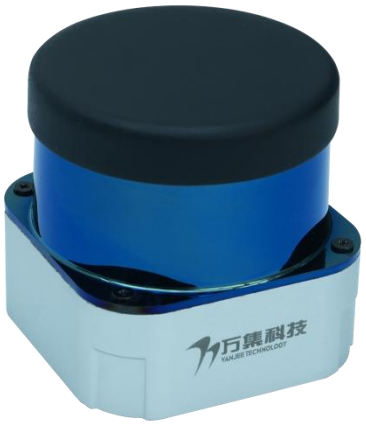
WLR-719C 4-Line LiDAR Brochure



Version information: V2.0.1 2022-9-16 Scan to follow VANJEE LIDAR Wechat

Safety Instructions

Please read the following safety instructions carefully to avoid damage the product or other devices connected to the product.

- Power cable: only the power cable approved by the country is allowed to be used.
- Check the nominal values: to avoid excessive current, please check the nominal values and signs on the product, please refer to this manual for detailed information about nominal values before connecting the product.
- Over-voltage protection: ensure that no over-voltage is connected to the product.
- Grounding: in order to avoid electric shock, before connecting any input or output of the product, please ensure that the ground side of the power cable is reliably connected to the protective earthing.
- Anti-static protection: static electricity may damage the equipment; it should be carried out in an anti-static area or under the premise of good grounding.
- Optical cover protection: it is prohibited to scratch the optical cover with hard objects, otherwise it may cause irreversible damage to the LiDAR; in order to avoid dust affecting the ranging performance, please keep the optical surface of the product clean.
- Operating environment: in order to ensure the normal operation of the LiDAR, it is not allowed to use or store the equipment in a flammable, explosive and corrosive environment.
- Eye safety: the laser safety level of this LiDAR system meets the criteria of Class 1, but the infrared laser is emitted continuously when the device is running. To ensure safety, please do not look directly at the light-emitting surface for a long time.
- Product failure: if you suspect that the product is malfunctioning, please contact VanJee Technology for inspection. Any maintenance, adjustment or parts replacement must be performed by technician in VanJee; it is prohibited to disassemble the equipment and open the cover without authorization.

MENU

1.Product Introduction

WLR-719C is a 4-line Light Detection And Ranging (LiDAR) that supports NTP time synchronization, which facilitate the point cloud fusion between multiple LiDARs. Its high robustness, customization for the indoor and outdoor applications and IP67 protection level make it more suitable to use under indoor and outdoor scene.

1.1 Main Features

- 4-Line scanning, high-precision ranging
- Good environmental adaptability
- Supporting NTP time synchronization

1.2 Product Specification Parameters

Basic Parameters	Distance measuring method	ToF (Time of Flight)
	Ranging ability	0.05m~40m（20m@10% reflectivity）
	Ranging precision	1cm（10% reflectivity, 1σ）
	Ranging accuracy	±1cm（10% reflectivity, typical）
	Horizontal FoV	360°
	Horizontal (angle) resolution	0.2°
	Vertical (angle) distribution	0.3°, 0°, -5°, -10°
	Scanning frequency	10Hz
	Echo mode	Single echo
Mechanical/Electrical	Laser wavelength	905nm
	Eye safety level	Class1 (Eye safety)
	Output communication interface	Ethernet
	Operating voltage	12-28V DC (power supply more than 15W)
	Power consumption	6W (Typical)
	Protection level	IP67
	Dimension	Height：62.6 mm Base length：65 mm
	Net Weight	300 g (0.66 lbs)
	Operating Temperature	-20℃-60℃
	Storage Temperature	-25℃-85℃
Data Input/Output	Communication method	UDP communication, Fast Ethernet
	Output data	Distance, pulse width data, NTP timestamp
	Time source	NTP
	NTP synchronization precision	≤10ms

Table 1 Production specification parameter table

1.3 Optical and Mechanical Features

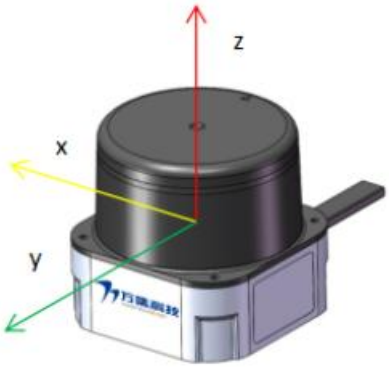


Figure 1.1 Coordinates system

Figure 1.2 Rotation direction (top view)

Figure 1.1 is the coordinate system of the LiDAR, Z-axis is the axis of rotation; Figure 1.2 is the view of the LiDAR rotation direction; Figure 1.3 is vertical angle distribution.

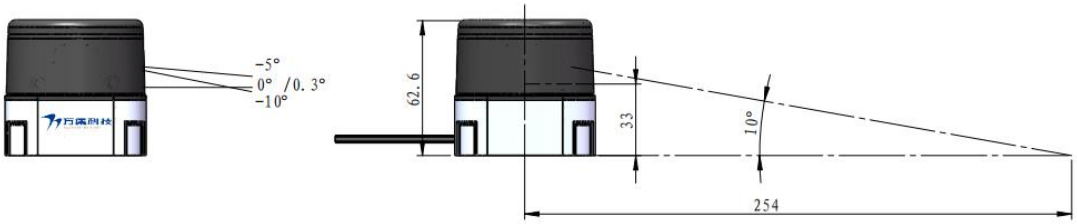


Figure 1.3 Vertical angle distribution

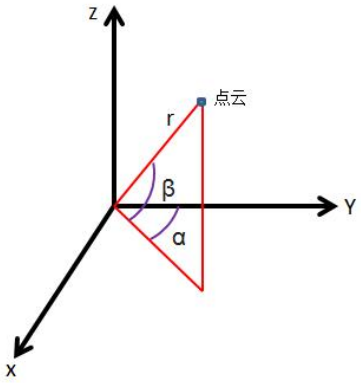


Figure 1.4 Point cloud coordinates schematic diagram

As shown in the Figure 1.4, the LiDAR point cloud coordinates schematic diagram, where r is the distance of the point cloud output, α is the horizontal angle, and β is the vertical angle.

2.Electrical Port

2.1 Power Supply Description

WLR-719C integrates wide-voltage function. Its operating voltage is 12-28V DC, nominal operating voltage is 24V DC, nominal operating current is 0.25A, nominal power is 6W. The LiDAR can be connected to the 24V DC power supply for usage. Once powered on, the LiDAR starts working.

Notice! If the power supply voltage is too low or too high, it will affect the performance of WLR-719C or cause irreversible damage to the LiDAR!

2.2 Electrical Port

WLR-719C has two types of ports: power port and network port. The corresponding wires and cable are labelled in Figure 2.1, the ports are described in Table 2.

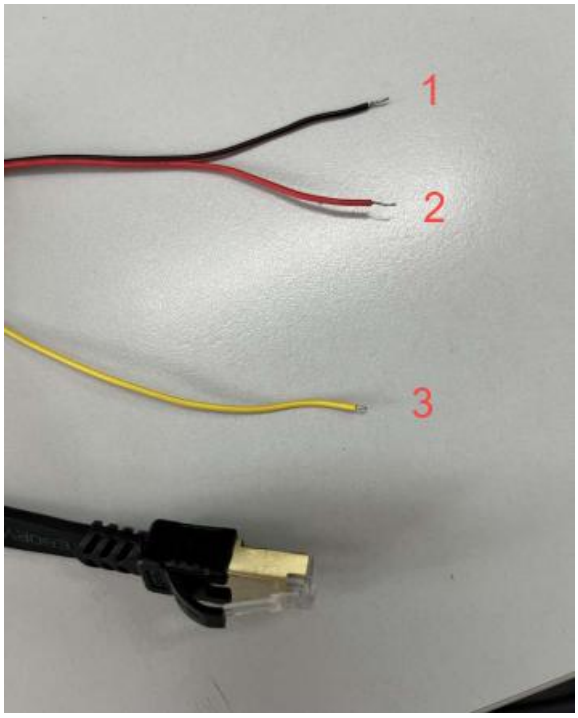


Figure 2.1 WLR-719C ports

Power port	Negative pole of the power supply is black (wire 1 in Figure 2.1)
	Positive pole of the power supply is red (wire 2 in Figure 2.1)
	Chassis ground is yellow (wire 3 in Figure 2.1)
Network port	RJ45 crystal head

Table 2 WLR-719C ports description

3.Communication Protocol

Fast Ethernet UDP communication protocol is adopted for data output. The total length of each packet of LiDAR data is 1426 bytes, including 42 bytes of Ethernet header and 1384 bytes of actual point cloud data, as shown in Figure 3.1.

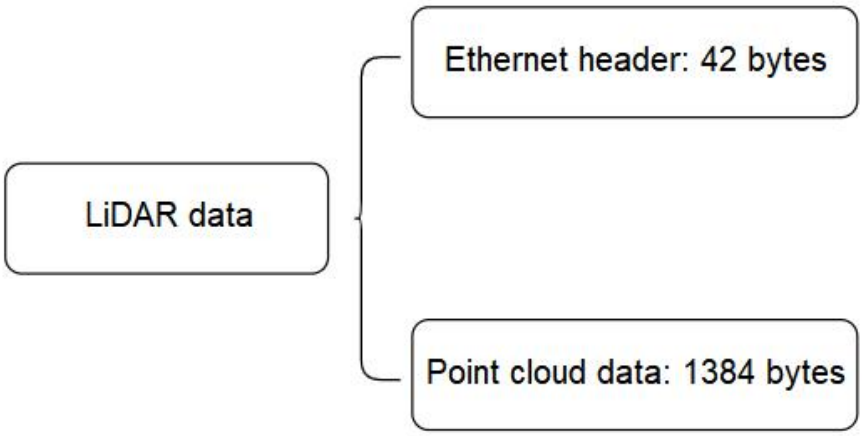


Figure 3.1 General structure of LiDAR data packet

3.1 Ethernet Header

```
> Frame 368: 1426 bytes on wire (11408 bits), 1426 bytes captured (11408 bits)
> Ethernet II, Src: BeijingW_71:19 (f8:b5:68:90:71:19), Dst: 00:2b:67:95:09:2a (00:2b:67:95:09:2a)
> Internet Protocol Version 4, Src: 192.168.0.2, Dst: 192.168.0.64
> User Datagram Protocol, Src Port: 6050, Dst Port: 58587
> Data (1384 bytes)
```

Figure 3.2 Ethernet header

Each LiDAR has a unique MAC address. The default LiDAR IP is 192.168.0.2 and the corresponding port number is 6050. At this point, the computer IP should be configured as the same network segment 192.168.0.X, such as 192.168.0.64, and the corresponding port number is 58587.

Ethernet header: 42 bytes		
Parameter name	**Number of bytes**	**Default value**
LiDAR IP address	4	192.168.0.2
Computer IP address	4	192.168.0.64
LiDAR port	2	6050
Destination port	2	58587

Table 3 Default value of IPs and ports

3.2 Point Cloud Data

The effective length of the WLR-719C data packet is 1380 bytes, which is transmitted through the UDP.

The point cloud data protocol is shown in the following Table 4.

Position	Byte number	Field	Content (Hex)	Description
0~1	2	Start of frame (SoF)	FF AA	\
2~3	2	Frame length	0564	Valid data length (Remove SoF and EoF) 1380
4~5	2	Frame serial number	00 00	Plus 1 per BANK
6~9	4	Reserved	00 00 00 00	
10	1	Verification type	01	01: BCC not includes SoF, EoF and check digit
11	1	Frame type	02	0x02: response（lower computer→upper computer）
12~13	2	Device type	00 0C	
14~15	2	Reserved		
16	1	Main command number	01	
17	1	Sub-command number	04	
18	1	Current BANK number		1-0X10（1~16）
19~20	2	Motor speed		
21~1370	1350	Scanning data 450 points		10 circles/second; 7200 points/circle; -10°, -5°, 0°, 0.3°in sequence; 24 bytes per point, 1-byte reserved + 7-byte intensity + 16-byte distance.
1371~1374	4	NTP accumulated seconds		1s/bit, the difference in seconds from 1900-01-01 00：00：00
1375~1378	4	NTP accumulated sub-seconds		0.23283ns/bit
1379	1	Reserved		
1380~1381	2	Check digit		BCC (Remove SoF, EoF and check digit)
1382~1383	2	End of frame (EoF)	EE EE	

Table 4 The frame format of point cloud data protocol

Point cloud data description: Each circle of point cloud data consists of 16 frames of data, each frame of data consists of start of frame (SoF), frame length, frame serial number, bank number, motor speed, point cloud data, NTP timestamp, check digit and end of frame (EoF). The Bank number is 0x01 ~ 0x10, corresponding to 16 frames of data respectively; the byte range of point cloud data per frame is 21 ~ 1370, every 3 bytes corresponds to a single point cloud information. It outputs point cloud data at -10°, -5°, 0° and 0.3° in cycle, where the lower 7 bits of the first byte represent the intensity value, and the last two bytes represent the distance.

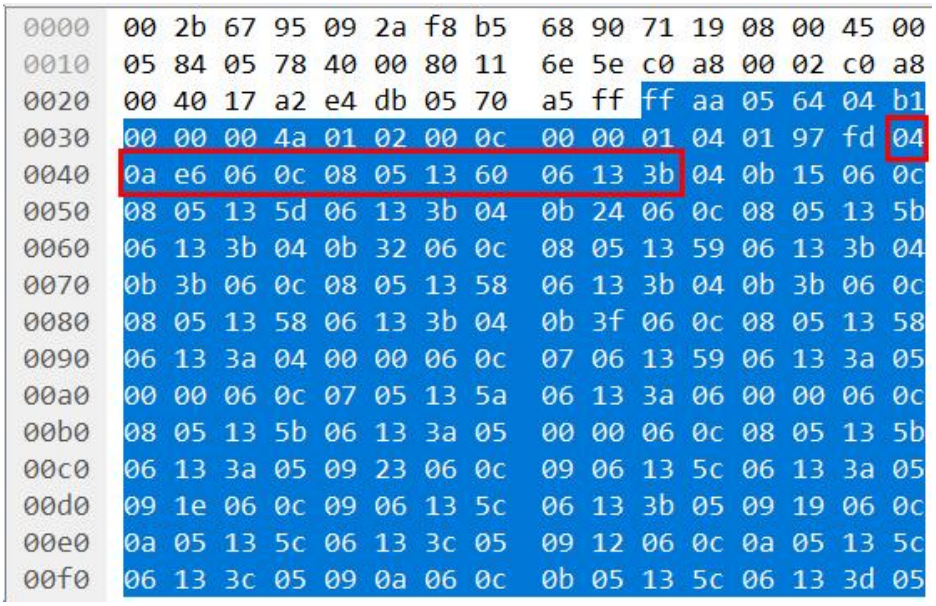


Figure 3.3 Screenshot of the point cloud data packet

As shown in Figure 3.3, the protocol frames are in blue background. Inside the red box is the point cloud data of four vertical angle distribution at the same horizontal angle, where 04 0a e6 represents -10°; 06 0c 08 represents -5°; 05 13 60 represents 0°; 06 13 3b represents 0.3°. Then cyclically output the point cloud information of four vertical angle distribution under each horizontal angle in turn. The detailed calculation is below.

- Ranging data

  The ranging data of the captured data packet: 0x0a 0xe6

  Since it is big-endian storage, they form in 16bit that is 0x0ae6

Convert to decimal as 2790, in mm

- Bandwidth data

  The intensity in the captured data packet is: 0x04

  Since only the lower 7 bits are used, 0x04 convert to decimal as 4, that is, the reflection intensity of the object is 4 * 1024 = 4096, unit ps

NTP timestamp：byte range is 1371 ~ 1378, 8 bytes in total. 1371 ~ 1374 bytes are NTP in second, which represents accumulated seconds from 00:00:00 on January 1st, 1900 to the current time; 1375 ~ 1378 bytes are NTP sub-seconds, 0xFFFFFFFF means 1s， then each bit means 0.23283ns (0.23283ns/bit). See Appendix A for detailed information about NTP timestamps.

4.Host/upper Computer Software Usage

4.1 Overall Function Introduction

If the factory default settings of the WLR-719C cannot meet the application requirements, subsequent settings can be performed through the exclusive software WLR-719C provided by VanJee.

Install the WLR-719C software, start the program after the installation is complete. The program interface is shown in Figure 4.1, and it mainly includes the following four parts:

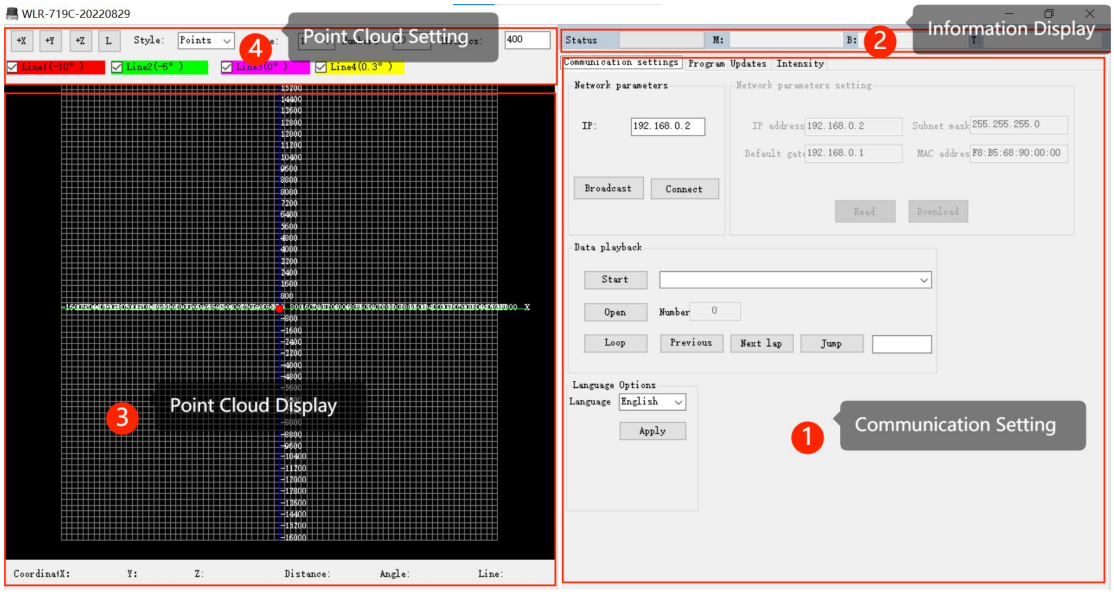


Figure 4.1 Host computer software overall function division

1) Communication setting section: used for network port connection, parameter configuration, pcap packet capture and data playback;

2) Information display section: display the connection status and version number;

3) Point cloud display section: display the real-time scanned point cloud data in the Cartesian coordinate system;

4) Point cloud setting section: used to set parameters such as point cloud views and size.

4.2 Network Connection

1）Connect the WLR-719C to the same network as the current PC.

2）Click "Broadcast" under the network settings in Figure 4.2 below, and the broadcast interface will pop up.

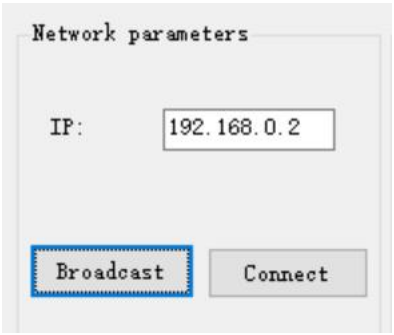


Figure 4.2 Broadcast communication interface

3）Click "Start Broadcast", as shown in Figure 4.3 below. When the IP and port number are displayed on the right side, write down the LiDAR IP and close the window.

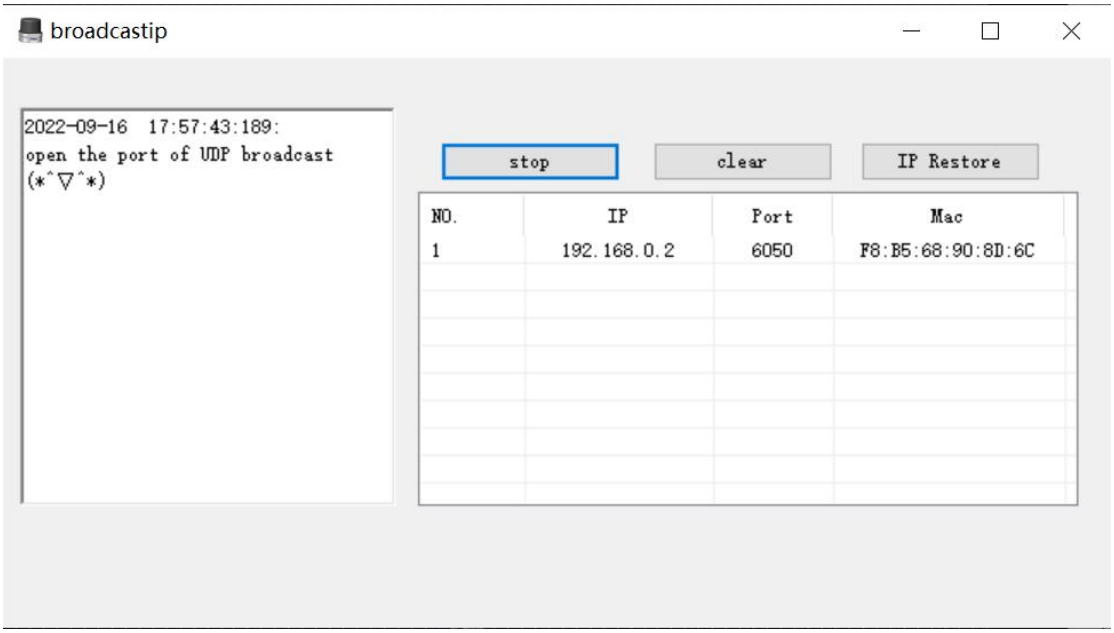


Figure 4.3 Broadcast query IP interface

If the IP and port number of the device cannot be queried in this step, first check whether the WLR-719C and the PC are correctly connected to the same network. If they are connected to the same network, you can try the steps 4 and 5. If the current PC is connected to the network through Ethernet, please disable other networks except "Ethernet".

4）Under the "Network and Internet" settings, set the current local IP according to the IP of the WLR-719C obtained by broadcasting. And set the current PC to be in the same network segment as the WLR-719C.

For example, the IP of the WLR-719C obtained by broadcasting is 192.168.2.123, then the IP address of the PC can be set to any IP between 192.168.2.2 and 192.168.2.255. The subnet mask is set to 255.255.255.0, and the default gateway is set to 192.168.2.1.

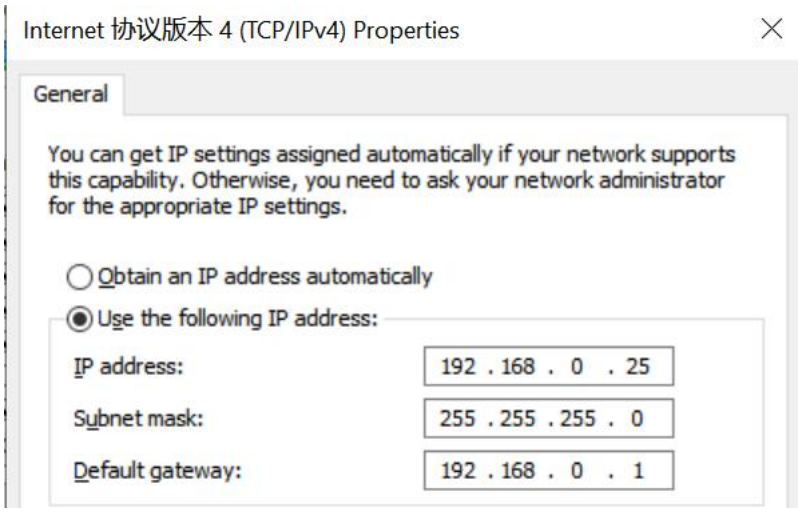


Figure 4.4 IP configuration on PC side

5）Return to the WLR-719C host computer and click "Connect" under "Network Settings".

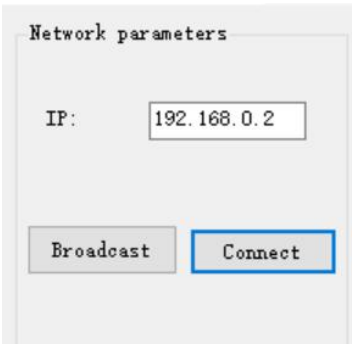


Figure 4.5 The host computer is connected to the LiDAR

If there is waveform in the display area and the connection status is green, means successfully connected.

4.3 Network Parameter Setting

As shown in Figure 4.6 below, users can query or set the IP address, subnet mask, and default gateway of the WLR-719C under the "Network Parameters" setting. The "MAC address" can only be queried but cannot be modified; after setting network parameters, the LiDAR will restart;

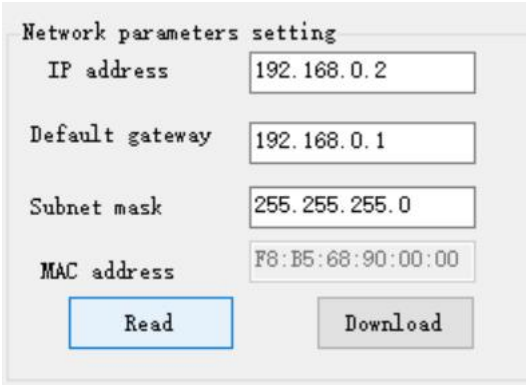


Figure 4.6 Network parameter settings

4.4 pcap Packet Capture and Data Playback

As shown in Figure 4.7 below, the module of pcap packet capture and data playback mainly includes two functions: capture pcap packets containing LiDAR point cloud data and replay the captured data.

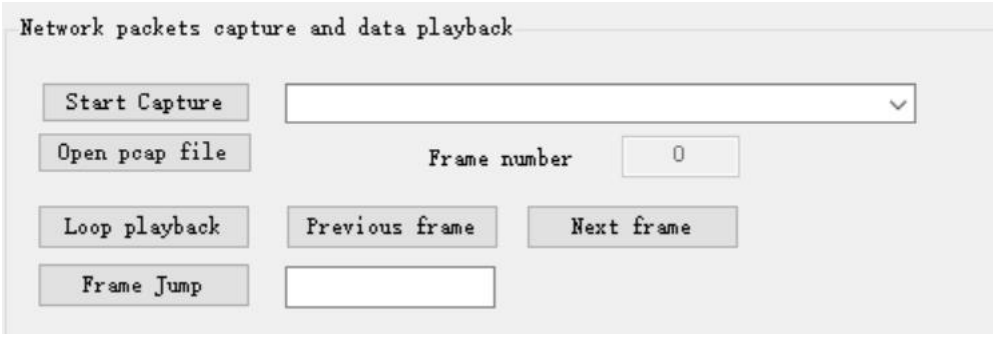


Figure 4.7 pcap packet capture and data playback

1）pcap packet capture: When the LiDAR and the computer are successfully connected and the point cloud is displayed normally, as shown in Figure 4.8, first select the corresponding network card, and then click the "Start packet capture" button. The packet capture starts and the "Start Packet Capture" button becomes the "Stop Packet Capture" button. When you want to stop the packet capture, click the "Stop Packet Capture" button. As shown in Figure 4.9, a box will pop up, and you can change the

captured pcap packet name and set the save location.

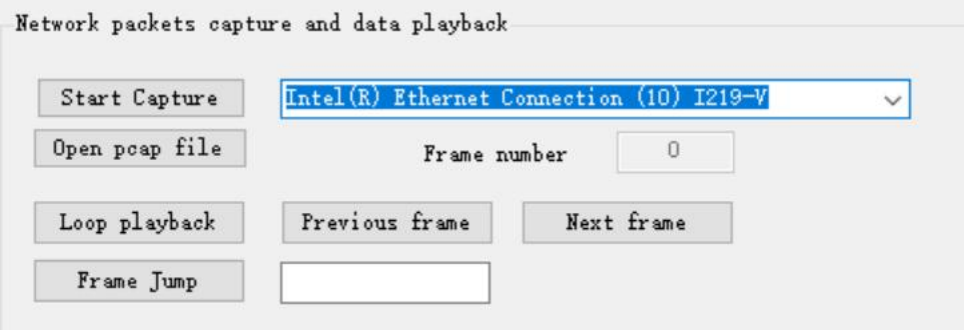


Figure 4.8 Select the corresponding network card

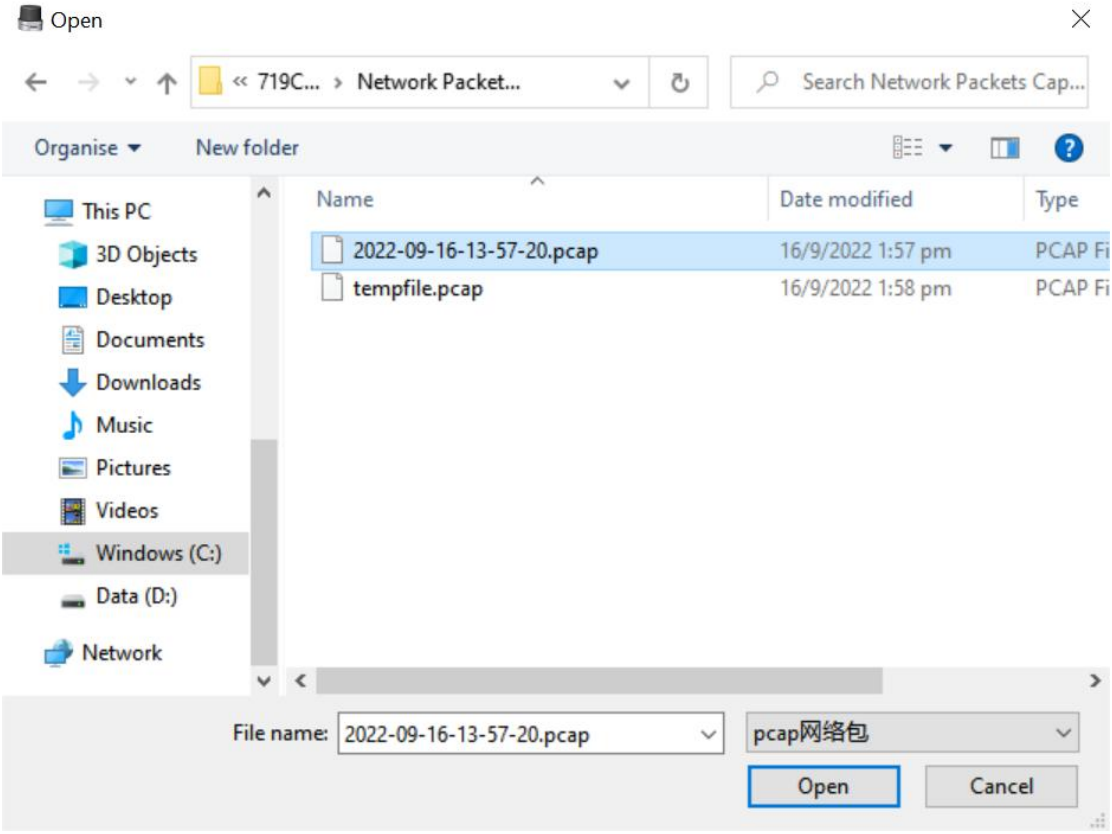


Figure 4.9 Set the pcap packet name and save location

2）Data playback: click the "Open" button, select the corresponding pcap file from the pop-up box. Click the "Loop Play" button to start playing back the data.

4.5 Data Display

For WLR-719C LiDAR, its scanning frequency 10Hz, horizontal angle range is 0°~360°, angular resolution is 0.2°, four vertical angle distribution -10°, -5°, -0°, and 0.3°. The intensity from the host

computer software will be displayed in four colors based on different vertical angle respectively, as shown in Figure 4.10, where x-axis is the point serial number, y-axis is intensity value.

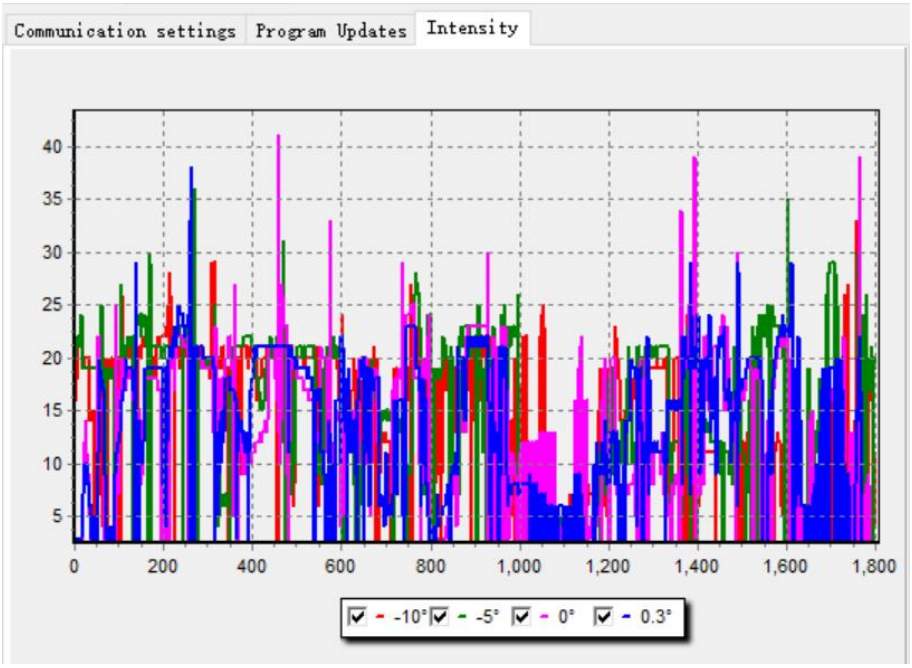


Figure 4.10 Intensity data display

The WLR-719C host computer displays the point data in the OpenGL 3D model. Four vertical angles are distinguished by different colors. Figure 4.11 shows the scanned data waveform of the Cartesian coordinate system, and the units of the x and y axis coordinates are mm.

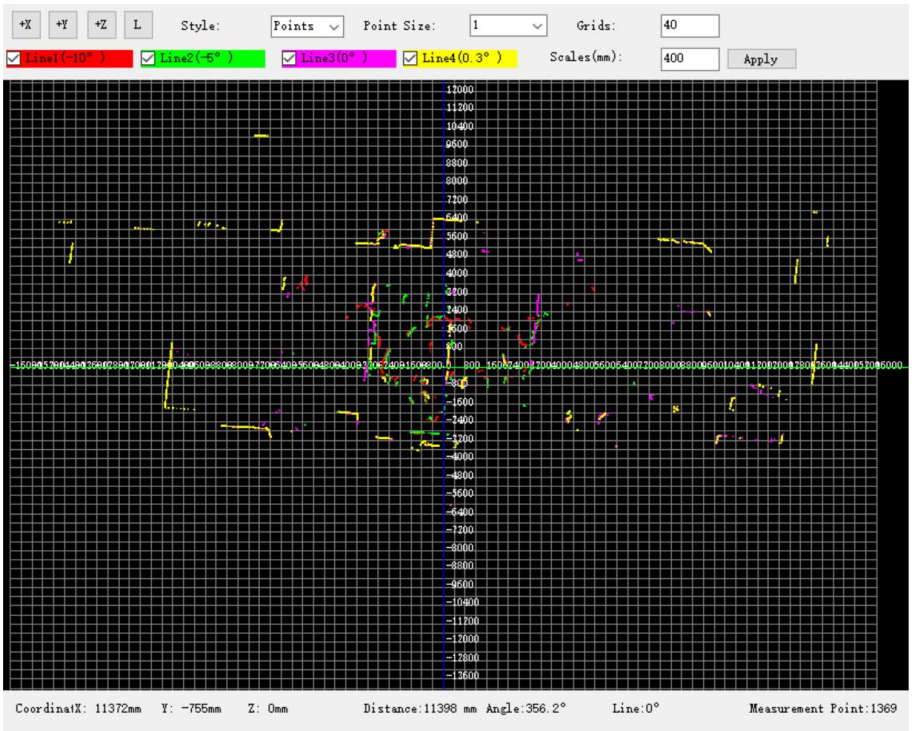


Figure 4.11 Waveform display in Cartesian coordinate system

4.6 Point Cloud Setting

The top of the point cloud image is the operation interface for setting the point cloud interface, as shown in Figure 4.12 below, which includes three view switch, Points/Lines switch, PointSize setting, and grid number and resolution settings.

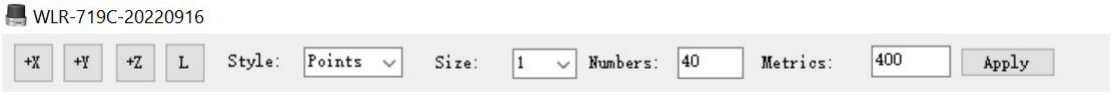
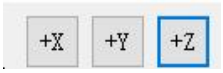


Figure 4.12 Point cloud operation interface

1）View switch 

. It is used to switch views from different angles to facilitate data observation. The flipping view may occur, as shown in Figure 4.13, the view is not parallel to the interface. For the convenience of observation, you can click the button 

, and the point cloud image is facing the eyes, as shown in Figure 4.14.

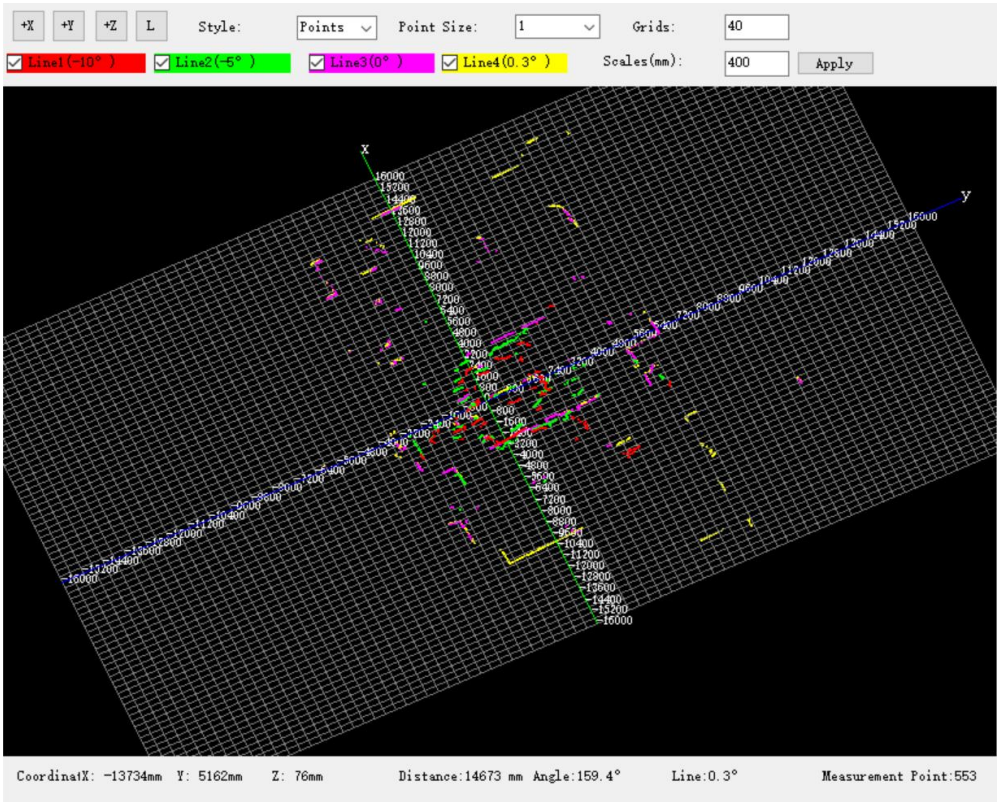


Figure 4.13 Flipping view

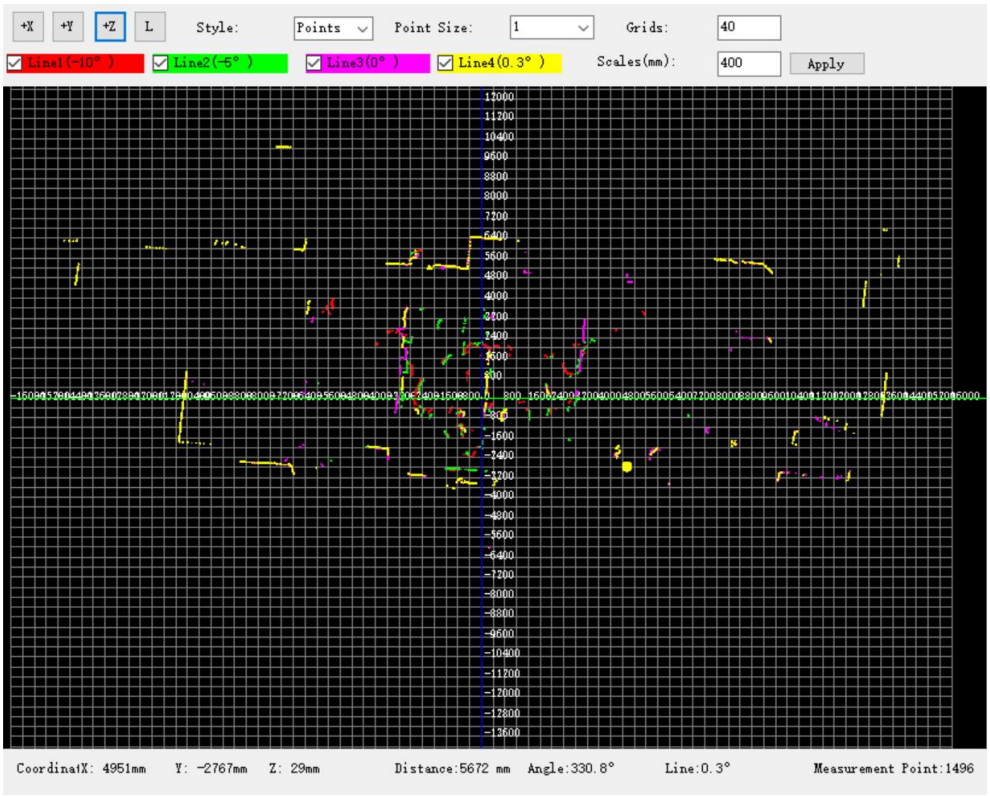


Figure 4.14 +Z view

2) Points/Lines switch 

. This function is used to switch between point display and line display. Figure 4.15 is the point cloud display; Figure 4.16 is the line mode display.

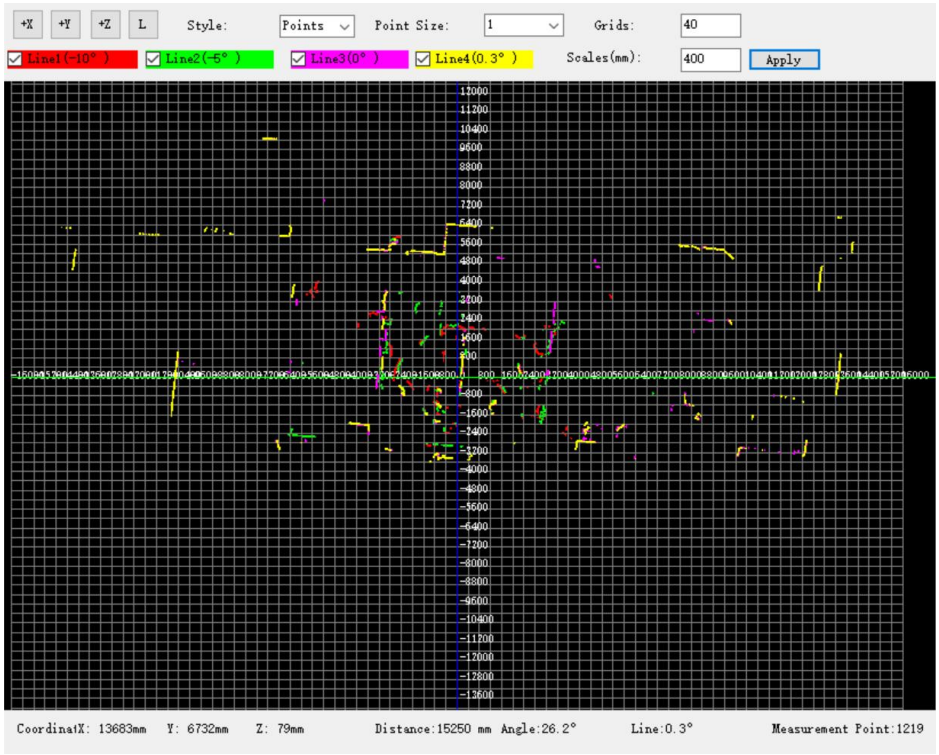


Figure 4.15 Dot mode display

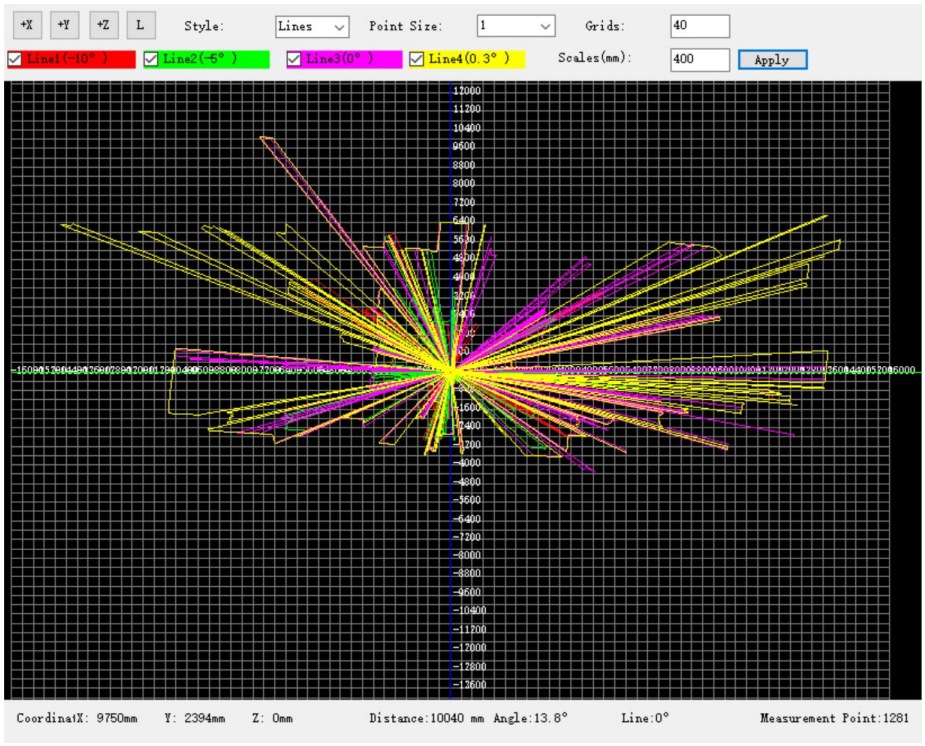


Figure 4.16 Line mode display

3）PointSize setting 

. This function sets the size of the point. Figure 4.17 shows an example with a point size of 1. Figure 4.18 shows an example with a point size of 3.

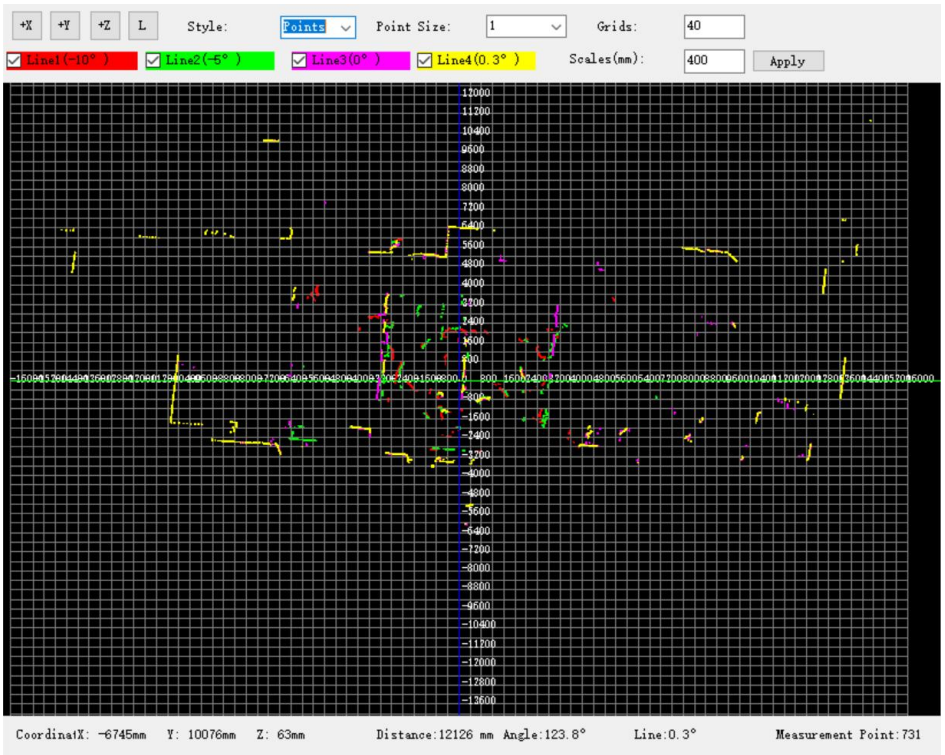


Figure 4.17 PointSize is 1

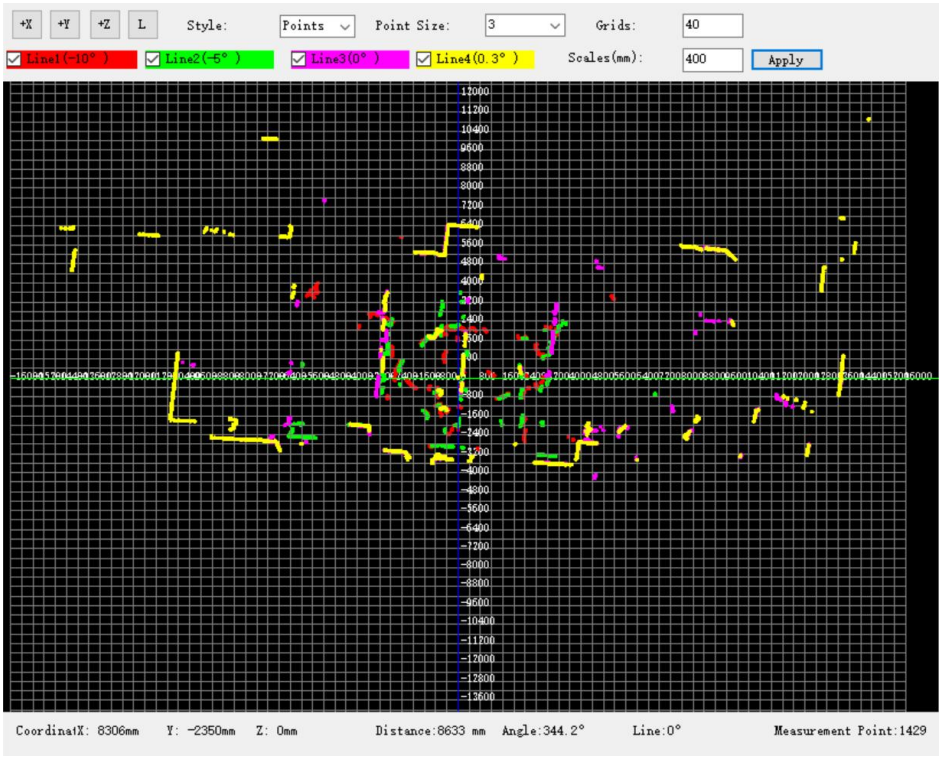


Figure 4.18 PointSize is 3

4) Grid number and resolution setting 

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Where “grids” is the number of grids, a maximum of 200 grids can be set, and a minimum of 0 grids can be set; “scale” represents the grid resolution with a minimum resolution of 10mm and a maximum resolution of 10,000mm. As shown in Figure 4.19 and 4.20.

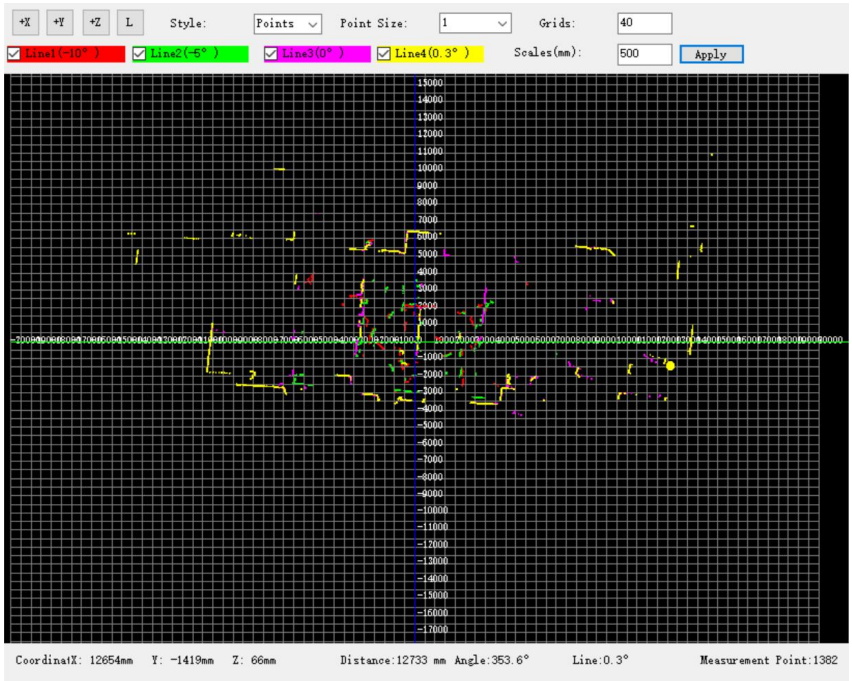

Figure 4.19 40×500 grid

Figure 4.20 40×100 grid

5. ROS Driver Usage

This product provides ROS driver to be used in the ROS system. The using method is as follows.

5.1 Compiling ROS drives

Create a workspace in the terminal:

mkdir –p catkin_ws/src

Move the ros driver source code of WLR-719C into the workspace folder catkin_ws/src

Figure 5.1 Create a workspace

Use the following command to enter the workspace folder

cd catkin_ws

Figure 5.2 Enter the workspace folder

Execute the compile command

catkin_make

```
xu@ubuntu:~/catkin_ws$ catkin_make
Base path: /home/xu/catkin_ws
Source space: /home/xu/catkin_ws/src
Build space: /home/xu/catkin_ws/build
Devel space: /home/xu/catkin_ws/devel
Install space: /home/xu/catkin_ws/install
####
#### Running command: "make cmake_check_build_system" in "/home/xu/catkin_ws/bui
ld"
####
####
#### Running command: "make -j4 -l4" in "/home/xu/catkin_ws/build"
####
[ 16%] Built target wj_719_lidar_gencfg
[100%] Built target wj_719_lidar
xu@ubuntu:~/catkin_ws$
```

Figure 5.3 Compiling ROS driver

5.2 Modifying Device Parameters

Open wj_719Cc_lidar\launch\ wj_719Cc_lidar_01.launch file, as shown below, fill the IP and port parameters of the current LiDAR in the WLR-719C LiDAR device into the corresponding locations.

```
<node name="wj_719c_lidar_01" pkg="wj_719c_lidar" type="wj_719c_lidar" respawn="false" output="screen">
<param name="communication_mode"  type="int"  value="1" />
<param name="lidar_ip"        type="string"  value="192.168.0.2" />
<param name="lidar_port"      type="int"  value="6050" />
<param name="frame_id"        type="string"     value="laser" />
<param name="min_ang"         type="double"  value="0" />
<param name="max_ang"         type="double"  value="360" />
<param name="line1"          type="int"  value="1" />
<param name="line2"          type="int"  value="1" />
<param name="line3"          type="int"  value="1" />
<param name="line4"          type="int"  value="1" />
```

Figure 5.4 Modifying device parameters

Note: The IP setting of LiDAR can only be done by the matched host computer of WLR-719C.

5.3 Modifying the starting and ending angles of LiDAR scanning

Open wj_719Cc_lidar\launch\ wj_719Cc_lidar_01.launch file, as shown below, modify the start and end angles of the WLR-719C LiDAR driver output data.

```
<param name="communication_mode"  type="int"  value="1" />
<param name="lidar_ip"        type="string"  value="192.168.0.2" />
<param name="lidar_port"      type="int"  value="6050" />
<param name="frame_id"        type="string"    value="laser" />
<param name="min_ang"         type="double"  value="0" />
<param name="max_ang"         type="double"  value="360" />
<param name="line1"           type="int"  value="1" />
<param name="line2"           type="int"  value="1" />
<param name="line3"           type="int"  value="1" />
<param name="line4"           type="int"  value="1" />
```

Figure 5.5 Modifying“min_ang”and ”max_ang”of LiDAR scanning

5.4 Running the Drive

First run roscore, as shown in Figure 5.5. Open the folder where the project file is located, and load the launch file, command is as follows:

cd catkin_ws

source devel/setup.bash

roslaunch wj_719Cc_lidar wj_719Cc_lidar_01.launch

```
xu@ubuntu:~$ cd catkin_ws/
xu@ubuntu:~/catkin_ws$ source devel/setup.bash
xu@ubuntu:~/catkin_ws$ roslaunch wj_719_lidar wj_719_lidar_01.launch
... logging to /home/xu/.ros/log/87caef1e-36c6-11ec-acc2-000c29b82c5f/roslaunch-
ubuntu-2884.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://ubuntu:45515/

SUMMARY
========

PARAMETERS
 * /rosdistro: kinetic
 * /rosversion: 1.12.17
 * /wj_719_lidar_01/angle_increment: 0.005235
 * /wj_719_lidar_01/filepath: /home/lvyanjie/TE...
 * /wj_719_lidar_01/frame_id: laser
 * /wj_719_lidar_01/hostname: 192.168.0.2
 * /wj_719_lidar_01/max_ang: 3.141592654
 * /wj_719_lidar_01/min_ang: -3.141592654
 * /wj_719_lidar_01/port: 2110
 * /wj_719_lidar_01/range_max: 65.0
 * /wj_719_lidar_01/range_min: 0.05
 * /wj_719_lidar_01/resize: 7200
 * /wj_719_lidar_01/time_increment: 4.166667e-05

NODES
  /
    wj_719_lidar_01 (wj_719_lidar/wj_719_lidar)

auto-starting new master
process[master]: started with pid [2895]
ROS_MASTER_URI=http://localhost:11311

setting /run_id to 87caef1e-36c6-11ec-acc2-000c29b82c5f
process[rosout-1]: started with pid [2908]
started core service [/rosout]
process[wj_719_lidar_01-2]: started with pid [2911]
laser ip: 192.168.0.2, port:2110
wj_719_lidar_protocl start success
TCP-Connection is initialized!
[ INFO] [1635298685.927706483]: Start connecting laser!
[ INFO] [1635298685.928766951]: Succesfully connected. Hello wj_719_lidar!
Sending command for getting MAC!
Sending command for getting ROtation Direction!
Connection Alive
```

Figure 5.6 Running ROS driver

Open a new terminal and run the coordinate transformation tool with the following command:

rosrun tf static_transform_publisher 0 0 0 0 0 0 map laser 100

```
xu@ubuntu: ~
xu@ubuntu:~$ rosrun tf static_transform_publisher 0 0 0 0 0 0 map laser 100
```

Figure 5.7 run the coordinate transformation tool

When the LiDAR is connected, open a new terminal, run the following command to load rviz to view

the waveform:

rosrun rviz rviz

When rviz outputs the LiDAR scanning waveform, it means that the ros driver is working normally, as shown in Figure 5.7.

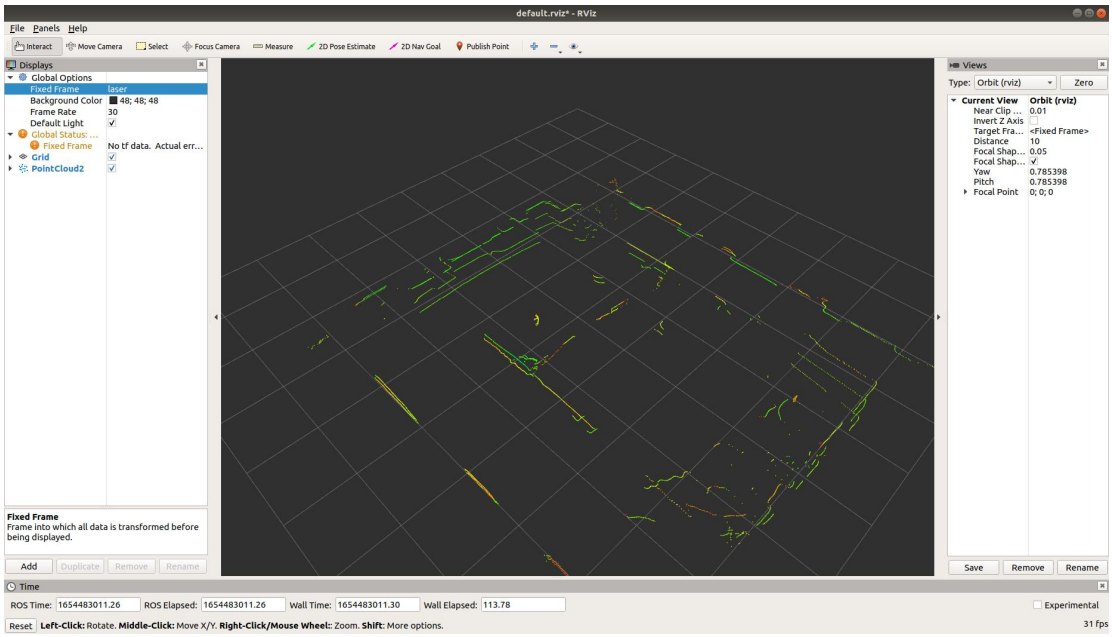

Figure 5.8 Rviz display waveform

6. Linux Firmware Update Program Usage

6.1 Using Steps

1）Connect the LiDAR

Connect the LiDAR to the computer network port, ensure the LiDAR is powered on.

2）Update the program

Run the program with the specified format parameters to update the firmware program that is connected to WLR-719C LiDAR.

The parameter options and descriptions are shown in the figure below, and the detailed description is shown in Figure 6.1.

```
Options:
  -a, --addr, --IP <DeviceIP>      Target lidar device IP
  -p, -P, --port <DevicePort>      Target lidar device port
  -f, -F, --file <FilePath>        Update Firmware file path
  -m, --Mode, --mode <UpdateMode>  Update mode: ARM or FPGA
  -v, --version                    Displays version information.
  -h, --help                       Displays this help.
```

Figure 6.1 Parameter options and description

3）Complete update

Take the update of ARM program as an example, execute the following command in the terminal to complete the update:

./Update719CConsole -m ARM -a 192.168.0.2 -p 2110 -f ../../WLR-M719C-0002-20210827.bin

6.2 Parameter Description

1）Update mode (UpdateMode)

-m, --Mode, --mode <UpdateMode> Update mode: ARM or FPGA	
Options	-m, --Mode, --mode
Parameter value	<UpdateMode> is replaced with update mode ARM/FPGA
Description	The firmware update mode
Default value	ARM
Note	Can be default, it will set to be the default value ARM; Parameter can be ARM or FPGA (case insensitive)

Table 5 The parameters description of the update mode

2）Device IP (DeviceIP)

-a, --addr, --IP <DeviceIP> Target lidar device IP	
Options	-a, --addr, --IP
Parameter value	<DeviceIP> is replaced with the device IP
Description	The device IP that is connected to the LiDAR
Default value	192.168.0.2
Note	Can be default, it will automatically set to be the default value 192.168.0.2

Table 6 The parameters description of the device destination IP

3）Device port (DevicePort)

-p, -P, --port <DevicePort> Target lidar device port	
Options	-p, --Port, --IP
Parameter value	<DeviceIPort> is replaced with the device port
Description	The device port that is connected to the LiDAR
Default value	2110
Note	Can be default, it will automatically set to be the default value 2110

Table 7 The parameters description of the device destination port

4）File path (FilePath)

-f, -F, --file <FilePath> Update Firmware file path	
Options	-f, --F, --file
Parameter value	<FilePath> is replaced with file path of the firmware
Description	The file path for updating the firmware
Default value	Null
Note	Cannot be default, specify the file path of the firmware is required; The file of ARM update mode should be in .bin format; The file of FPGA update mode should be in .rbf format.

Table 8 The parameters description of the file path

Appendix A NTP Synchronization

NTP protocol

NTP（Network Time Protocol）NTP time synchronization is a protocol for synchronizing time over a network.

Adopt NTP as the time source, should start the NTP service on the PC first.

■ Start NTP service under Windows system (win10 as an example):

1）Use the key combination WIN + R to start the Run window, enter “regedit” in the opened window, and click the OK button.

2）Enter in the opened registry:

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\Config, find the Config directory, double-click the AnnounceFlags in the Config directory, set the registry key to 5, and click OK.

3）Then enter the registry path:

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\TimeProviders\NtpServer, double-click the Enabled file under NtpServer, set Enabled to 1, and click the OK button.

4）Open the Command Prompt Window, enter "net stop w32time" to stop the service, and then enter "net start w32time" to start the service.

5）Enter the command "w32tm /stripchart /computer:127.0.0.1". If there are time outputs, configuration is successful.

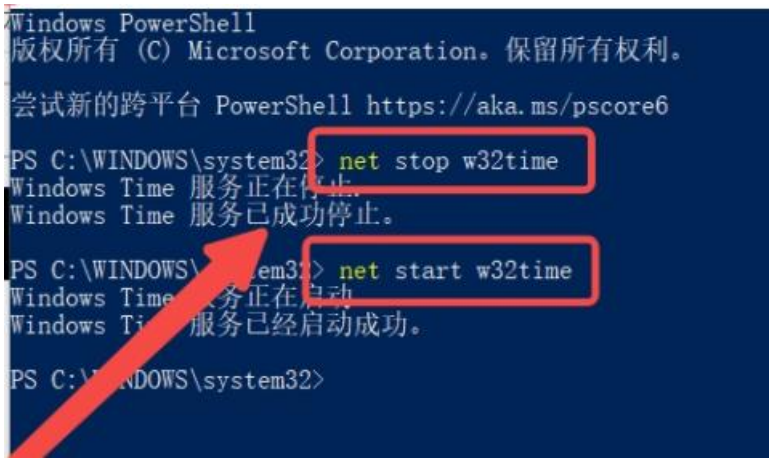

Figure 1 Start service and stop service

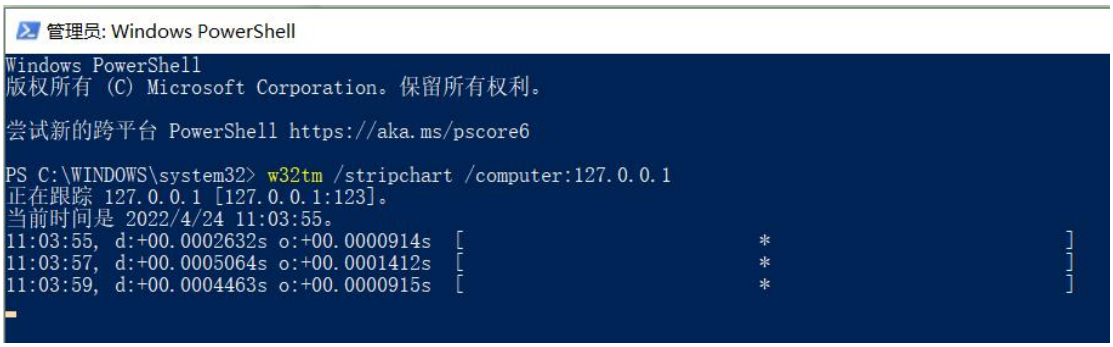

Figure 2 Indicating that configuration is successful

- Install NTP service under Ubuntu system (Ubuntu 18.04 as an example):

  1. Command too install ntp service online: apt-get install ntp
  2. Command to check NTP service is launched or not: Service --status-all

  Or command: ps -aux | grep ntp

1）If permission is denied during installation, you can switch to the “root” user to execute, enter “sudo su” in the terminal to switch.

Figure 4 Switch the permission

2）Then execute the command "apt-get install ntp" (this operation needs to download an installation file online). After the installation is complete, execute the next command to check whether the NTP service starts "service --status-all".

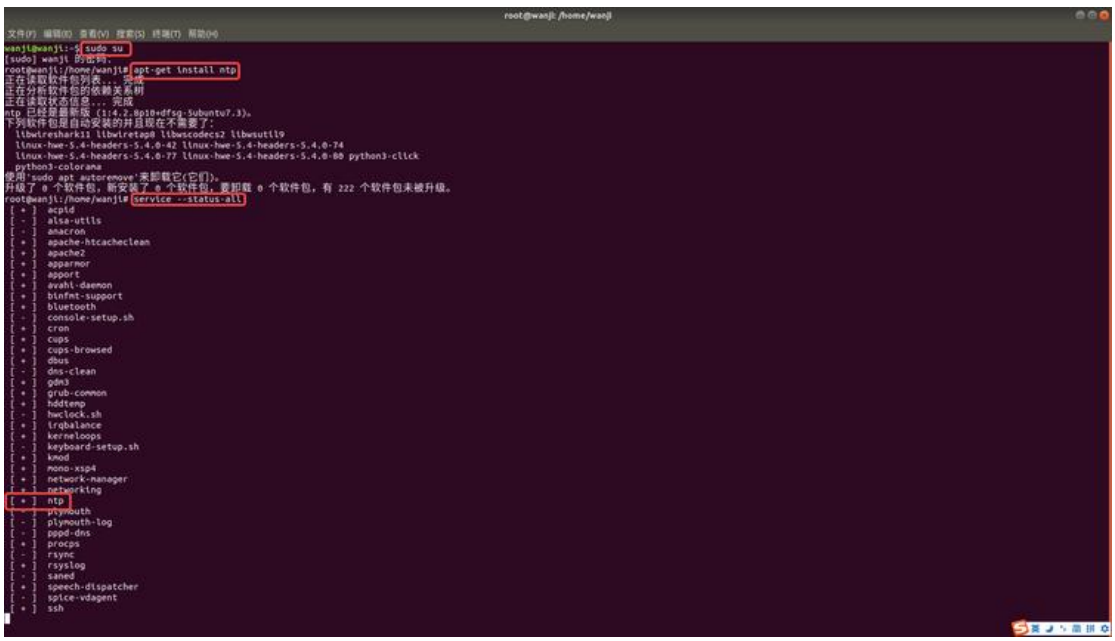

Figure 5 Check whether the NTP is started

3）Check current time status “ps -aux | grep ntp”

```
root@wanji:/home/wanji# ps -aux | grep ntp
ntp         1152  0.0  0.0 111952  4388 ?        Ssl  13:05   0:00 /usr/sbin/ntpd -p /var/run/ntpd.pid -g -u 123:128
root        6357  0.0  0.0  16184  1016 pts/0    S+   13:15   0:00 grep --color=auto ntp
root@wanji:/home/wanji#
```

Figure 6 Check the current time status

4）Use the third-party packet capture software "Wireshark" to check whether the output data of the current device contains NTP information:

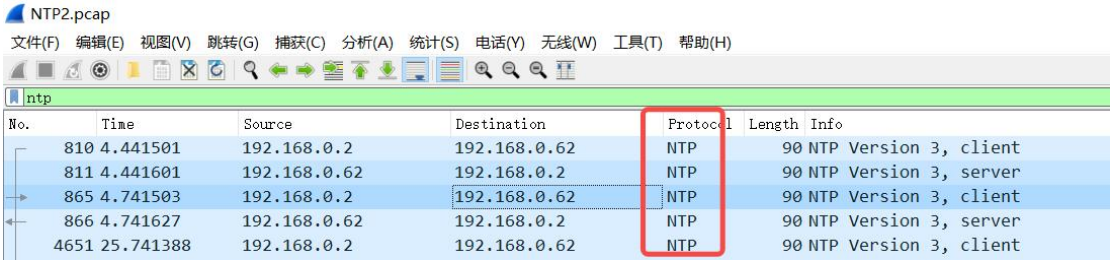

Figure 7 View NTP information

Appendix B Mechanical Installation

Mounting holes are reserved at the rear of the WLR-719C. Please use 4×M3 screws that are 4-5mm beyond the installing surface to mount the LiDAR. An optional mounting base is available to complete the installation of the WLR-719C. Figure 1 shows the WLR-719C external dimension and the hole position.

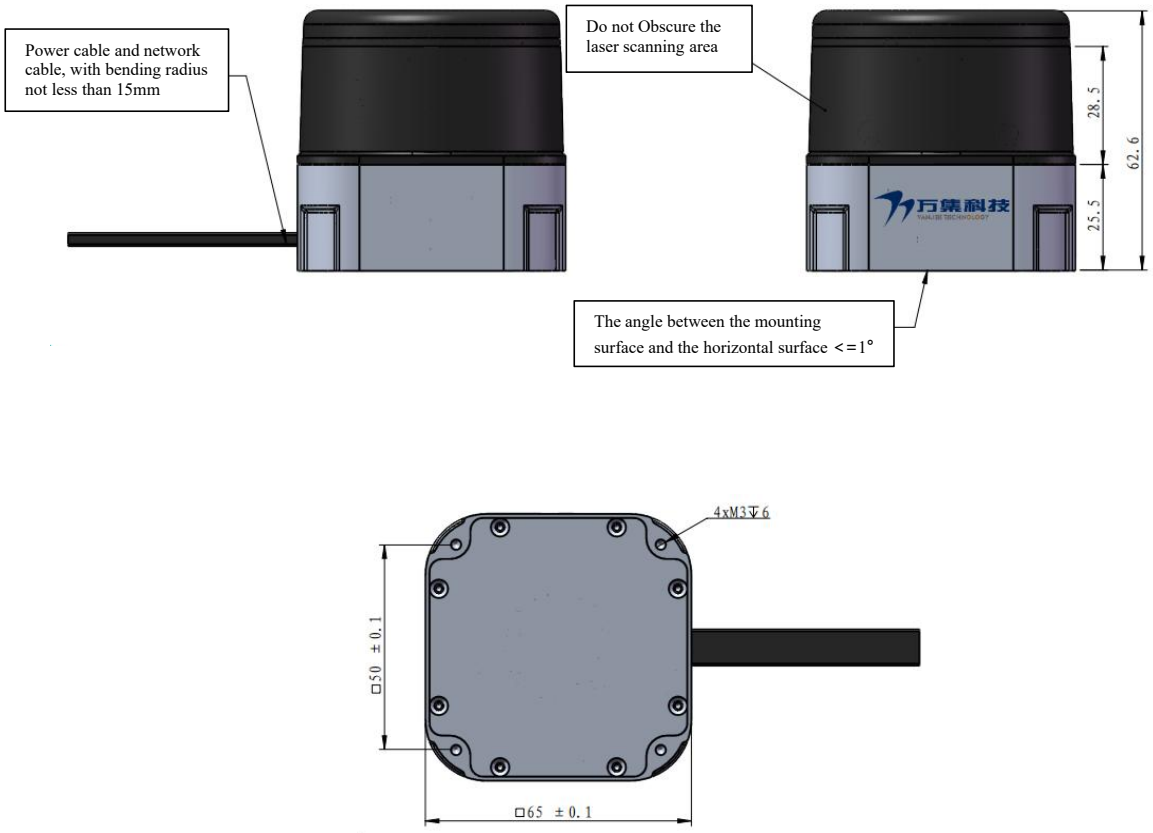

Figure 1 External dimension and installation hole position drawings

■ Notes:

1. The reserved bending radius of the outlet port is 30mm.
2. Please do not block the laser emitting area when the LiDAR is working
3. Ensure that the appearance of WLR-719C is clean, otherwise it will affect the effect of point cloud data.

Appendix C Troubleshooting

If the following steps cannot be implemented, or the problem is not resolved after implementation, please contact VanJee Technology Technical Support.

Troubles	Analysis	Measures
LiDAR not working	1）Power supply problem 2）Internal error	1）check power connection, ensure input voltage and current meet the requirement in “2. Electrical Interface” 2）Please contact VanJee after-sales service in time
LiDAR working but no point cloud display	Network failure	1）Make sure the network is connected；make sure IP address is correct, see “3. Communication Protocol” for details 2）Turn off the network firewall, or add the host computer to the whitelist
Abnormal size of data packet	1）Packet loss during data transmission 2）The internal parameters of the LiDAR are abnormal	1）Check the network cable and connect the computer to only one LiDAR 2）Please contact VanJee after-sales service in time
Missing point cloud	1）Loss data packet during data transmission 2）Insufficient data processing performance 3）Motor coded disc abnormal	1）Check the network cable and connect the computer to only one LiDAR 2）Replace the computer with the required performance 3）Please contact VanJee after-sales service in time

Table 9 Troubleshooting table

Appendix D After-sales Service

■ After-sales service

This product has a 12-month free warranty service or the date agreed in the contract from the date of purchase. If the product is damaged or not working due to non-human factors or product quality problems during the warranty period, please contact VanJee Technology in time and provide the receipt, the technician will repair your product for free;

No maintenance will be given to the products that is self-disassembled by the user;
After the warranty expired, the technician of VanJee Technology is also responsible for the maintenance of product failure, damage and other problems, but the material cost of maintenance and components replacement will be charged;

After the warranty period expired, the technicians of VanJee Technology will still provide users with free service to answer questions, including consulting services such as purchase guidance, usage method, and product installation.