Introduction and use of lidar

1. Program function description

After the program runs, drive the LIDAR, turn on the lidar scanning data, visualise the data scanned by the LIDAR in rviz.

2. Program code reference path

The location of the source code for this function is located at.

```
cd ~/cartographer_ws2
source install/setup.bash
#MS200雷达
#MS200 lidar
/home/pi/cartographer_ws2/src/olidar_lidar/launch/ms200_scan.launch.py
#MS200雷达可视化
#MS200 lidar visualisation
/home/pi/cartographer_ws2/src/olidar_lidar/launch/ms200_scan_view.launch.py
```

3. Programme start

Since the lidar chassis is already booting up and self-starting, to start the lidar separately, please stop the self-starting service first and enter the command in the terminal:

```
sudo systemctl stop XgoStart.service
```

```
#启动MS200雷达
# Activate MS200 lidar
ros2 launch olidar_lidar ms200_scan.launch.py
#启动MS200雷达+rviz可视化数据
#Start MS200 lidar + rviz visualisation data
ros2 launch olidar_lidar ms200_scan_view.launch.py
```

Screenshot of the run, for example starting "MS200 lidar + Visualisation".
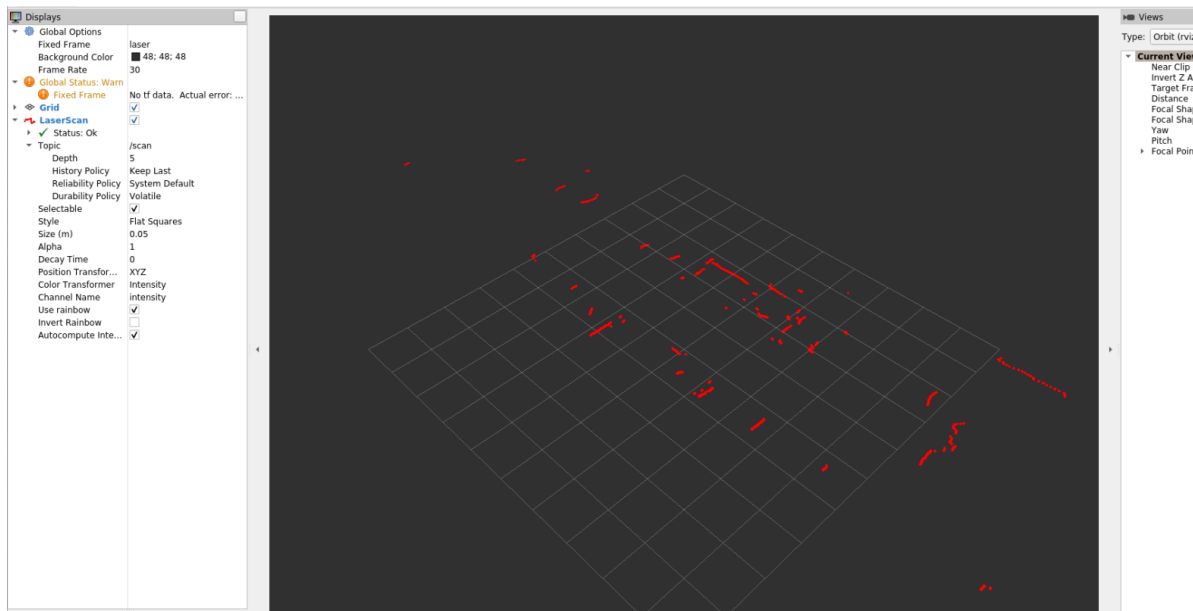
The data from the lidar scan can be printed with the following command,

```
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
- 2.548000972747803
- 2.548000972747803
- 2.5399999618530273
```

4. Introduction to Silan lidar

4.1 Overview

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

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

Sensitivity of single-line LIDAR is faster, so it is more accurate in the 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 uses a laser beam to irradiate the target at a certain angle of incidence, the laser light reflects and scatters on the surface of the target, and the laser light is transmitted to the target at another angle using a transmission beam.

  Laser reflection and scattering on the surface of the target, in another angle using a lens 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 moving distance of the object.

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

  Since the incident and reflected light form a triangle, the calculation of the spot displacement applies the geometric triangle 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, which is reflected by the object to be measured and then received by the laser detector, by measuring the phase difference between the transmitted laser and the received laser, the distance can be calculated.

  By measuring the phase difference between the transmitted laser light and the received laser light, the distance to 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. Differences between various LIDAR models

Series	triangulation				TOF rangefinding	
	A1M8	A2M8	A3M1		S1M1	S2M1 (IP65)
			enhanced mode	outdoor mode		
Model Number						
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 lidar's operational performance.

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 the LIDAR-mounted robot achieves faster speeds and guarantees the quality of the map construction. But to Increase the scanning frequency is not simply a matter of accelerating the rotation of the scanning motors inside the LiDAR, but corresponds to an increase in the ranging sampling rate. Otherwise, when the sampling rate is fixed, a faster scanning speed will only reduce the angular resolution. In addition to the range and scanning frequency, parameters such as measurement resolution and map building accuracy are also important. In addition to the range and scanning frequency, parameters such as measurement resolution and map building accuracy are also important for Lidar performance, and these are the most important parameters to ensure the stability of the robot. These parameters are important for the stability of the robot.