance between the object and the baseline can be calculated from the spot displacement distance by the algorithm design.

  Since the incident and reflected light form a triangle, the calculation of the spot displacement utilizes the geometric triangulation theorem, so the measurement method is called laser

  Triangulation.

- TOF Ranging

  TOF LIDAR is based on measuring the time of flight of light to obtain the distance to a target. The principle of operation is that a modulated laser signal is emitted by a laser transmitter.

  The laser transmitter sends out a modulated laser signal, and the modulated light is reflected by the object under test and received by the laser detector.

  By measuring the phase difference between the transmitted laser light and the received laser light, the distance of the target can be calculated.

4.3. Baud rate used

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

4.4 Various Lidar Model Differences

Series	triangulation				TOF rangefinding	
Model Number	A1M8	A2M8	A3M1 enhanced mode	A3M1 outdoor mode	S1M1	S2M1 (IP65)
						
Recommended Applications	Intelligent sweeper, domestic robot (indoor)	3D modelling of commercial or consumer robots (indoor)	High performance (indoor)	High reliability, reliable sunlight resistance (indoor and outdoor)	Reliable sunlight resistance (indoor and outdoor)	Reliable sunlight resistance (indoor and outdoor)
Supply Voltage : 5V Scan range : 360°						
measuring radius	0.15m - 12m	0.2m - 16m	White objects: 25m Black objects: 10m	White objects: 20m Black object: To be determined	White objects: 40m Black objects: 10m	White objects: 0.05~30m Black objects: 0.05~10m
Measurement blindness	No reference value	No reference value	0.2m		0.1m	0.05m
communication rate	115200bps		256000bps			1M
sampling frequency	8K		16K	10K	9.2K	32K
scanning frequency	5.5Hz-10Hz	5Hz-15Hz	15Hz (10Hz-20Hz adjustable		8Hz-15Hz	
angular resolution	≤1°	0.9°	0.225°		0.391°	0.12°
Mechanical dimensions	96.8mm*70.3mm*55mm	⌀76mm*41mm	⌀76mm*41mm		55.5mm*55.5mm*51mm	77.1mm*77mm*38.85mm

Supply Current	100mA	450mA - 600mA	400mA	
power wastage	0.5W	2.25W-3W	> 2W	
exports	UART serial port (3.3V level)			
working temperature	0℃~40℃		(-5℃-45℃)	(-10℃~50℃)
Ranging accuracy	material distance 1% (≤3 m) material distance 2% (3-5 m) material distance 2.5% (>5m)		±5cm	±3cm

From the above figure, it can be seen that parameters such as measurement radius, sampling speed, scanning frequency and angular resolution are important indicators of the performance of the lidar operation.

mark	descriptions
Measuring radius	Measuring distance range of the lidar
Ranging Sampling Rate	How many ranging outputs in a second
Scan Frequency	How many lidar scans in a second?
angular resolution	Angular stepping of two neighbouring ranges
Measurement resolution/accuracy	Distance variation minimum can be perceived

A higher **scanning frequency** ensures that Lidar-mounted robots can move faster and that the quality of map construction is maintained. However, increasing the scanning frequency is not simply a matter of accelerating the rotation of the scanning motors inside the lidar, it corresponds to the need to increase the ranging sampling rate. Otherwise, when the sampling frequency is fixed, faster scanning speed will only reduce the angular resolution. In addition to the distance, scanning frequency, measurement resolution and map building accuracy and other parameters for lidar performance is also important, these are to ensure that the robot can have a stable performance of important parameters.