M10P

User Manual

V2.0.0 2022.07

LeiShen Intelligent System Co., LTD http://www.lslidar.com/

Safety Instruction

Before using the product, please read and follow the instructions of this manual carefully, and refer to relevant national and international safety regulations.

ΔAttention

Please do not disassemble or modify the Lidar privately. If you need special instructions, please consult the technical support staff of LSLiDAR.

ΔLaser Safety Level

The laser safety of this product meets the following standards:

- IEC 60825-1:2014
- 21 CFR 1040.10 and 1040.11 standards, except for the deviations (IEC 60825-1, third edition) stated in the Laser Notice No. 56 issued on May 8, 2019. Please do not look directly at the transmitting laser through magnifying devices (such as microscope, head-mounted magnifying glass, or other forms of magnifying glasses).

Eye Safety

The product design complies with Class 1 human eye safety standards. However, to maximize self-protection, please avoid looking directly at running products.

ΔSafety Warning

In any case, if the product is suspected to have malfunctioned or been damaged, please stop using it immediately to avoid injury or further product damage.

Housing

The product contains high-speed rotating parts, please do not operate unless the housing is fastened. Do not use a product with damaged housing in case of irreparable losses. To avoid product performance degradation, please do not touch the photomask with your hands.

Operation

This product is composed of metal and plastic, which contains precise circuit electronic components and optical devices. Improper operations such as high temperature, drop, puncture or squeeze may cause irreversible damage to the product.

Power Supply

Please use the connecting cable and matching connectors provided by LeiShen

Intelligent to supply power. Using cables or adapters that are damaged or do not meet the power supply requirements, or supply power in a humid environment may cause abnormal operation, fire, personal injury, product damage, or other property loss.

Light Interference

Some precise optical equipment may be interfered with by the laser emitted by this product, please pay attention when using it.

Vibration

Please avoid product damage caused by strong vibration. If the product's mechanical shock and vibration performance parameters are needed, please contact LSLiDAR for technical support.

Radio Frequency Interference

The design, manufacture and test of this product comply with relevant regulations on radiofrequency energy radiation, but the radiation from this product may still cause other electronic equipment to malfunction.

Deflagration and Other Air Conditions

Do not use the product in any area with potentially explosive air, such as areas where the air contains high concentrations of flammable chemicals, vapours or particles (like fine grains, dust or metal powder). Do not expose the product to the environment of high-concentration industrial chemicals, including near evaporating liquefied gas (like helium), so as not to impair or damage the product function.

Maintenance

Please do not disassemble the Lidar without permission. Disassembly of the product may cause its waterproof performance to fail or personal injury.

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1 Product Profile

1.1 Overview

Based on TOF (time of flight), the M10P lidar can two-dimensionally scan and detect the environment across 360°. The lidar uses wireless power supply and wireless communication internally, and the pulse repetition frequency (PRF) is 20KHz. The lidar reaches a measurement accuracy of ±3 cm with a maximum range of 25 m. With such high performance, the lidar mainly applies to scenarios that require precise location and obstacle avoidance, including indoor service robots, AGV, cleaning and sterilization robots, drones, and so on.

1.2 Mechanism

1.2.1 Time of Flight

Based on the TOF (time of flight) methodology, the M10P lidar measures the distance between a target object and the sensor, by calculating the difference between the emission and return times of modulated laser. The laser emitter sends out the modulated pulse laser, and an internal timer starts timing(t1). The laser encounters the target object, part of the energy returns. When the lidar receives the return laser signal, the timer will stop timing(t2). The formula for distance between the lidar and the target object:

Distance = Speed of Light*(t2 – t1)/2

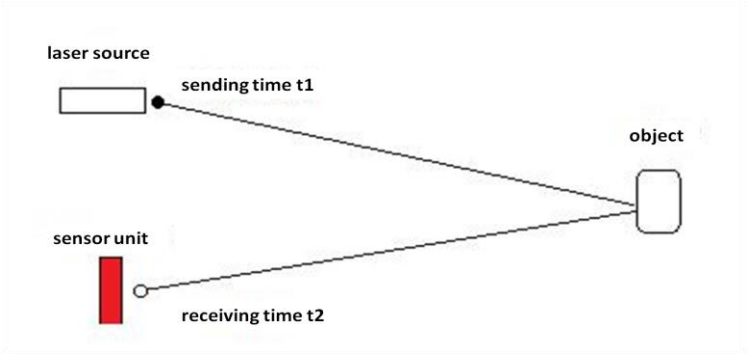

Figure 1.1 Mechanism of M10P

1.2.2 Grid Map Presentation

You can get the 2D grid map information of the surrounds across 360° within

the detecting distance, based on the combination of the distance value calculated in real-time by the signal processing unit embedded in the M10P and the angle information output by the highly accurate self-adjusted angle measuring module.

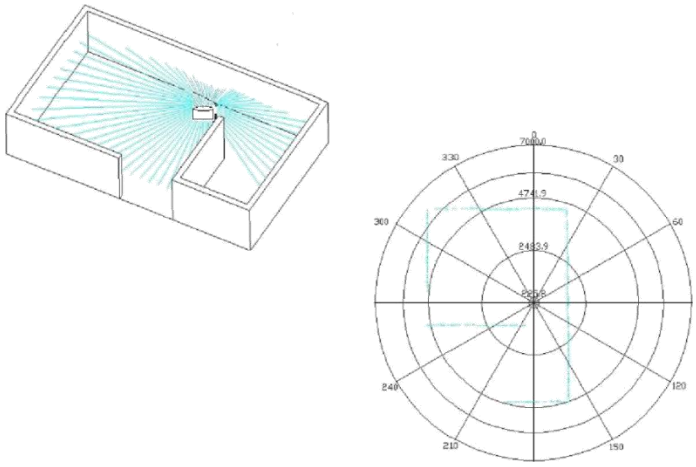

Figure 1.2 Demonstration of Ranging Function

*__Note:__ The figures only demonstrate the function of the distance measuring system. They are not proportional.

1.3 Specifications

Table 1.1 Specifications of M10P

Model	M10P
scanning angle	360°
PRF	20 KHz
Data Generating Rate	20,000 pts/sec
Angular Resolution	0.22°
Scanning Rate	12 Hz
Measurement Accuracy	±3 cm
Output Data Resolution	1 mm
Wavelength	905 nm
Laser Safety Level	CLASS I
Detection Range	10 m @10%
Data Content	Azimuth, Distance, High Reflector Recognition
Network Power Supply	5 V ~ 15 VDC
Operating Temperature	-10°C ~ 50°C
Noise	Starting-up: <60 dB, Operating:<50dB
Motor	Built-in Brushless Motor
Communication Interface	Standard Serial Port (Baud Rate: 512000 bps)
Shock Test	500 m/sec², lasting for 11 ms

Vibration Test	5 Hz～2000 Hz, 3G rms
Dimensions	Φ79.3*39 mm
Weight	About 200 g

1.4 Dimensions

A set of laser transmitting and receiving devices is fixed to the rotor of the lidar, which is rotated by an internal motor to achieve a 360° scan in the horizontal direction.

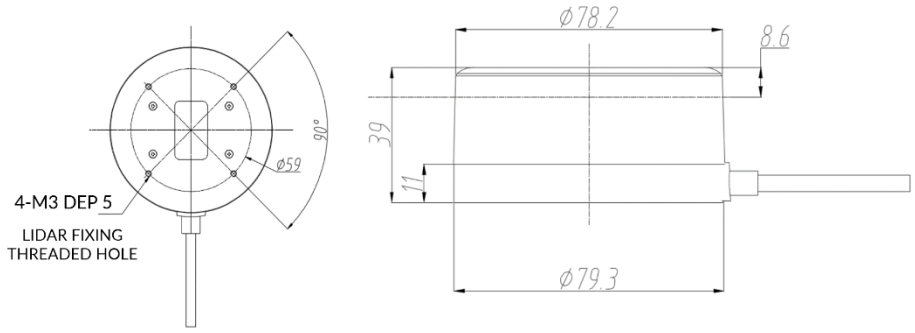

Figure 1.3 Lidar Mounting and Mechanical Dimensions (unit: mm)

1.5 Interface Definition

The specification of M10's base connector is HY2.0-6P. The M10 lidar gets data transmission, system power and data communication via a network interface box.

1.5.1 LiDAR Base Connector

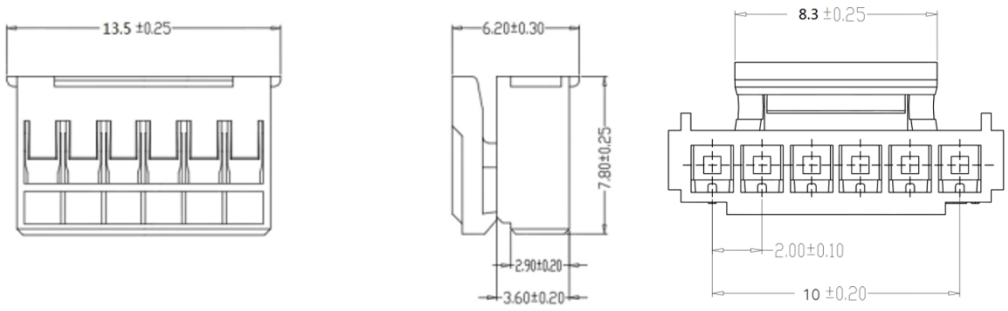

Figure 1.4 Dimensions of Lidar Base Connector (unit: mm)

The M10P lidar supports GPS function. See the GPS port definition below:

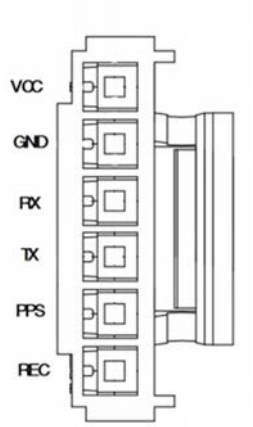

Figure 1.5 Lidar GPS Port

Table 1.2 GPS Port Definition

Pin	Description	Typical Value	Range	Remark
VCC	Power+	5V	4.75~5.25	Ripple within 80 MV
GND	Power-	0V	0V	
RX	System serial input		TTL	Data Stream: External Device → LiDAR
TX	System serial output		TTL	Data Stream: LiDAR → External Device
PPS	GPS second signal			
REC	GPS latitude, longitude, hour, minute and second			

1.5.2 Interface Box

A TTL to Ethernet adapter module is available for the M10 lidar to enable the conversion of TTL to network data. This Interface box is not a necessary accessory for lidar operation. The function of each port of the box is described as follows:

- Power port: system power supply.
- Standard Ethernet port: connection of the lidar to the host computer network port via a network cable.
- Lidar port: connection to the lidar.
- GPS port: connection to the GPS module.

The GPS port specification of the interface box is JST company's SM06B-SRSS-TB. It is recommended to use JST's SHR-06V-S-B as the external GPS module.

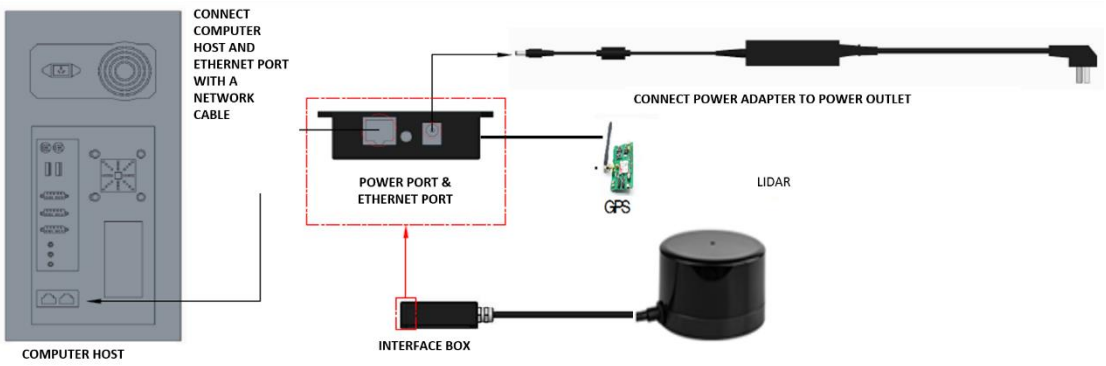

Figure 1.6 Connect All Modules Through Interface Box

Table 1.3 GPS Port Definition

Pin	Definition	I/O	Description
1	PPS Sync Signal	I	TTL level range from 3.3V to 12V; its cycle is 1 second, and the recommended pulse width is more than 5 ms
2	GPS Power Supply 5V	O	No hot plug or unplug
3	GPS_GND	O	Good contact
4	GPS (latitude/longitude, hour/minute/second)	I	RS232 level, baud rate 9600 bps
5	GPS_GND	O	Good contact
6	NC	-	-

2 Electrical Parameters

The M10P lidar communicates with Fast Ethernet. An M10P lidar is made of a high frequency ranging core, a wireless transmission system, and a rotating subsystem. The rotating subsystem is driven by a brushless DC motor spinning inside the system. The signal cable of M10P can be interfaced with the UART port of the FPGA/DSP/ARM/SCM without the need for the conversion of RS232, 422 chips. You connect an external system and the lidar and follow the communication protocol of the lidar system to obtain the scanned point cloud data, device information and status, and set the working mode in real-time.

Table 2.1 Electrical Parameters

Item	Minimum	Recommended	Maximum	Note
Power Supply Voltage	4.75V	5V	5.25V	The power supply not in the range may lead to inaccurate ranging or irreversible damage. The output of external power supply should be at least 5W.
Voltage Ripple	-	-	80MV	Too much ripple can cause irreversible damage to the hardware.

Operating Current	-	400mA	450mA	Lidar at maximum power consumption
High Signal Level	2.0V	-	3.3V	Threshold value: 2V
Low Signal Level	0V	-	0.8V	Threshold value: 0.8V
Baud Rate		512000 bps		Note the stability of data communication
GPS PPS	3V		12V	Cycle time 1 second, recommended pulse width over 5MS
GPS REC	3V		12V	RS232 level, baud rate: 9600 bps

3 Communication Protocol

When the M10P is working, each set of data is output through the communication interface. The output data has uniform message formats. If you need the detailed communication protocol, please contact LSLiDAR support.

4 Optical Features

4.1 Laser Feature

Dependent on a 905 nm laser, M10P emits high-frequency pulsed lasers through the optical assembly, receives the laser signal through the optical assembly, and completes the photoelectric conversion by the receiver board. The distance value calculation is completed by the master control chip and the laser optical parameters are as follows:

Table 4.1 Laser Optical Parameters

Item	Minimum	Recommended	Maximum	Note
Wavelength	895nm	905nm	915nm	-
Peak Power	-	25W	-	-
Average Power	-	0.8mW	-	-
FDA	Class I			IEC 60825-1:2014

4.2 Light Spot

The light spot of the M10P lidar is a vertical oval. Its vertical divergence angle is 6.8 mrad, and the horizontal divergence angle is 2.5 mrad. The spot size at any distance can be calculated by multiplying the divergence angle by the distance.

For example, the calculation of a spot at 10 m is as follows:

Vertical direction at 10 m: $10*6.8*10^{-3}=0.068$ m

Horizontal direction at 10 m: $10*2.5*10^{-3}=0.025$ m

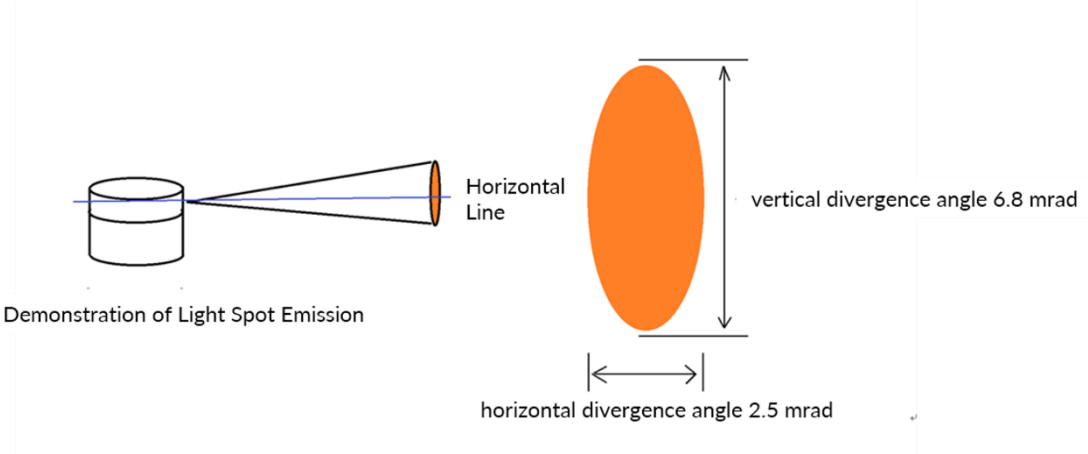

Figure 4.1 Light Spot Demonstration

4.3 Optical Structure

The M10P lidar uses a telescopic optical structure with the receiver and transmitter placed horizontally side by side. When designing the lidar installation and robot system integration, it is necessary to focus on the internal optical structure of the lidar so that the effective detection angle of the lidar can be designed accurately. To facilitate your use, especially in terms of the calculation of geometric relationships, LSLiDAR defines a polar coordinate system with the center point of the lidar as the pole, clockwise as positive, and the opposite direction to the lidar base connector as the zero-degree angle.

The internal optical structure (unit: mm) and the polar coordinates of M10P as shown in the figure below (top view):

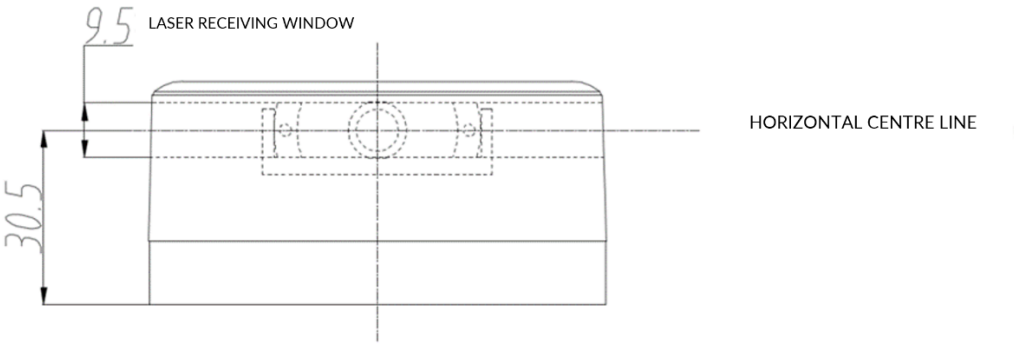

Figure 4.2 Internal Optical Structure

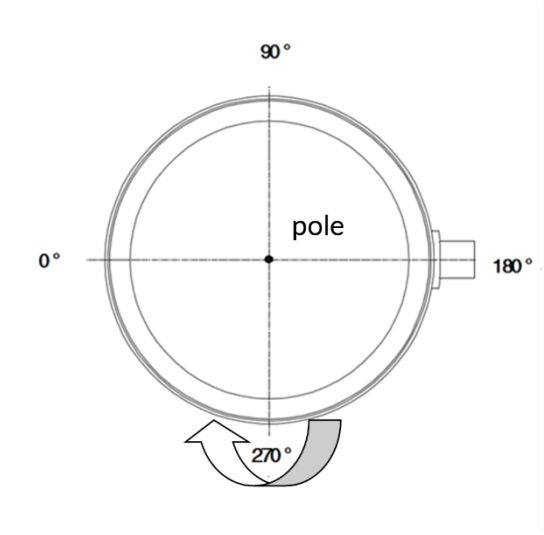

Figure 4.3 Lidar's Polar Coordinate

5 Development tools and supports

Made for the M10P lidar, LSLiDAR provides you with the SDK capable of processing scan data in real-time and displaying it as an image. This SDK facilitates you to get familiar with the lidar and helps to shorten the project development cycle. At present, LSLiDAR only provides SDK for Linux, ROS, and Windows X86. We will release versions for Android, Mac OS, and other platforms later. Please follow the official website of LSLiDAR for the latest information.

5.1 Point Cloud Display Software on Windows

This section introduces the point cloud display and software usage of LSLiDAR M10P LIDAR on Windows OS. The M10P LIDAR point cloud display software is for M10P LIDAR point cloud display, parameter configuration, simple lidar testing, etc.

5.1.1 Software Interface Introduction

The software interface contains a menu area, a toolbar area, a 3D view area, a data table area, a company website link, etc.

Click the icon  to open the software. The initial interface is shown below

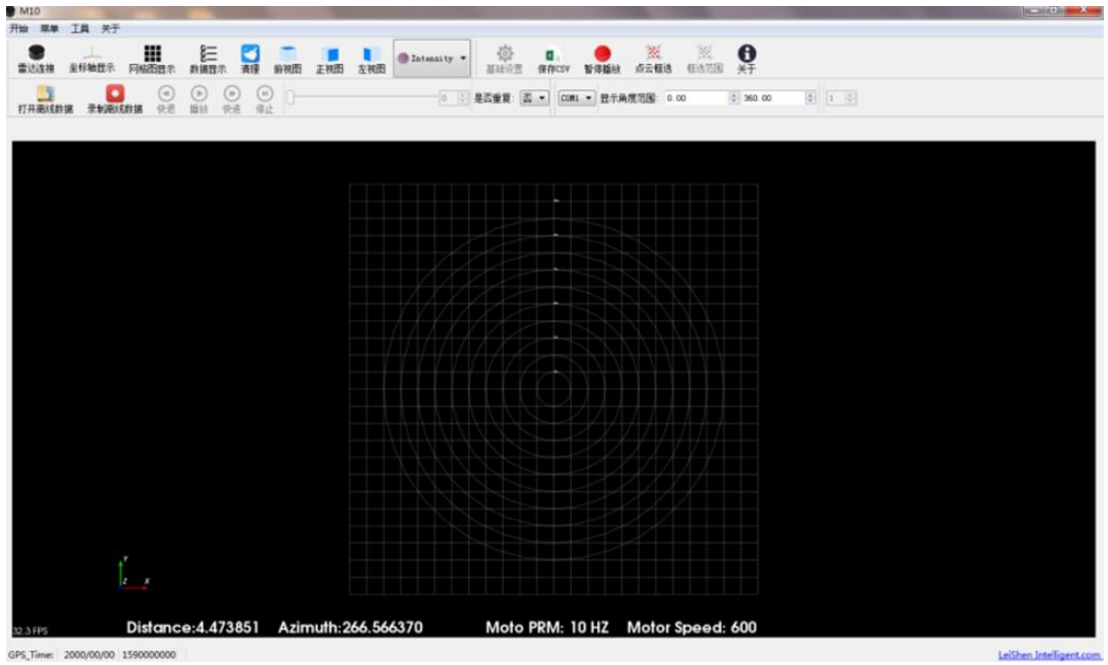

Figure 5.1 Software Interface

5.1.2 Software Operation

After connecting the lidar to the power and network cables, click the button  for real-time lidar data reception.

The data table contains PointID, Points_m_XYZ, Azimuth, Distance, Intensity, Laser_id, and timestamp. PointID is the point number and Points_m_XYZ is the spatial x, y, and z coordinates. Azimuth indicates the azimuth angle, Distance indicates the distance between the lidar and the measured target, Intensity indicates the reflection intensity of the measured target, Laser_id indicates which laser channel, and timestamp indicates the time.

5.1.3 Software Interface Introduction

■ Introduction to Point Cloud Display

A 24*24 grid with 10 circles. The radius difference between every two adjacent circles is 1 m, and the radius for the outermost circle is 12 m. The grid and circles make it easy for you to view the location of the point cloud. The direction of the coordinate axes on the 3D display interface is the same as the direction of the X-Y axis on the frame of reference of the point cloud system.

The point cloud display interface supports the following actions:

1) Scroll the mouse wheel to zoom in/out the display image; you can also hold the right mouse button and drag the image up/down to zoom in/out the

display image.

2) Hold the left mouse button and drag the display image to adjust the viewing angle.

3) Hold the mouse wheel and drag the image to move the display image; you can also hold both the shift key on the keyboard and the left mouse button to move the display image.

■ Introduction to Menu Bar Buttons

Table 5.1 Lidar Menu Button Description

Button	Description
	Click to start receiving and displaying data
	Show/hide the measurement grid
	Mark the selected points in the point cloud image; Select point clouds from different angles
	Pause the live point cloud image and data
	Clear screen
	Show/hide the coordinate
	Show/hide the data column on the left
	Three-view option: set the observation angle from top, front, and left.
	Set the display mode of the point cloud
	View the software version
	Open lidar parameter form
	Save the data in .csv format
	Save, open, play, stop playing the offline data, adjust the play speed, etc.
	Select the angle of view, the software will only display the set angle point cloud, with the ability to accumulate multiple frames

5.2 Notes

■ Notice about the Lidar setting and usage

1) It is not possible to use the M10P Windows client to receive data in two processes (open twice at the same time) on the same computer. The port occupancy of the PC is generally exclusive, so after a process is bound to a specified port number, the other software using the same process or the

same port number cannot work normally. When the M10P Windows client detects that the port is occupied, it will prompt that the communication network port configuration has failed, and automatically close the software. You need to close the software process that occupied the port, and reopen the M10P Windows client to use it normally.

2) Meanwhile, since Qt is adopted in the low-level software development, please create English paths when naming files and path folders.

3) The default IP of the network interface box is 192.168.1.102. You can use the network configuration tool provided by LSLiDAR to configurate the IP.

■ Notice about computer graphics settings

The information about dual graphics cards can be viewed in the computer configuration. In My Computer > Right Click > Properties > Device Manager, you can see the computer's display adapter information:

You need to manually set a high-performance discrete graphics card as the applicable graphics card of the software. The setting steps are as follows:

1) Take a laptop with Intel(R)HD Graphics 530 integrated graphics and NVIDIA GeForce GTX 960 discrete graphics as an example. Right-click on a blank space on the desktop to pop up a right-click menu and select “NVIDIA Control Panel”.

2) Select the “Manage 3D Settings” in the NVIDIA Control Panel interface.

3) Click the “Program Settings” button in the Manage 3D Settings interface.

4) Click the “Add” button on the Manage 3D Settings interface.

5) Click the “Browse” button in the pop-up interface.

6) Find the application file (.exe file) of the software according to its installation path in the pop-up browsing interface.

7) Click “OK” to automatically return to the NVIDIA control panel, select the high-performance NVIDIA processor in the combo box of the preferred graphics processor for this program in Option -2., and click “Apply” in the lower right corner. After the computer application is set, close the NVIDIA Control Panel to complete the setting.

6 ROS Driver Operation Under Linux OS

This section introduces the point cloud display and driver usage of LSLiDAR M10P LIDAR on Linux. You can acquire the ROS driver from LSLiDAR technical support. The LSLiDAR M10P ROS driver is applicable for M10P point cloud display, parameter configuration, etc.

6.1 Hardware Connection and Test

1) Connect the lidar to the internet and power supply

2) Set the computer wired IP according to the destination IP of the lidar (you can use the ifconfig command to check whether the computer wired IP is set successfully. As shown in the figure, the destination IP is 192.168.1.102)

```
ls-yy@lsyy-All-Series:~$ ifconfig
enp3s0    Link encap:Ethernet  HWaddr 88:d7:f6:42:4c:a2
          inet addr:192.168.1.102  Bcast:192.168.1.255  Mask:255.255.255.0
          inet6 addr: fe80::548a:d3bd:713f:1bd4/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:124400 errors:0 dropped:0 overruns:0 frame:0
          TX packets:36210 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:45490512 (45.4 MB)  TX bytes:4469863 (4.4 MB)
```

Figure 6.1 ifconfig Command Feedback

Note: The default destination IP of the lidar is 192.168.1.102, and the computer must be configured according to the actual Lidar destination IP. (By default, the lidar is not activated when powered up.)

3) After the lidar is powered on, open a new terminal and input the starting instruction: rostopic pub -1 /lslidar_difop_switch std_msgs/Int8 "data: 1". Then the lidar starts scanning.

4) After the lidar is powered on and started, check the wired connection icon of the computer to see whether it is connected properly.

5) Open the terminal: ping the lidar IP, and test whether the hardware is connected normally. If the ping is successful, then the data is received, otherwise check the hardware connection.

6) Use “sudo tcpdump -n -i eth3s0” (here eth3s0 is the name of the wired network device, see the device name of ifconfig wired connection display for details) to view the data packets sent by the lidar (as shown in the figure, there are 1206-byte data packets sent by the Lidar to the destination, which means that the lidar data is sent normally).

7) If you want to stop the lidar, please input the stop instruction: rostopic pub -1 /lslidar_difop_switch std_msgs/Int8 "data: 0".

```
ls-yy@lsyy-All-Series:~$ sudo tcpdump -ni enp3s0
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on enp3s0, link-type EN10MB (Ethernet), capture size 262144 bytes
11:38:30.207320 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
11:38:30.207900 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
11:38:30.208501 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
11:38:30.209088 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
11:38:30.209682 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
11:38:30.210270 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
11:38:30.210859 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
11:38:30.211451 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
11:38:30.212045 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
11:38:30.212652 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
11:38:30.213236 IP 192.168.1.206.2369 > 192.168.1.102.2366: UDP, length 1206
```

Figure 6.2 sudo tcpdump -n -i eth3s0 Command Feedback

6.2 Software Operation Example

1) **Establish a workspace and build a compilation environment**

   mkdir -p ~/leishen_ws/src

   Note: The workspace can be named arbitrarily. (But the path of workspace shall be in English only.) For example, “leishen_ws” can be changed to any name.

2) **Download the LiDAR ROS driver**

   The ROS driver can also be obtained directly from our website or customer service. Copy the obtained driver file to the newly created workspace “src”, and decompress it.

3) **Compile and package**

   cd ~/leishen_ws

   catkin_make

4) **Run the program**

   source devel/setup.bash

   roslaunch lslidar_m10_decoder lslidar_m10.launch

```
started core service [/rosout]
process[lslidar_m10_driver_node-2]: started with pid [14799]
process[lslidar_m10_decoder_node-3]: started with pid [14805]
[ INFO] [1632907605.840754669]: Opening UDP socket: address 192.168.1.200
[ INFO] [1632907605.840809794]: Opening UDP socket: port 2368
[ INFO] [1632907605.840832413]: expected frequency: 238.095 (Hz)
[ INFO] [1632907605.843174618]: Opening UDP socket: port 2368
[ INFO] [1632907605.843207558]: Initialised lslidar m10 without error
[ WARN] [1632907607.845344559]: lslidar poll() timeout
[ WARN] [1632907609.847535987]: lslidar poll() timeout
```

Figure 6.3 ROS Program Running

Input starting instruction: rostopic pub -1 /lslidar_difop_switch std_msgs/Int8 "data: 1"

Note: If timeout appears, it means that the driver has no data reception. Please check whether the IPs and terminals of the hardware connection and the launch file are the same.

Open a new terminal and execute the command: rviz

5) **Display the data detected by the LiDAR**

In the “Displays Window” that pops up, modify the value of "Fixed Frame" to “laser_link”. Click the “Add” button at the same time, and click “LaserScan ” under “By topic” to add a single-beam point cloud node.

6) **Set parameters**

In the /src/lslidar_m10/lslidar_m10_decoder/launch/lslidar_m10.launch file, you can set the IP port, maximum and minimum distance values and angle cutting, etc.

7 LiDAR Maintenance

7.1 Shipping Requirements

LSLiDAR has customized the package for the M10P lidar to withstand a certain amount of vibration and impact. Special packages must be used for long-distance transportation to avoid irreversible damage during transportation.

7.2 Installation

Fix the lidar to the base using screws that meet the specifications, and pay attention to the base heat dissipation. Wear powder-free and clean gloves when installing, so as not to cause the optical window to be dirty, and not to cause mechanical damage to the optical window.

7.3 Cleaning

When using the lidar, if the optical window is polluted by fingerprints, mud, leaves, insect corpses, etc., it will affect the lidar ranging effect. Please follow the following steps for cleaning.

Tools: PVC gloves, dust-free cloth, anhydrous ethanol (99%)

Environment: ventilated and dry, away from fire sources

1) Wear the PVC gloves and secure the lidar base with your fingers; For a stain that is not stubborn, use a dust-free cloth to gently wipe it off or dry air to blow it off.

2) For a stubborn stain, fill the spray bottle with ethanol, spray evenly on the stain, wait for a while until the stain is dissolved, and then use a dust-free cloth dipped in ethanol to gently wipe the optical window. If the dust-free cloth is polluted, replace it immediately. After cleaning off the stain, use a new dust-free cloth to wipe off the remaining liquid.

Revision History

Rev.	Release Date	Revised Content	Issued/Revised By
V2.0.0	2022-07-16	Initial version	LS1286

Make Safer Driving, Smarter Machine, and Better Life!

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*This product information is subject to change without notice.