

How to use lidar

Note: The baud rate is different between A1/A2<115200>, A3/S1<256000> and S2<1000000>.

Note: The information of the lidar M2M2 and the radar of this course (A1/A2/A3/S1/S2) are different, please view the information according to the corresponding model

Note: "Slam Lidar Course" is based on the use of Transbot crawler vehicles, for reference only!!!

How to use lidar

- 1、 Overview
- 2、 Silan lidar components
 - 2.1、 Laser
 - 2.2、 Receiver
 - 2.3、 Signal processing unit
 - 2.4、 Rotating mechanism
- 3、 Principle of single-line lidar
 - 3.1、 Triangular Ranging Method
 - 3.1.1、 Direct shot
 - 3.1.2、 Oblique shot
 - 3.2、 TOF Ranging Method
- 4、 Lidar parameter comparison
- 5、 Application scenarios
- 6、 Run rplidar node
 - 6.1、 Build the rplidar ros package
 - 6.2、 Remap the USB serial port
 - 6.3、 Run rplidar ros package
- 7、 RoboStudio test
 - 7.1、 Install
 - 7.2、 View device
 - 7.3、 Log in
 - 7.4、 Connect
 - 7.5、 Test
- 8、 frame_grabber
 - 8.1、 View device
 - 8.2、 connect
 - 8.3、 Start up

Lidar technology support Email : support@slamtec.com

Lidar wiki: <http://wiki.ros.org/rplidar>

Lidar SDK: https://github.com/Slamtec/rplidar_sdk

Lidar ROS: https://github.com/Slamtec/rplidar_ros

Lidar tutorials: https://github.com/robopeak/rplidar_ros/wiki

Lidar website: <http://www.slamtec.com/cn/Support>

Test the PC computer: <https://www.slamtec.com/cn/RoboStudio>

1、 Overview

Single-line lidar refers to a single-line laser beam emitted by the laser source. It is divided into triangular ranging and TOF lidar. It is mainly used in the field of robotics.

2、Silan lidar components

Take SLAMTec lidar as an example, which is mainly composed of 4 core components: laser, receiver, signal processing unit and rotating mechanism.

2.1、Laser

The laser is the laser emitting mechanism in the lidar. During work, it will light up in pulses.

The RPLIDAR A3 series lidar of SLAMTec will turn on and off 16000 times per second.

2.2、Receiver

After the laser emitted by the laser hits the obstacle, the reflected light will be converged on the receiver through the lens group through the reflection of the obstacle.

2.3、Signal processing unit

The signal processing unit is responsible for controlling the emission of the laser and processing the signal received by the receiver.

Based on this information, the distance information of the target object is calculated.

2.4、Rotating mechanism

The above three components constitute the core part of the measurement.

The rotating mechanism is responsible for rotating the above-mentioned core components at a stable speed, so as to realize the scanning of the plane and generate real-time plan information.

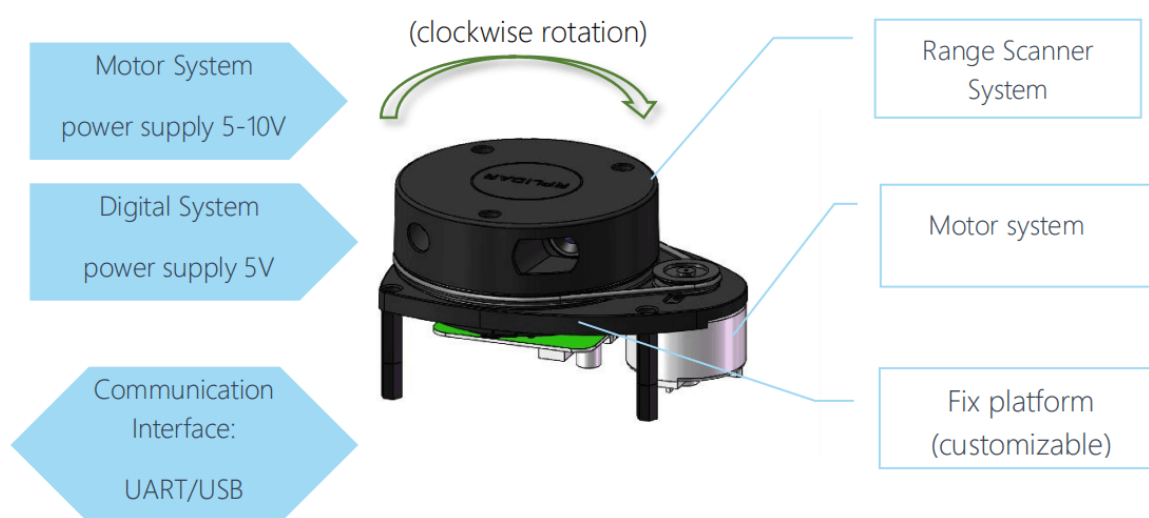
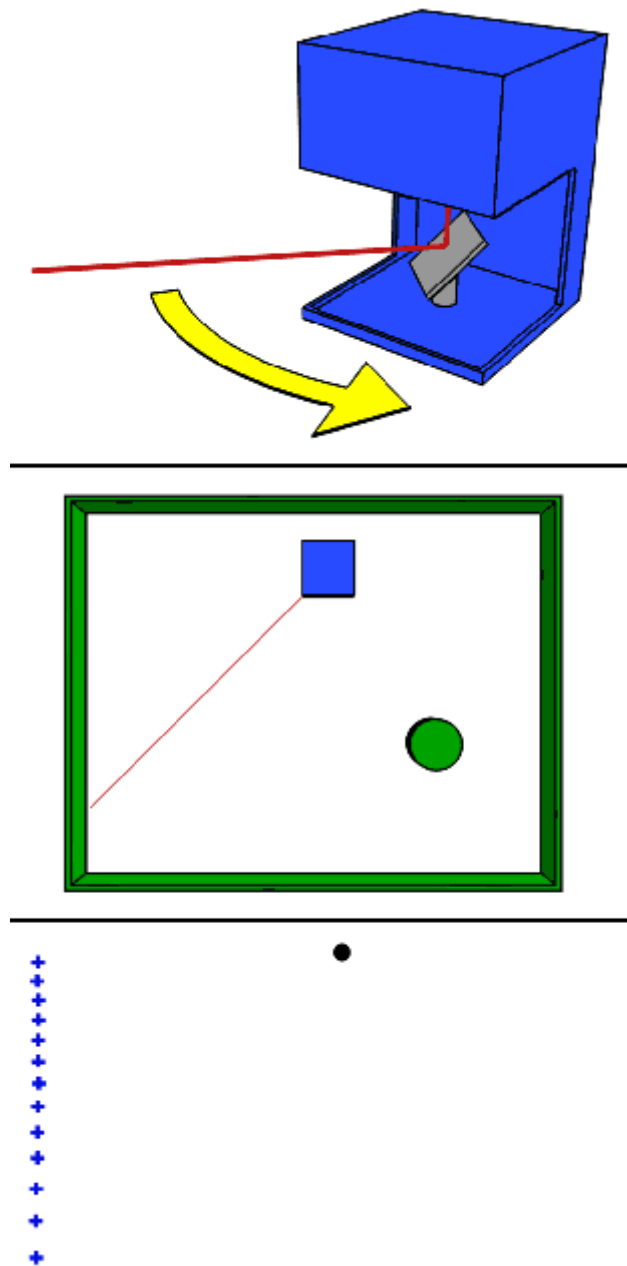


Figure 1-1 RPLIDAR A1 System Composition

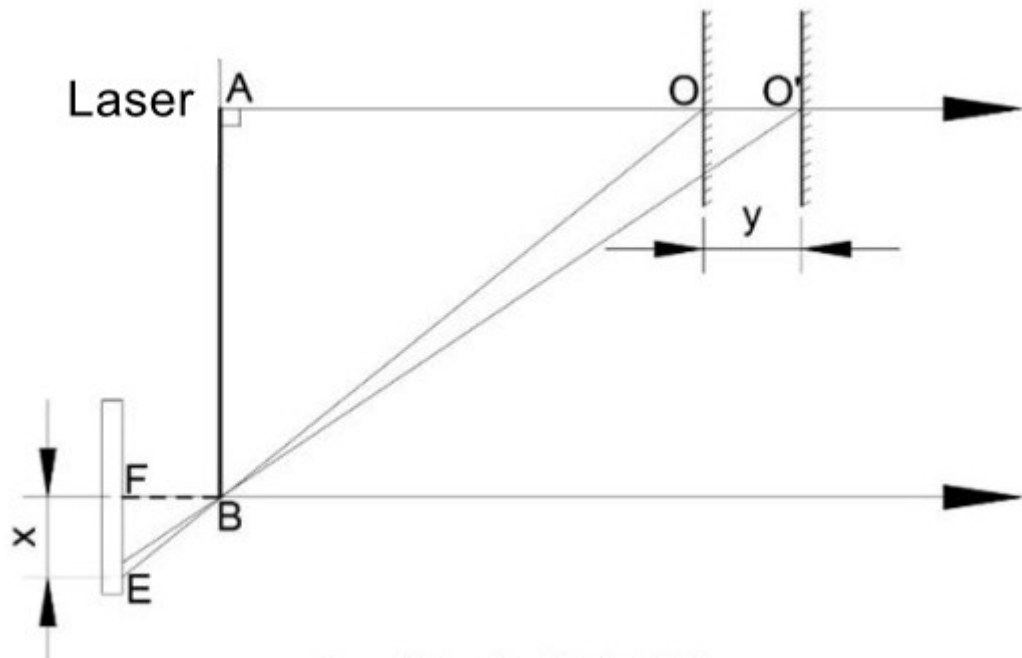
3、Principle of single-line lidar

The working principle of the radar is shown in the figure below:

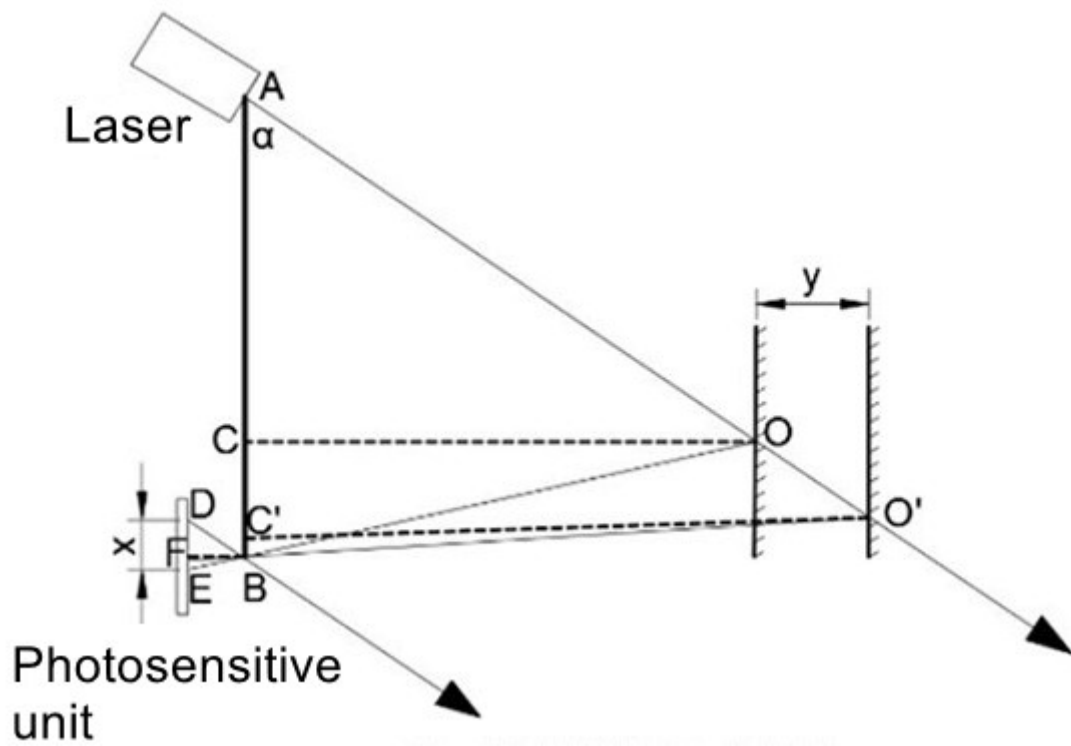


3.1、 Triangular Ranging Method

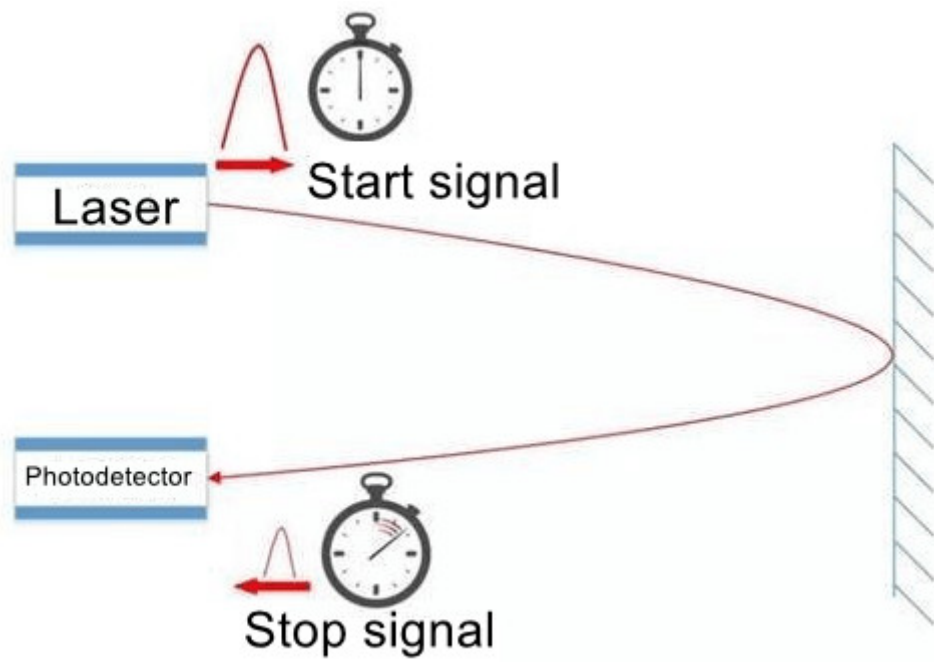
3.1.1、 Direct shot



3.1.2, Oblique shot



3.2, TOF Ranging Method



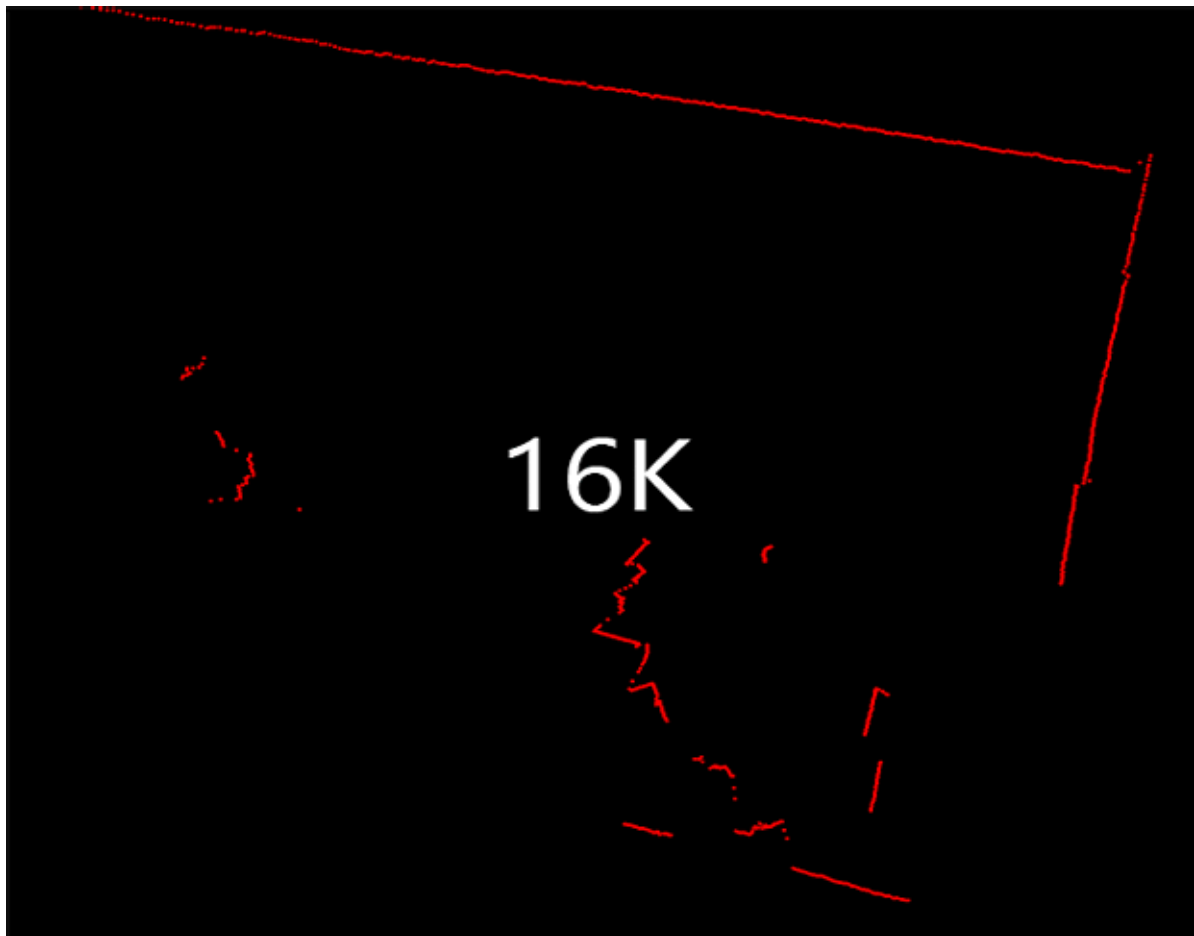
4、 Lidar parameter comparison

RPLIDAR Parameter comparison

Series	Triangular Ranging				TOF ranging		
Model	A1M8	A2M8	A3M1		S1M1	S2M1(IP65)	M2M2
			Enhanced mode	Outdoor mode			
							
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)	Strong ability to resist sunlight (indoor/outdoor)	Commercial robot environmental mapping, hand-held measurement (indoor/outdoor)
Measuring radius	0.15m - 12m	0.2m - 16m	White object: 25m Black object: 10m	White object: 20m	White object: 40m Black object: 10m	White object: 0.05~30m Black object: 0.05~10m	0.1m~40m
Measurement dead zone	No reference value	No reference value	0.2m		0.1m	0.05m	No reference value
Communication rate	115200bps		256000bps			1M	
Sampling frequency	8K		16K	10K	9.2K	32K	9.2K
Scanning frequency	5.5Hz-10Hz	5Hz-15Hz	15Hz (10Hz-20Hz Adjustable)		8Hz-15Hz		
Angular resolution	≤1°	0.9°	0.225°		0.391°	0.12°	0.391°
Mechanical dimensions (unit: mm)	96.8*70.3*55	ø76*41	ø76*41		55.5*55.5*51	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°C~40°C				(-5°C-45°C)	(-10°C~50°C)	(-5°C-45°C)
Ranging accuracy	Actual distance 1% (≤3 m) Actual distance 2% (3-5 m) Actual distance 2.5% (>5m)				±5cm	±3cm	≤5cm (Within the range)
Supply voltage: 5V Scanning Range: 360°							

It can be seen from the figure above that parameters such as measurement radius, sampling speed, scanning frequency, and angular resolution are important indicators of radar performance.

Performance	Description
Ranging radius	Radar measurement range
Ranging sampling rate	How many ranging outputs are performed in one second
Scanning frequency	How many scans the radar does in one second
Angular resolution	Angular steps of two adjacent ranging
Measurement resolution/accuracy	Can perceive the minimum distance change



5、Application scenarios

Lidar plays an indispensable role in many fields such as autonomous robot positioning and navigation, spatial environment mapping, and security.

6、Run rplidar node

6.1、 Build the rplidar ros package

Function download link: https://github.com/Slamtec/rplidar_ros/

Clone this feature pack to your workspace src folder

Run catkin_make to build rplidarNode and rplidarNodeClient

Note: If you do not write the update environment variable to `【.bahrsrc】` , you must update the environment variable before each execution of the running program.

```
source devel/setup.bash # Update environment variables
```

6.2、 Remap the USB serial port

Under the path of rplidar_ros function package, install USB port remapping:

```
./scripts/create_udev_rules.sh
```

Use the following command to modify the remapping:

```
ls -l /dev | grep ttyUSB
```

```
lrwxrwxrwx 1 root root      7 Sep 14 15:04 rplidar -> ttyUSB0
crwxrwxrwx 1 root dialout 188, 0 Sep 14 15:04 ttyUSB0
jetson@jetson-yahboom:~$
```

After changing the USB port and remapping, change the startup file related to the serial_port value.

```
<launch>
  <node name="rplidarNode" pkg="rplidar_ros" type="rplidarNode" output="screen"
  respawn="true">
    <param name="serial_port" type="string" value="/dev/rplidar"/>
    <param name="serial_baudrate" type="int" value="115200"/>
    <param name="frame_id" type="string" value="laser"/>
    <param name="inverted" type="bool" value="false"/>
    <param name="angle_compensate" type="bool" value="true"/>
  </node>
</launch>
```

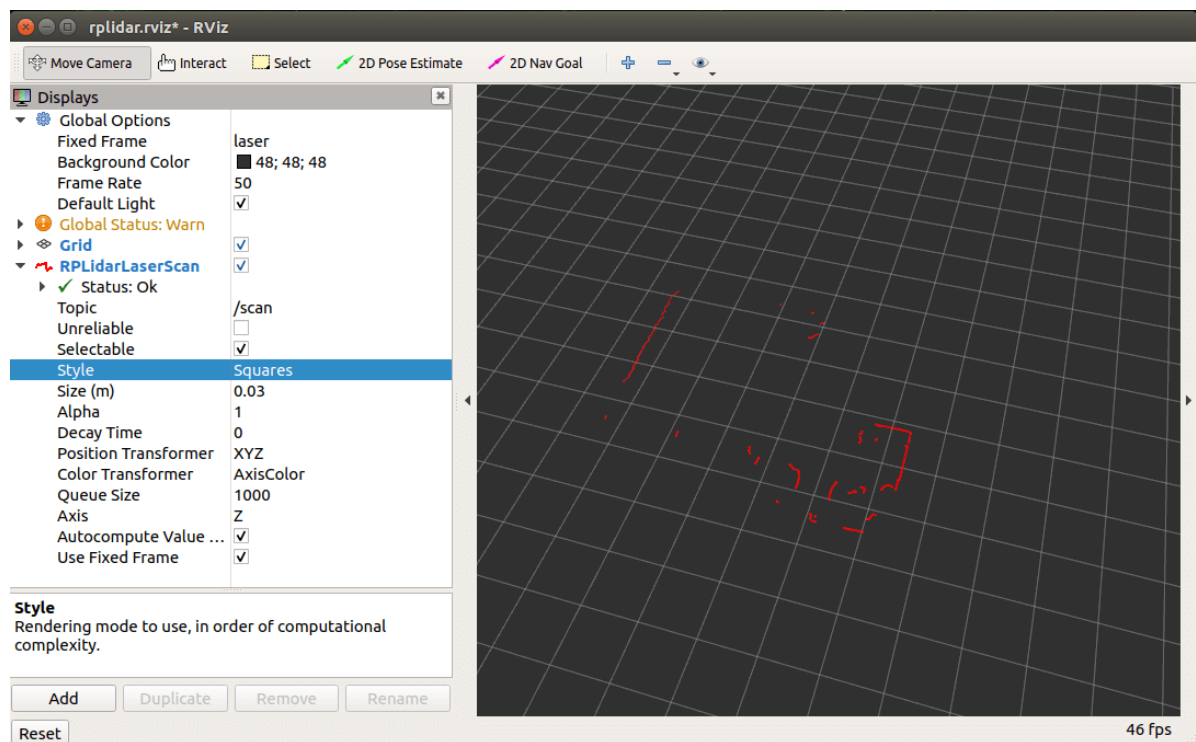
6.3、 Run rplidar ros package

- Method 1

Run rplidar node, view in rviz

```
roslaunch rplidar_ros view_rplidar.launch # RPLIDAR A1/A2
roslaunch rplidar_ros view_rplidar_a3.launch # RPLIDAR A3
roslaunch rplidar_ros view_rplidar_s1.launch # RPLIDAR S1
roslaunch rplidar_ros view_rplidar_s2.launch # RPLIDAR S2
```

You can see rplidar scan results in rviz.



- Method 2

Run rplidar node

```
roslaunch rplidar_ros rplidar.launch      # RPLIDAR A1/A2
roslaunch rplidar_ros rplidar_a3.launch   # RPLIDAR A3
roslaunch rplidar_ros rplidar_s1.launch   # RPLIDAR S1
roslaunch rplidar_ros rplidar_s2.launch   # RPLIDAR S2
```

Start the test application

```
roslaunch rplidar_ros rplidarNodeClient
```

You should see rplidar scan results in the console

```
/home/jetson/software/transbot_library/src/rplidar_ros/launch/rplidar.launch http://192.168.2.88:11311
/home/jetson/software/transbot_library/src/rplidar_ros/launch/rplidar.launch http://192.168.2.88:11311

ROS_MASTER_URI=http://192.168.2.88:11311

process[rplidarNode-1]: started with pid [30121]
[ INFO] [1631603935.771331312]: RPLIDAR running on ROS package rplidar_ros. SDK
Version: 'RPLIDAR_SDK_VERSION'
RPLIDAR S/N: 6A97EDF9C7E29BD1A7E39EF2FA44431B
[ INFO] [1631603938.283765720]: Firmware Ver: 1.29
[ INFO] [1631603938.283878164]: Hardware Rev: 7
[ INFO] [1631603938.286787688]: RPLidar health status : 0
[ INFO] [1631603938.852257002]: current scan mode: Sensitivity, max_distance: 12
.0 m, Point number: 7.9K , angle_compensate: 2

jetson@jetson-yahboom: ~ 80x13
[ INFO] [1631604001.255756570]: : [-165.019455, 2.292000]
[ INFO] [1631604001.255823084]: : [-164.520142, 2.300000]
[ INFO] [1631604001.255875013]: : [-164.020844, 2.304000]
[ INFO] [1631604000.796763781]: : [-91.621681, 1.466000]
[ INFO] [1631604000.796990301]: : [-91.122375, 1.466000]
[ INFO] [1631604000.797332139]: : [-90.623070, 1.466000]
[ INFO] [1631604000.797995606]: : [-90.123764, 1.464000]
[ INFO] [1631604000.798390416]: : [-89.624458, 1.462000]
[ INFO] [1631604000.798731785]: : [-89.125160, 1.462000]
[ INFO] [1631604000.799267069]: : [-88.625847, 1.460000]
[ INFO] [1631604000.799543800]: : [-88.126549, 1.192000]
[ INFO] [1631604000.799790009]: : [-87.627243, 1.192000]
```

7、RoboStudio test

Test tool download link: <https://www.slamtec.com/cn/RoboStudio>

Take S1M1 radar as an example, other models are similar.

7.1、Install

Double-click robostudio icon to install, and continue to the next step until the installation is complete. Adjust the radar to the corresponding baud rate [A1/A2: 115200, A3/S1: 256000, S2: 1000000].

Using the original data cable to connect the device (for example: PC).

7.2、View device



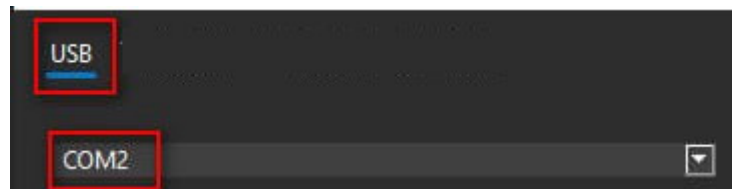
由上图可知道，激光雷达的端口是【COM2】。

7.3、Log in

Log in for the first time, you need to register before you can use it. Select [Radar], right-click in the blank area of the radar bar, and select [Manually connect to radar...].

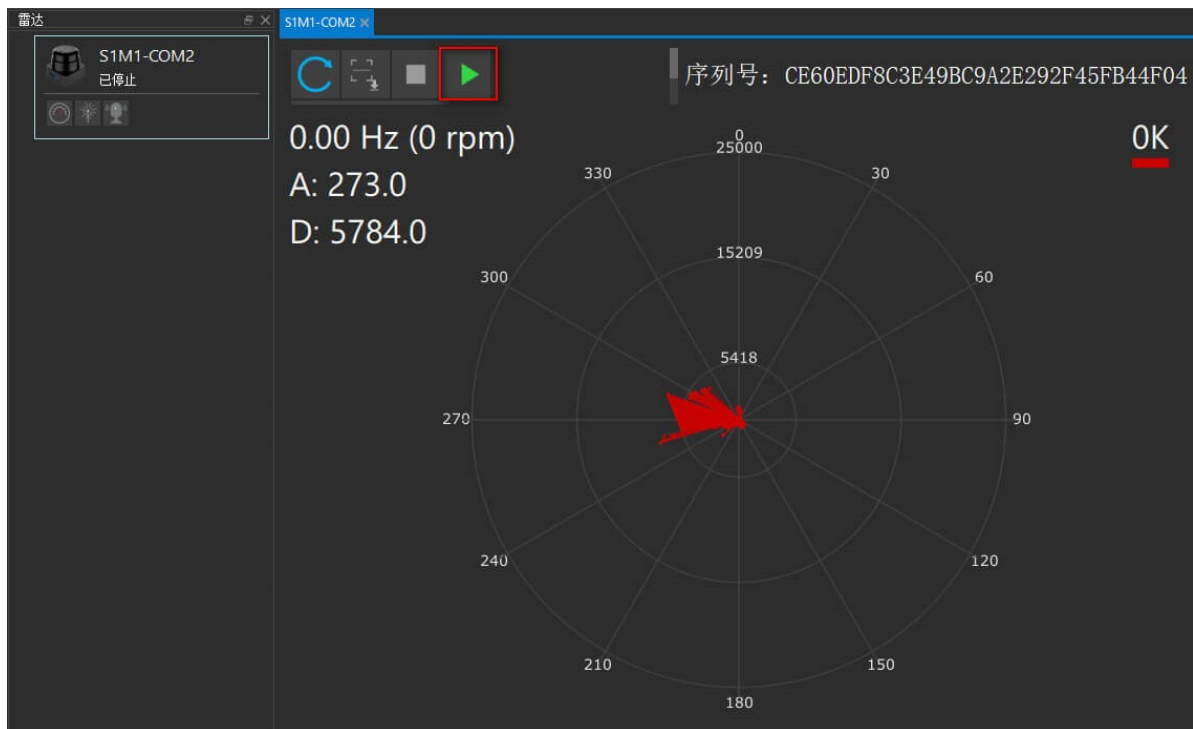
7.4、Connect

Select the corresponding [COM2], and click [Connect].

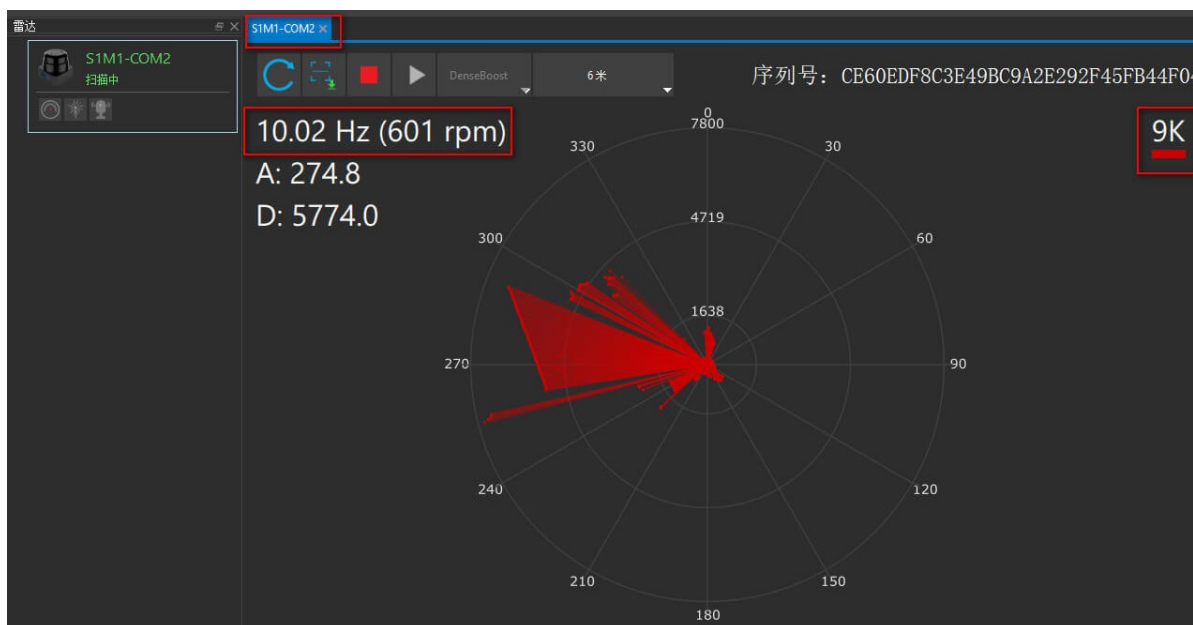


7.5、Test

Enter the test interface, click the green triangle to start the lidar test.



We can view the basic information of the radar: model [S1M1], sampling frequency [9K], scanning frequency [10.02Hz], etc.



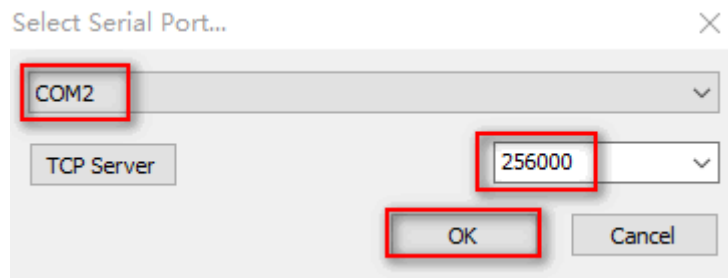
8、frame_grabber

8.1、View device

The operation is the same as in 7.2.

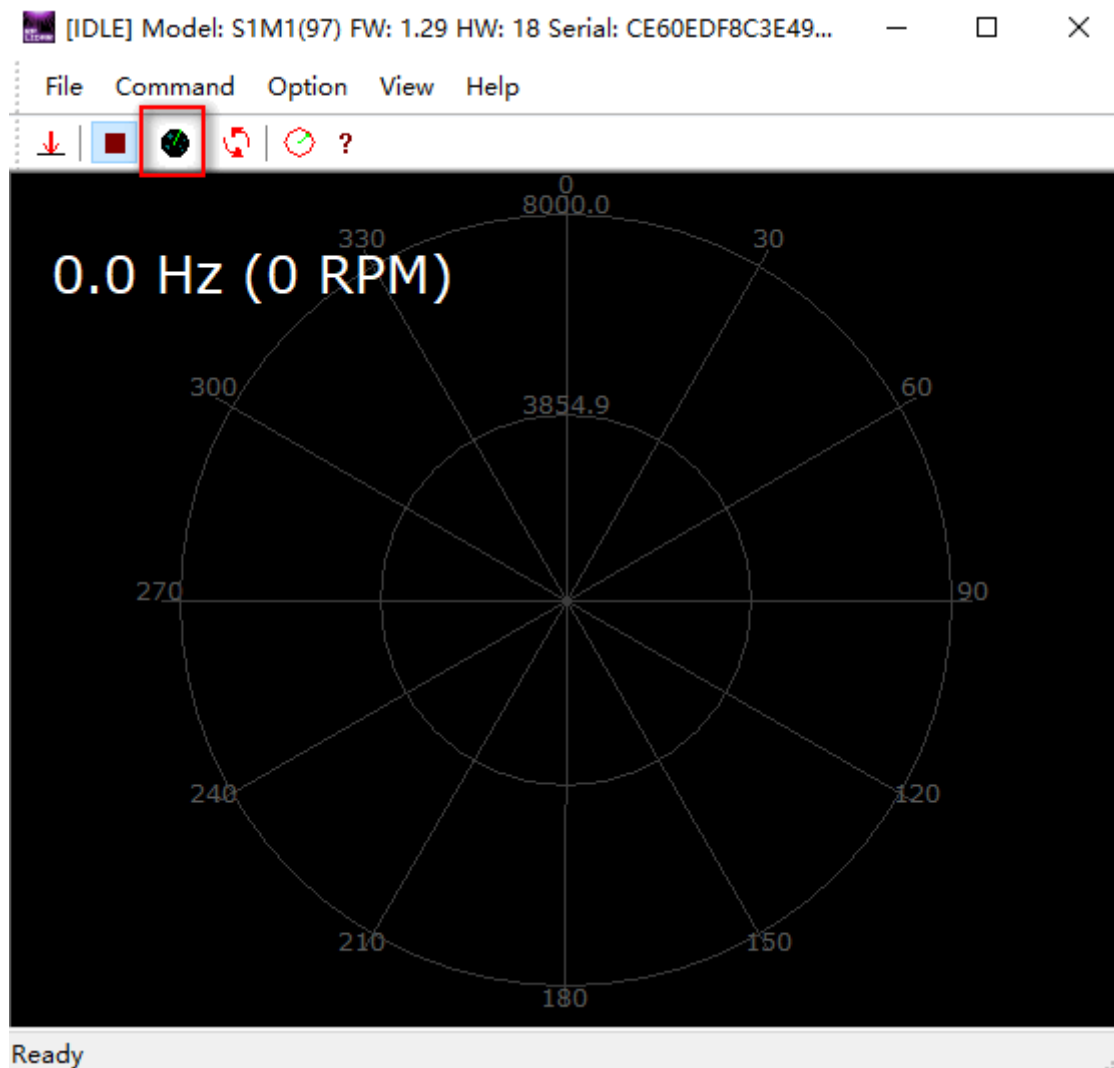
8.2、connect

Select the corresponding port [COM2] and baud rate [256000], and click [OK].



8.3、Start up

Click as shown in the figure below to activate the button.



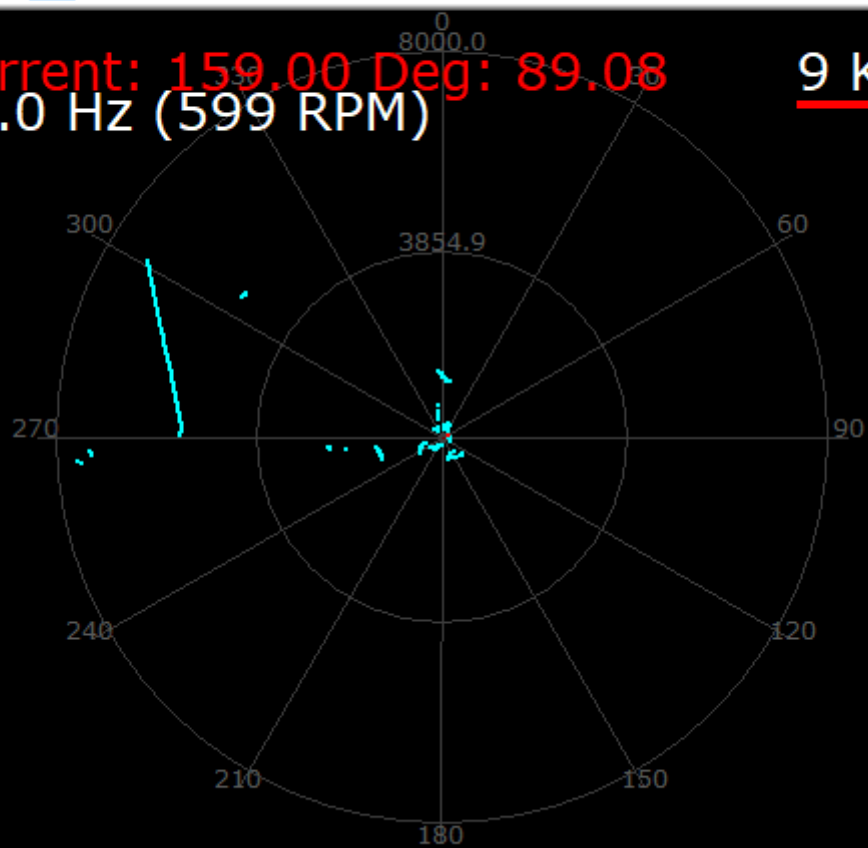
The effect diagram is as follows.

File Command Option View Help



Current: 159.00 Deg: 89.08
10.0 Hz (599 RPM)

9 K



Ready