1、Introduction and use of radar

1、Program function description

After the program runs, drive the LiDAR of Silan, turn on the radar scan data, and visualize the LiDAR scan data in RVIZ.

2、Program code reference path

Raspberry Pi PI5 master needs to enter the docker container first, Orin motherboard does not need to enter,

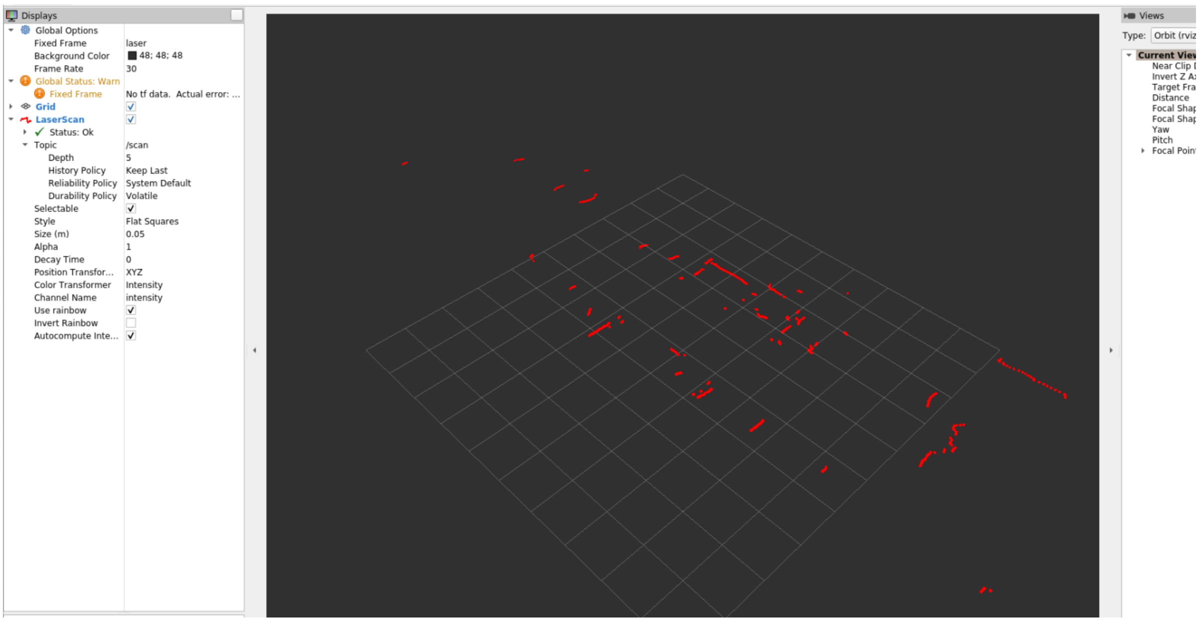
the location of the source code of this function is located at,

```
#A1 radar
~/yahboomcar_ros2_ws/software/library_ws/src/sllidar_ros2/launch/sllidar_launch.py
#S2 radar
~/yahboomcar_ros2_ws/software/library_ws/src/sllidar_ros2/launch/sllidar_s2_launch.py
#A1 radar visualization
~/yahboomcar_ros2_ws/software/library_ws/src/sllidar_ros2/launch/view_sllidar_launch.py
#S2 radar visualization
~/yahboomcar_ros2_ws/software/library_ws/src/sllidar_ros2/launch/view_sllidar_s2_launch.py
```

3、The program starts

```
#Start the A1 radar
ros2 launch sllidar_ros2 sllidar_launch.py
#Start A1 radar + rviz to visualize data
ros2 launch sllidar_ros2 view_sllidar_launch.py
#Start the S2 radar
ros2 launch sllidar_ros2 sllidar_s2_launch.py
#Start S2 radar + rviz to visualize data
ros2 launch sllidar_ros2 view_sllidar_s2_launch.py
```

Run the screenshot, take the launch of "A1 radar + visualization" as an example,



You can print the data of radar scans by the following command:

```
ros2 topic echo /scan
```

4、Introduction to Silan Radar

4.1、Overview

Single-line lidar refers to a single-line radar with a single line of wiring emitted by the laser source, with triangulation ranging and TOF lidar, mainly based on robots

Most of the applications in the field. Its scanning speed is fast, the resolution is strong, the reliability is high, compared with multi-line lidar, single-line lidar has a corner frequency and The sensitivity response is faster, so the distance and accuracy of obstacles are more accurate.

4.2、the principle of ranging

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

- Triangulation ranging method

The laser triangulation ranging method mainly irradiates the measured target with a certain angle of incidence through a laser beam, and the laser reflects and scatters on the surface of the target

Radiation, at another angle using a lens to reflect the laser convergence imaging, spot imaging in CCD (Charge-coupled Device, photosensitive coupling

component) on the position sensor. When the measured object moves in the direction of the laser, the spot on the position sensor will move, and its displacement is large

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

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

Triangulation ranging method.

- 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 manifested as laser emission

The device emits a modulated laser signal, which is reflected by the measured object and received by the laser detector, and the laser is emitted and the reception excitation is transmitted by measurement

The phase difference of light calculates the distance to the target.

4.3、the baud rate used

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

4.4、differences in various lidar models

RPLIDAR Parameter comparison

Series	Triangular Ranging				TOF ranging		
Model	A1M8	A2M8	A3M1 Enhanced mode	A3M1 Outdoor mode	S2L	S2	M2M2
							
Recommended Applications	Smart sweeper, household robot (indoor)	Commercial or consumer robot 3D modeling (indoor)	High performance (indoor)	Stable performance, strong ability to resist sunlight (indoor/outdoor)	Strong ability to resist sunlight (indoor/outdoor)		commercial robot environmental mapping, han-held measurement (indoor/outdoor)
Measuring radius	0.15m - 12m	0.2m - 16m	White object: 25m Black object: 10m	White object: 20m Black object:	White object: 0.05~18m Black object: 0.05~8m	White object: 0.05~30m Black object: 0.05~10m	0.1m~40m
Measurement dead zone	No reference value	No reference value	0.2m		0.05m		No reference value
Communication rate	115200bps		256000bps		1M		
Sampling frequency	8K		16K	10K	32K		9.2K
Scanning frequency	5.5Hz-10Hz	5Hz-15Hz	15Hz (10Hz-20Hz Adjustable)		8Hz-15Hz		
Angular resolution	≤1°	0.9°	0.225°		0.12°		0.391°
Mechanical dimensions (unit: mm)	96.8*70.3*55	⌀76*41	⌀76*41		77.1*77*38.85		77.1*57*74.9
Supply current	100mA	450mA - 600mA			400mA		750mA - 1300mA
Power consumption	0.5W	2.25W-3W			> 2W		3.75W-6.5W
Output	UART serial port (3.3V leve)						Ethernet/WiFi
Operating temperature	0℃~40℃					(-10℃~50℃)	(-5℃-45℃)
Ranging accuracy	Actual distance 1% (≤3 m) Actual distance 2% (3-5 m) Actual distance 2.5% (>5m)					±3cm	≤5cm (Within the range)
ROS version	ROS1 / ROS2						
Supply voltage: 5V Scanning Range: 360°							

As can be seen from the above figure, the measurement radius, sampling speed, scanning frequency, angular resolution and other parameters are important indicators of radar working performance.

index	description
Radius of ranging	The range of the radar measuring distance
Ranging sample rate	How many ranging outputs are performed in 1 second
Scan frequency	How many scans the radar performs in 1 second

index	description
Angular resolution	Angular step of two adjacent ranges
Measurement resolution/accuracy	The minimum change in distance can be perceived

The high scanning frequency ensures that the LiDAR-mounted robot can achieve faster movements and the quality of the map construction. However, to increase the scanning frequency, it is not just as simple as accelerating the rotation of the internal scanning motor of LiDAR, corresponding to the need to increase the ranging sampling rate. Otherwise, when the sampling frequency is fixed, the faster scanning speed will only reduce the angular resolution. In addition to ranging distance and scanning frequency, parameters such as measurement resolution and mapping accuracy are equally important for lidar performance, which are important parameters to ensure stable performance of the robot.