



# M10

## **Navigation & Obstacle Avoidance LiDAR Manual**

### **V1.1**

## Catalogue

<b>Safety Tips.....</b>	<b>4</b>	<b>6. Communication Protocol.....</b>	<b>18</b>
<b>1. Introduction.....</b>	<b>7</b>	<b>7. Development Tool and Supports.....</b>	<b>19</b>
<b>2. Operating Principle.....</b>	<b>7</b>	<b>7.1 Point Cloud Display Software under Windows.....</b>	<b>19</b>
<b>2.1 Ranging Principle.....</b>	<b>7</b>	7.1.1 Software Interface Introduction.....	19
<b>2.2 Two-dimensional Display.....</b>	<b>8</b>	7.1.2 LiDAR Data Reception, Point Cloud Display.....	21
<b>2.3 Optical Principle.....</b>	<b>9</b>	7.1.3 Menu Function Introduction.....	22
2.3.1 Laser Properties.....	9	7.1.4 Display of Data Bar.....	24
2.3.2 Optical Structure.....	10	7.1.5 Point Cloud Display Interface Instruction.....	25
2.3.3 Light Spot Property.....	11	7.1.6 Offline Data Display.....	25
<b>3. Product Parameter.....</b>	<b>12</b>	7.1.7 Windows Software and Supporting Software Information.....	28
<b>4. Component Connection.....</b>	<b>13</b>	7.1.8 Problems of LiDAR Settings.....	29
<b>4.1 Installation and Mechanical Dimensions (Unit: mm) .....</b>	<b>13</b>	<b>7.2 ROS Driver.....</b>	<b>37</b>
<b>4.2 Interface Definition.....</b>	<b>14</b>	7.2.1 Hardware Connection and Testing.....	37
4.2.1 LiDAR Side Connector Size Specifications.....	14	7.2.2 Software Operation Example.....	37
4.2.2 Interface Definition.....	15	<b>8. Instrument Maintenance.....</b>	<b>39</b>
4.2.3 Adapter Board.....	16	<b>8.1 Transportation requirement.....</b>	<b>39</b>
<b>5. Electrical Parameter.....</b>	<b>18</b>	<b>8.2 Installation.....</b>	<b>39</b>
		<b>8.3 Storage Conditions.....</b>	<b>39</b>

<b>8.4 Clean.....</b>	<b>39</b>
<b>9. Remark History.....</b>	<b>40</b>

## Safety Tips

Before using the product, please follow all instructions carefully and consult all relevant national and international safety regulations for your application.

## Notice

Please do not disassemble the LiDAR in any way. It is forbidden to watch the transmitting laser through a magnifying device (such as microscope, eye loupe or other magnifying glass). For repairs and maintenance inquiries, please contact authorized agents or the technical support staff of LS LiDAR. Unauthorized open may cause risk and loss of the warranty of the product.



## Laser Safety Class 1

The device satisfies the requirement of

- IEC60825-1:2014
- 21 CFR 1040.10 & 1040.11 standards, except for the deviations (IEC 60825-1 Edition 3 ) described in Laser Notice No. 56 issued on May 8, 2019

## **Safety Warning**

In any case, if you suspect that the product has malfunctioned or been damaged, please stop using it immediately to avoid injury to the user.

## **Handling**

This product consist of metal, glass, plastic, as well as sensitive electronic components. Improper handling such as dropping, piercing or squeezing may cause irreversible damage to the product.

## **Power Supply**

Only the cables and cable junction box were provided by LS LiDAR. Please make sure the power adapters that meet the product voltage 9~36VDC (Typical 12~24VDC). Using damaged cables, adapters or supplying power in a humid environment can result in fire, electric shock, personal injuries, product damage, or property loss.

## **High Temperature of Housing**

When the product is running or after running, touching the housing may cause discomfort or even scald. At this time, avoid direct skin contact with the product; if you use this LiDAR product as part of your product, please be sure to inform the user of your product about the high temperature risk of the housing.

## **Light Interference**

Some precision optical instruments may be interfered by the laser emitted from the product. Please pay attention to it.

## **Vibration Conditions**

The product is designed to withstand specified vibration and shock condition defined in the specification of the product. Damage caused by vibration and/or beyond the specified value is not covered by warranty.

## **RF Interference**

Please observe the signs and notices on the product that prohibit or restrict the use of electronic devices. Although the product is designed, tested, and manufactured to comply with the regulations on RF radiation, the radiation from the product may still influence other electronic devices.

## **Medical Device Interference**

Some components in the product can emit electromagnetic fields, which may interfere with medical devices such as cochlear implants, heart pacemakers, and defibrillators. Consult your physician and medical device manufacturers for specific information regarding your medical devices and whether you need to keep a safe distance from the product. If you suspect that the product is interfering with your medical device, stop using the product immediately.

## **Explosive Atmosphere and Other Air Conditions**

Do not use the product in any area where is potentially explosive atmospheres are present, such as high concentrations of flammable chemicals, vapors, or particulates (including particles, dust, and metal powder) in the air. Exposing the product to high concentrations of industrial chemicals, including liquefied gases that are easily vaporized (such as helium), can damage or weaken the product's function. Please observe all the signs and instructions on the product.

## 1. Introduction

This manual describes the operating principle, specifications, parameters, installation, and data format of the M10 LiDAR. The product manual is updated with the product technical upgrade. For the latest version, please contact LeiShen's technical support.

The M10 LiDAR adopts TOF (time of flight) principle to capable of 2 D scanning detection of the surrounding 360 ° environment. M10 uses wireless power supply and optical communication, measuring frequency for 10khz. The accuracy is to reach the ± 3cm with the maximum range from 10 meters. It is mainly used in indoor service robot, cleaning robot, UAV and other precise positioning and obstacle avoidance applications.

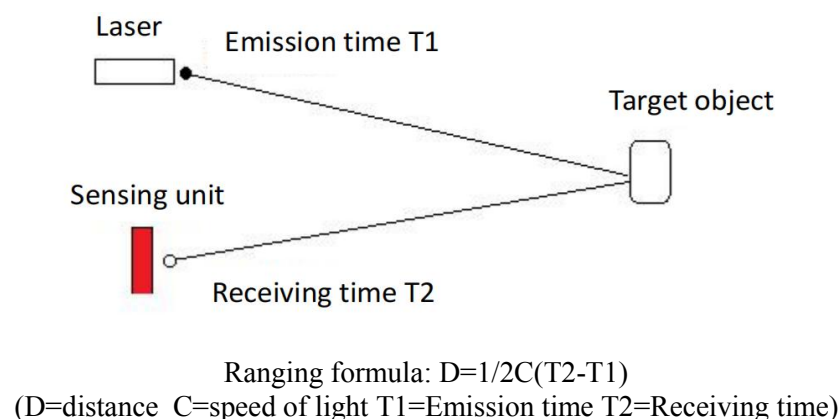
## 2. Operating Principle

### 2.1 Ranging Principle

Distance Measurement: Time of Flight (TOF)

- (1) A laser diode emits a beam of ultrashort laser pulses onto the target object.
- (2) The laser pulses are diffusely reflected after hitting the target object. The returning beam is detected by an optical sensor.
- (3) Distance to the object can be accurately measured by calculating the time between laser emission and receipt.

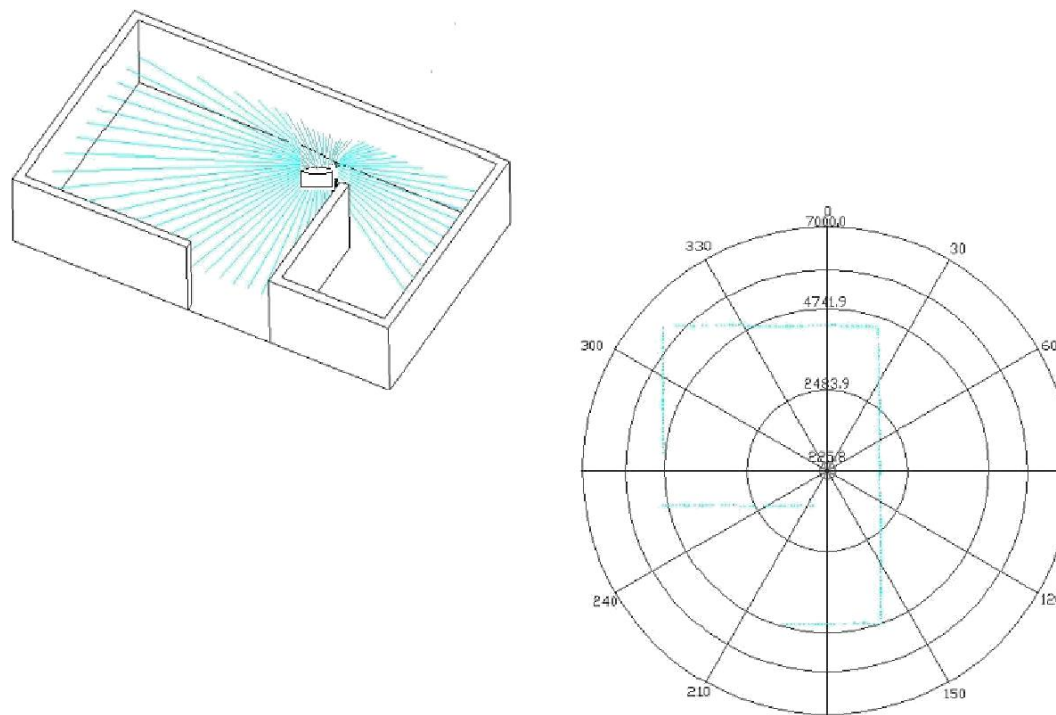
The working principle is shown in the figure below:



## 2.2 Two-dimensional Display

The distance value of the detected object is calculated by the signal processing unit inside the M10. Combined with the angle information output by the angle measurement module, the two-dimensional plane information of the surrounding 360-degree environment in the range can be obtained.

The two-dimensional plane display effect diagram is shown in the figure below:





## 2.3 Optical Principle

### 2.3.1 Laser Properties

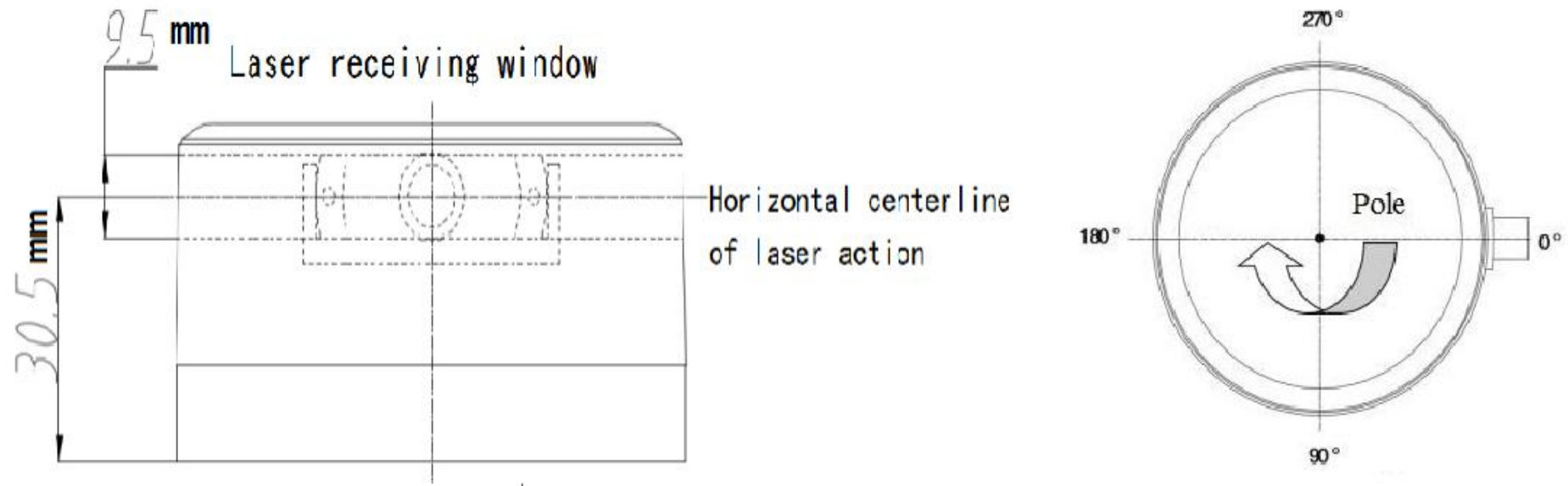
The optical parameters of N series LiDAR are as follows:

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

### 2.3.2 Optical Structure

M10 adopts the telescope-type optical structure placed in parallel at the receiving and emission level. In the installation of LiDAR and the integration into the robot system, the internal optical structure should be considered in order to fulfill the LiDAR function in high accuracy. In order to facilitate the customer's use, especially the calculation of geometric relationship, we define a polar coordinate system at the center point of the LiDAR. It turns clockwise and the zero degree angle start from the cable outlet.

Following is the figure of the M10 LiDAR (top view):

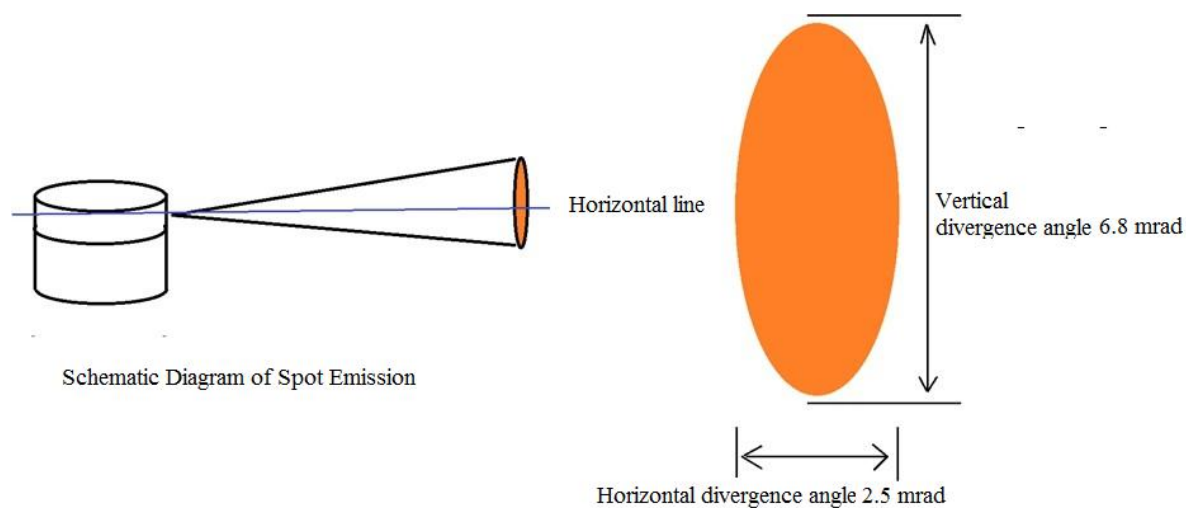


### 2.3.3 Light Spot Property

The light spot of M10 LiDAR is an oval shape placed vertically, And the divergence angle is 6.8mrad in vertical direction and 2.5mrad in horizontal direction. The spot size at any distance can be calculated by multiplying the divergence angle by the distance. For example, the calculation method of spot at 10m as follow: :

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

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



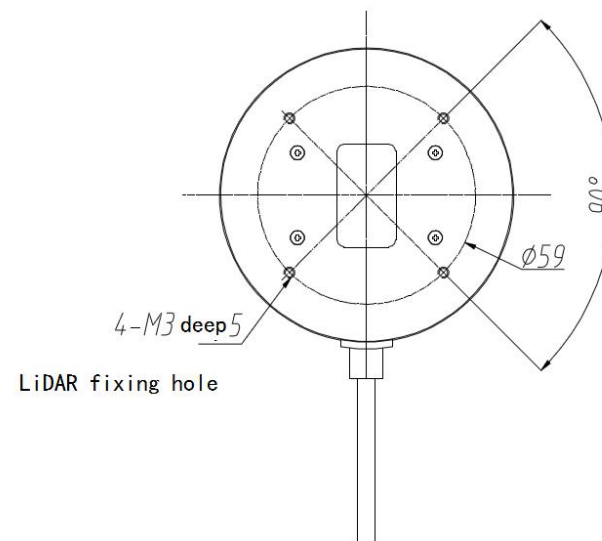
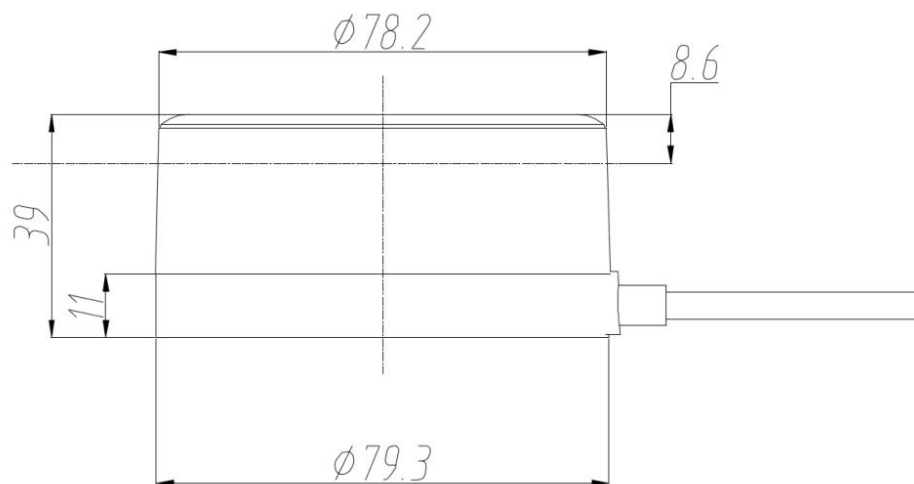
### 3. Product Parameter

Model	M10
Type	Short-range
Range	12m@70%
Scanning Angle	360°
Angular Resolution	0.36°
Scan Frequency	10HZ
Measurement Accuracy	±3cm
Output Data Resolution	1mm
Wavelength	905nm
Data Content	direction, distance, reflectivity
Ambient Temperature	Operating: -10°C~50°C, storage: -40°C~80°C
Power Supply	5V DC(4.75V±5.25V, ripple within 80MV)
Motor	Brushless Motor
Communication Interface	Standard serial port (baud rate: 460800 bps)
Size	Φ80*38.9mm
weight	200g ± 10g

## 4. Component Connection

A set of laser emitting and receiving modules are installed on the rotor of the LiDAR, and the internal motor rotates to achieve 360° scanning in the horizontal direction.

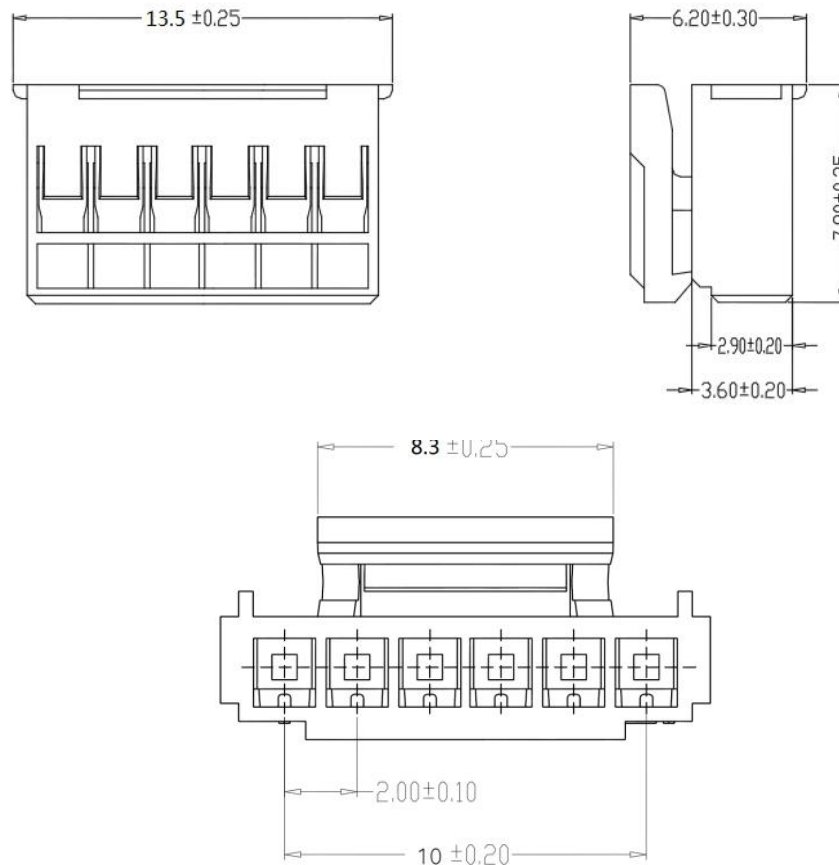
### 4.1 Installation and Mechanical Dimensions (Unit: mm)



## 4.2 Interface Definition

The external physical interface of M10 is HY2.0-6P, which realizes system power supply and data communication.

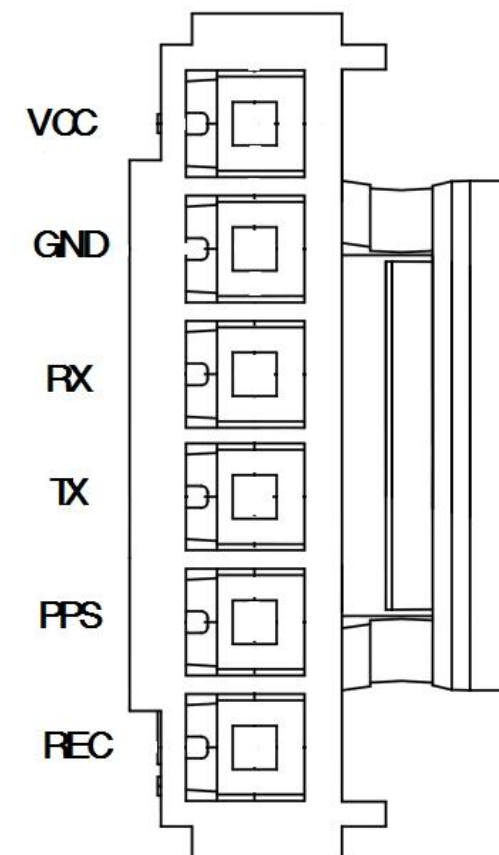
### 4.2.1 LiDAR Side Connector Size Specifications



Unit: mm

### 4.2.2 Interface Definition

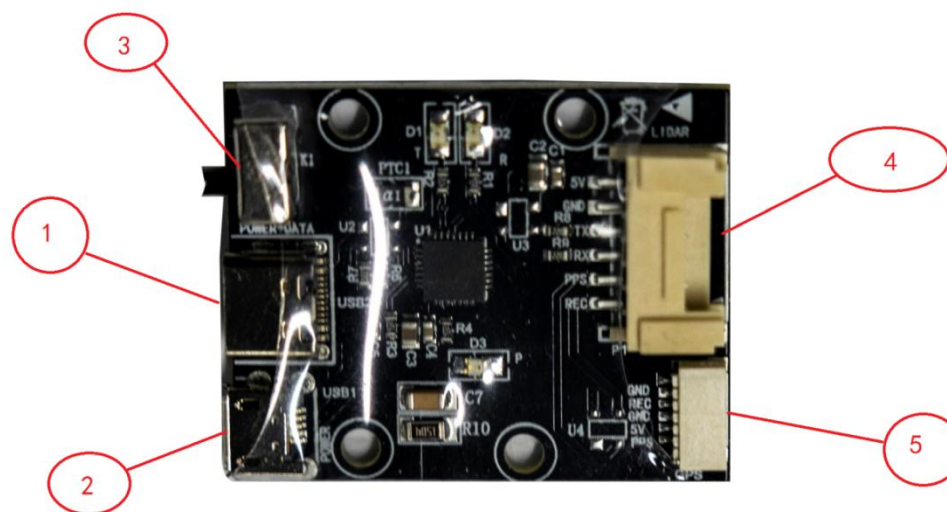
PIN	Description	Typical Value	Range	Note
VCC	Supply voltage positive	5	4.75~5.25	Ripple within 80MV
GND	Supply voltage negative	0	0V	
RX	System serial input		TTL	Data flow: peripheral → LiDAR
TX	System serial output		TTL	Data flow: LiDAR → peripheral
PPS	GPS second signal		TTL	
REC	GPS latitude and longitude		RS232	



### 4.2.3 Adapter Board

The adapter board was offered as accessory, transfer HY2.0-6P to Type-C USB, which realizes TTL TO USB data conversion. It is to facilitate customers for debugging use. However, this adapter board is not a necessary device for LiDAR operation.

Following picture is the instruction for each module in adapter board.



- ① Type-C USB: data communication and system power supply;
- ② Micro USB: Power supply only. When the power supply capacity of the Type-C USB port is insufficient, the port can be
- ③ used for additional auxiliary power supply;
- ④ K1: Power switch;
- ⑤ LIDAR: connect to radar;
- ⑥ GPS: Connect GPS module



Following the GPS interface specification of the adapter board, SM06B-SRSS-TB from JST Company and the recommended interface for external GPS module is SHR-06V-S-B from JST Company.

#### Interface Definition

S/N	Function Definition	I/O	Requirements
1	PPS Synchronization Signal	I	TTL Electrical Level Range 3.3V to 12V, period 1s, Recommended pulse width over 5MS
2	GPS Power Supply 5V	O	Do not plug or unplug with power
3	GPS Power GND	O	Good contact
4	GPS Latitude and Longitude	I	RS232 electrical level, Baud rate 9600 bps
5	GPS Power GND	O	Good contact
6	NC	-	-

## 5. Electrical Parameter

This product does not have a power switch, once powered on, the LiDAR will be in accordance with the factory default parameters to start working.

Item	Minimum	Typical Value	Maximum	Remarks
Supply Voltage	4.75V	5V	5.25	If the supply voltage is not within this range, it may cause inaccurate or irreversible damage, the output power of the external power supply shall be at least 5W
Voltage Ripple	-	-	80MV	Ripple too large causes irreversible damage to the hardware. The smaller the ripple, the better
Working Current	-	400mA	450mA	LiDAR is at maximum power consumption
Signal High Level	2.0	-	3.3	Threshold 2V
Signal Low Level	0	-	0.8	Threshold 0.8V
Baud Rate		460800 bps		Pay attention to the stability of data communication
GPS PPS	3V		12V	period 1s, Recommended pulse width over 5MS
GPS REC	3V		12V	RS232 electrical level, Baud rate 9600 bps

## 6. Communication Protocol

When M10 is working, each set of sample data is output through the communication interface. The output data has a uniform message format. If a detailed communication protocol is required, the M10 Communication Protocol V1.7 data message is required. Please contact LeiShen's Technical Support.

## 7. Development Tool and Supports


LeiShen provides customers with SDK development kit of M10 LiDAR , which can process scanning data in real time and offer a visual display. The SDK kit can help users to get familiar with the products and shorten the project development cycle. At present, only SDK kit based on Linux, ROS and windows X86 platform can be provided. For future versions of Android, mac os and other platforms, please pay attention to the official website [www.lslidar.com](http://www.lslidar.com).

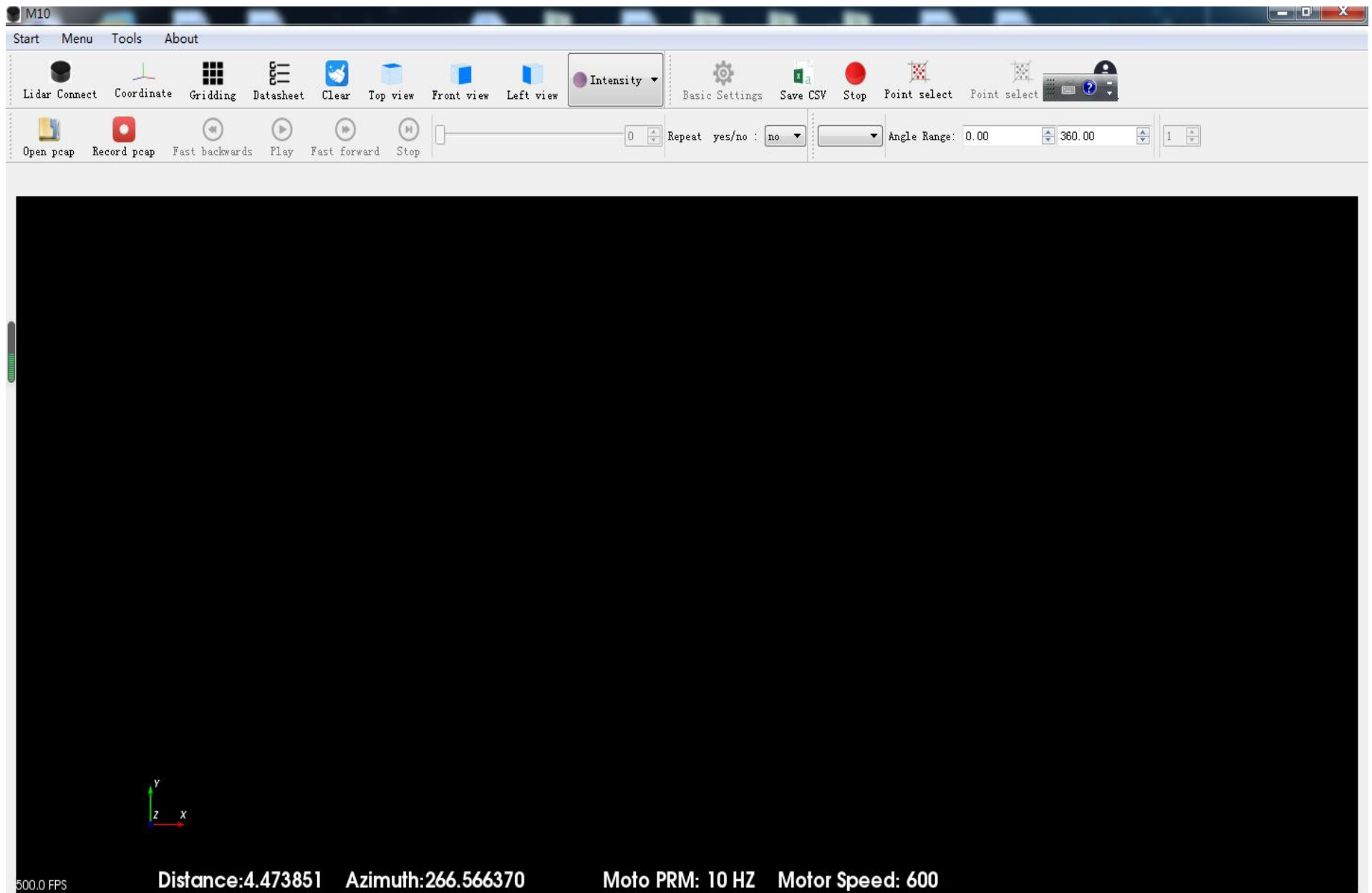
### 7.1 Point Cloud Display Software under Windows

The Windows point cloud display software of M10 LiDAR are introduced here, including the point cloud display software, parameter configuration, LiDAR test, etc.

#### 7.1.1 Software Interface Introduction


The software interface includes menu area, toolbar area, 3D window area, data table area, company website link, etc.

Double-click the shortcut icon  on the desktop. The initial interface is shown below:

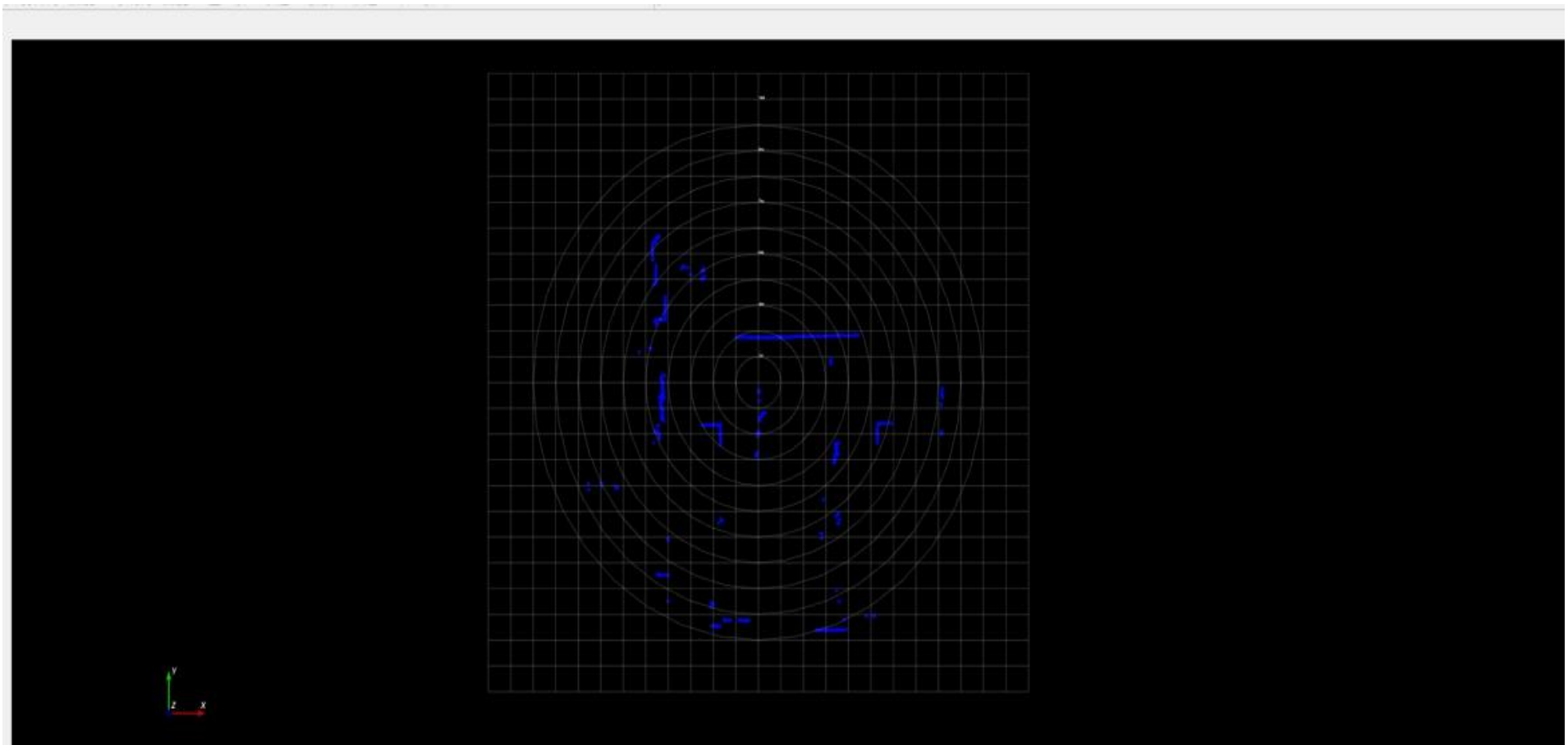


## 7.1.2 LiDAR Data Reception, Point Cloud Display

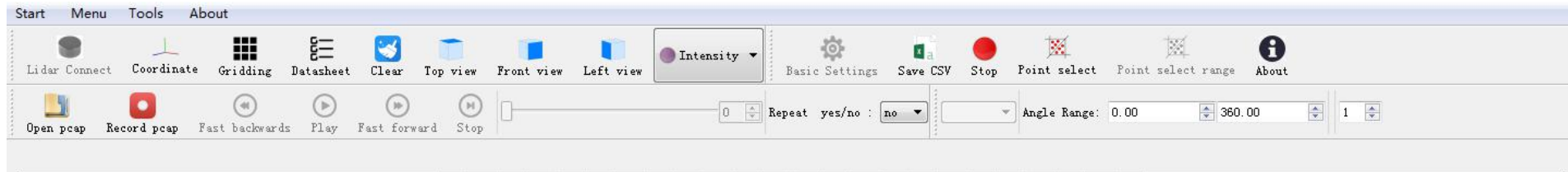
Select the designated LiDAR serial port  to receive data:










After the LiDAR is powered on and the Serial cable is connected, click on  to get real-time receiving LiDAR data.


The data receiving interface is shown in the figure.





### 7.1.3 Menu Function Introduction



- (1) Click the icon  Select the Start button to start receiving the display data.
- (2) Click the coordinate axis button  to control whether to display the coordinate axis of origin position.
- (3) Click button  to control Yes/No to display the measuring grid.
- (4) Click button  to controls whether to show/hide the left data bar
- (5) Click the clean button  clear the screen display.
- (6) Select the view button  to correspond to the top view, front view and left view respectively. Set the viewing angle to view the point cloud image from the top, front, and left.
- (7) Choose different types of point clouds  to display by reflectivity, horizontal angle and single color.
- (8) Click the icon  to pop up LiDAR parameter setting form.
- (9) Click the button  to save the 3D data of the point cloud.

(10) Click the button  to pause the point cloud image and data of the interface

(11) Select the button  to mark the selected point in the point cloud image

(12) Click  view windows software and company logo.

(13) Offline data saving, opening, playing, stopping, multiples, etc.



### 7.1.4 Display of Data Bar

The data sheet contains PointID, Points\_m\_XY, Azimuth, Distance, Reflectivity. In particular, Point ID is the point number, Points\_m\_XY is the 2D coordinate. Intensity is the object's materials reflection intensity, And the timestamp is the time parsed by the device package and the data package.

	ID	Points_m_XY	Azimuth	Distance	Intensity	Timestamp
1	0	0.0075 5.3400	0.0800	5.3400	15.0000	1394047973.0000
2	1	0.0158 5.3400	0.1700	5.3400	15.0000	1394048023.0000
3	2	0.0242 5.3359	0.2600	5.3360	15.0000	1394048020.0000
4	3	0.0331 5.3359	0.3550	5.3360	15.0000	1394048070.0000
5	4	0.0419 5.3398	0.4500	5.3400	15.0000	1394048067.0000
6	5	0.0504 5.3438	0.5400	5.3440	15.0000	1394048117.0000
7	6	0.0588 5.3437	0.6300	5.3440	15.0000	1394048114.0000
8	7	0.0675 5.3356	0.7250	5.3360	15.0000	1394048164.0000
9	8	0.0769 5.3714	0.8200	5.3720	15.0000	1394048161.0000
10	9	0.0950 5.4432	1.0000	5.4440	15.0000	1394048208.0000
11	10	0.1029 5.3830	1.0950	5.3840	15.0000	1394048258.0000
12	11	0.1131 5.4468	1.1900	5.4480	15.0000	1394048255.0000
13	12	0.1354 5.6624	1.3700	5.6640	15.0000	1394048302.0000
14	13	0.1446 5.6542	1.4650	5.6560	15.0000	1394048352.0000
15	14	0.1542 5.6619	1.5600	5.6640	15.0000	1394048348.0000
16	15	0.1629 5.6537	1.6500	5.6560	15.0000	1394048398.0000
17	16	0.1720 5.6614	1.7400	5.6640	15.0000	1394048395.0000
18	17	0.1814 5.6611	1.8350	5.6640	15.0000	1394048445.0000
19	18	0.1908 5.6608	1.9300	5.6640	15.0000	1394049080.0000
20	19	0.1996 5.6605	2.0200	5.6640	15.0000	1394049130.0000
21	20	0.2075 5.6322	2.1100	5.6360	15.0000	1394049127.0000
22	21	0.2170 5.6350	2.2050	5.6400	15.0000	1394049177.0000
GPS_Time:	2000-0-0 0:0:0	4294967295				





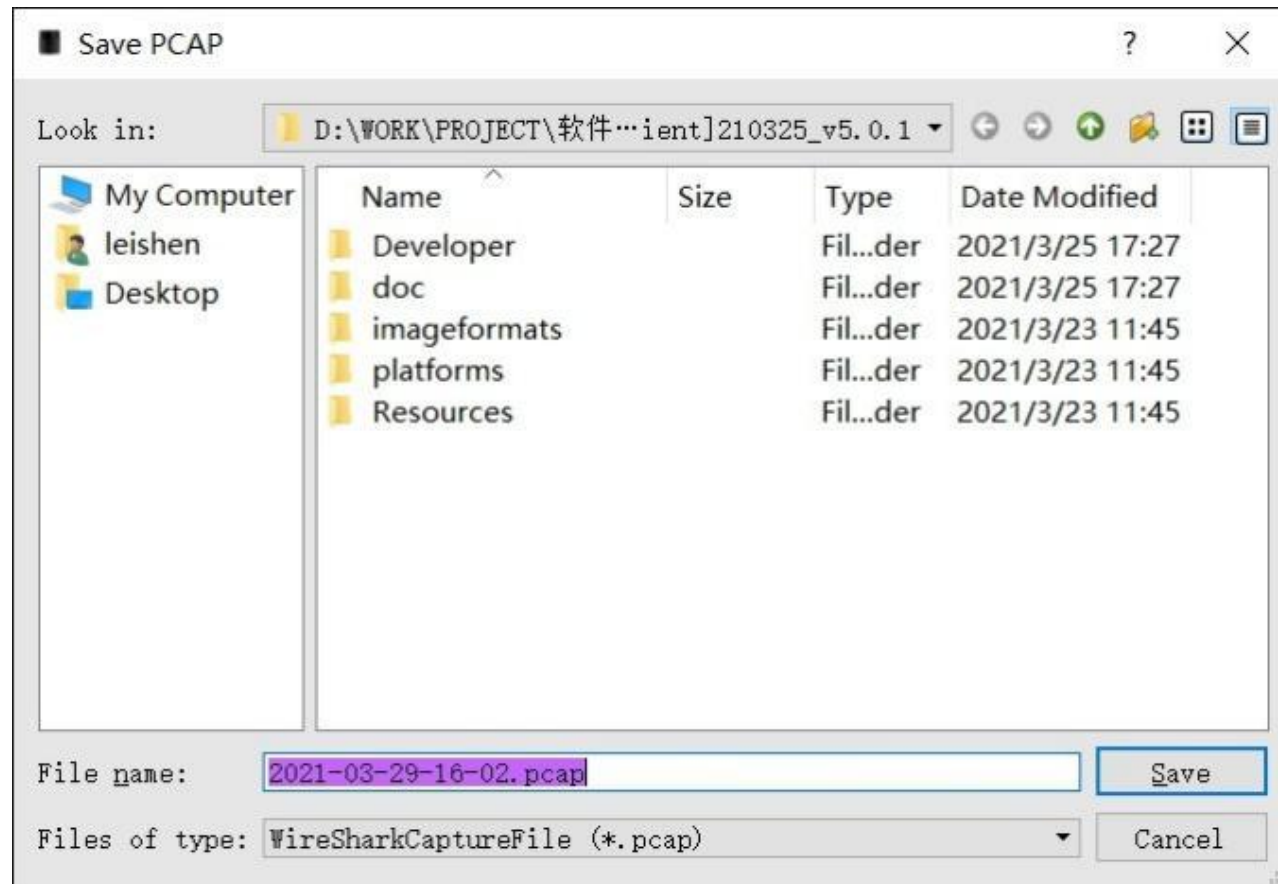
### 7.1.5 Point Cloud Display Interface Instruction

- (1) By moving the mouse wheel the display interface zooms in/out; holding down the right mouse button to drag up/down can also do.
- (2) Dragging while holding down the right mouse button helps to adjust the perspective of the display interface.
- (3) Dragging while holding down the mouse wheel helps to pan the display interface; pressing the shift key on the keyboard while clicking the left mouse button can also do.

### 7.1.6 Offline Data Display



- (1) Offline data saving

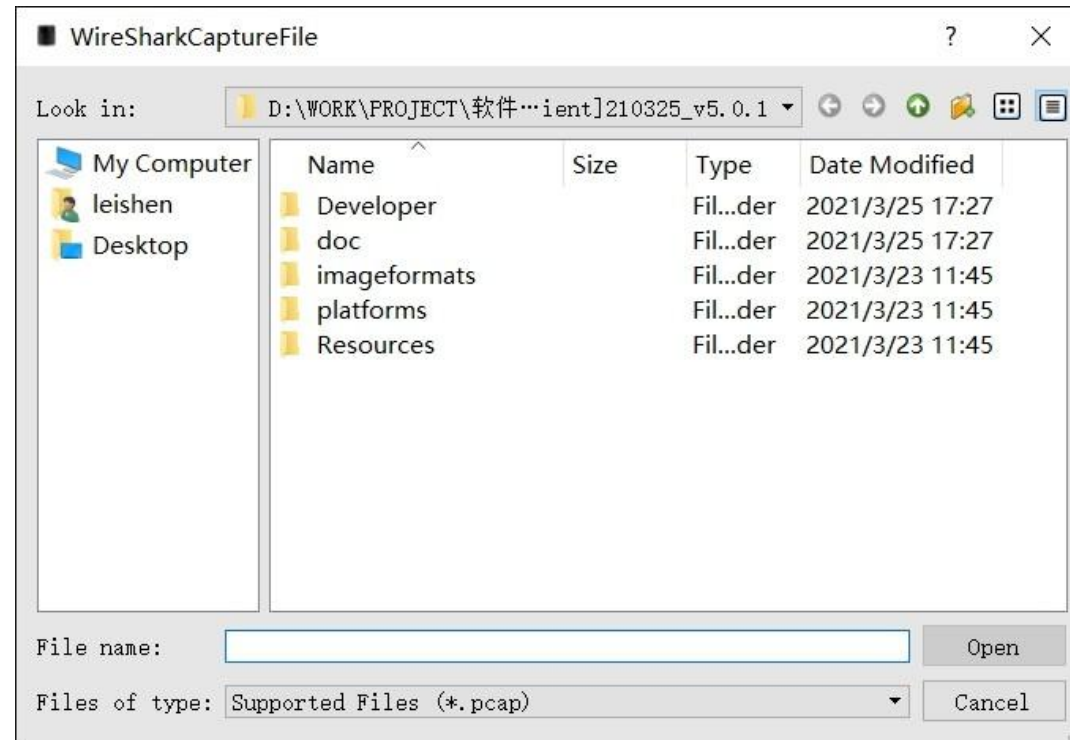
Select the button  to start saving the offline data. The LiDAR saves the real-time data. Select the save name and path, click "Save" and start recording. Click the button  again to end the recording.◦





Note: When playing an offline pcap file, the button is grayed out and the feature is unavailable.



## (2)Offline data play


Click the Open File button  to pop up the dialog box: select the .txt file to be played, and click the Open button. Click the button  to start playing the LiDAR offline point cloud file and visualize the point cloud data.。

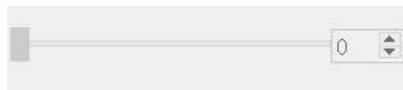


### (3) Introduction to play related buttons

For the play/pause button, a pause is enabled by clicking  when it is playing and playback resumes by clicking  when it is paused.

Click the button  during playback return quickly; Play the point cloud of the previous frame when paused, Click the button 

during playback to fast forward. Play the point cloud of the next frame when paused. Click the button  stop playing. The progress bar in the toolbar displays the progress of the playback file. The data in the display box is the number of frames currently played.



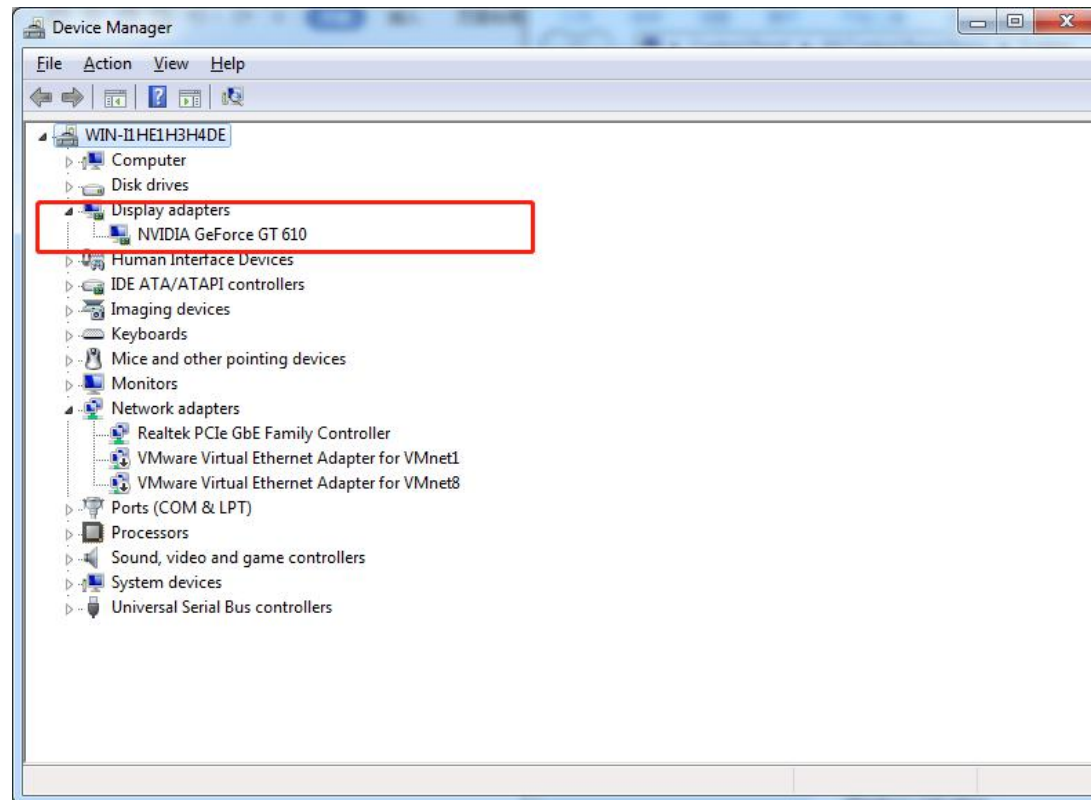
## 7.1.7 Windows Software and Supporting Software Information

Click  to view the company logo and Windows version information.

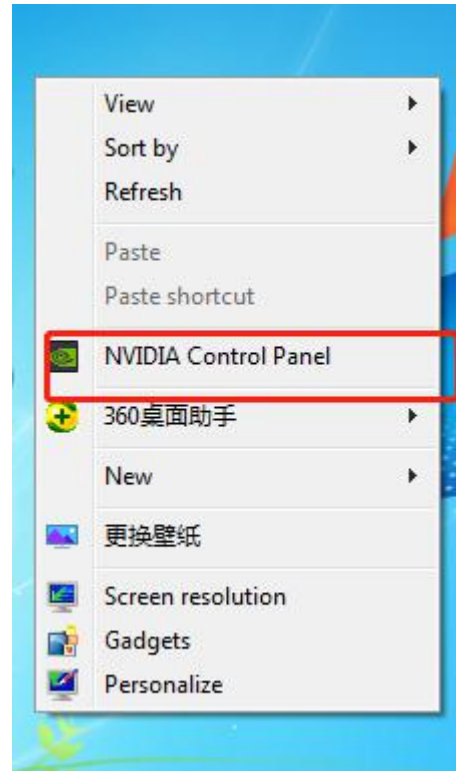


### 7.1.8 Problems of LiDAR Settings

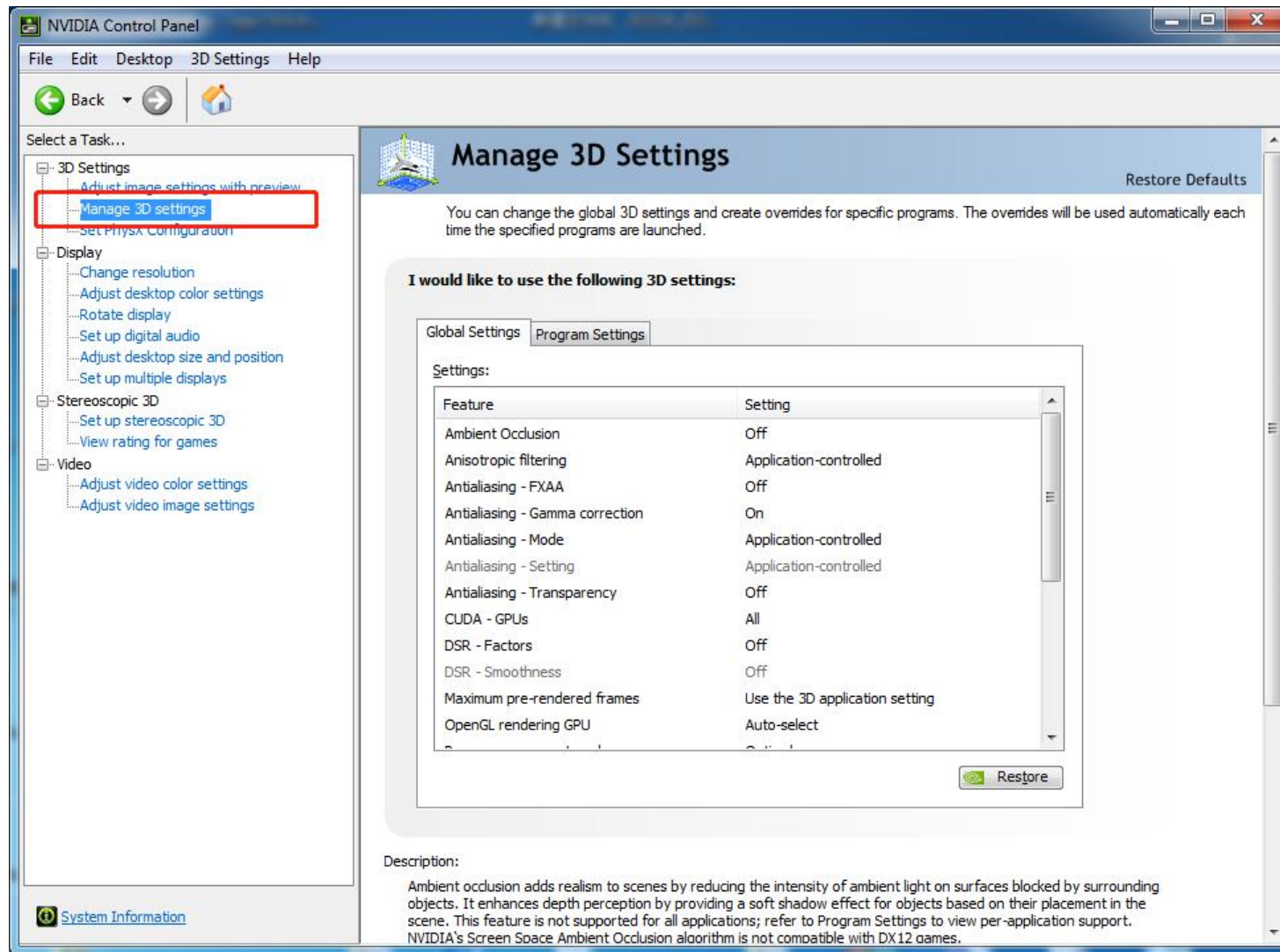
The LiDAR display software is running based on a PC with dual display cards. However, under global settings, the computer operating system's default is Integrated Graphics. Please set it into dual display card mode. Following the instruction: my PC-> Right-> Properties-> Device Manager:



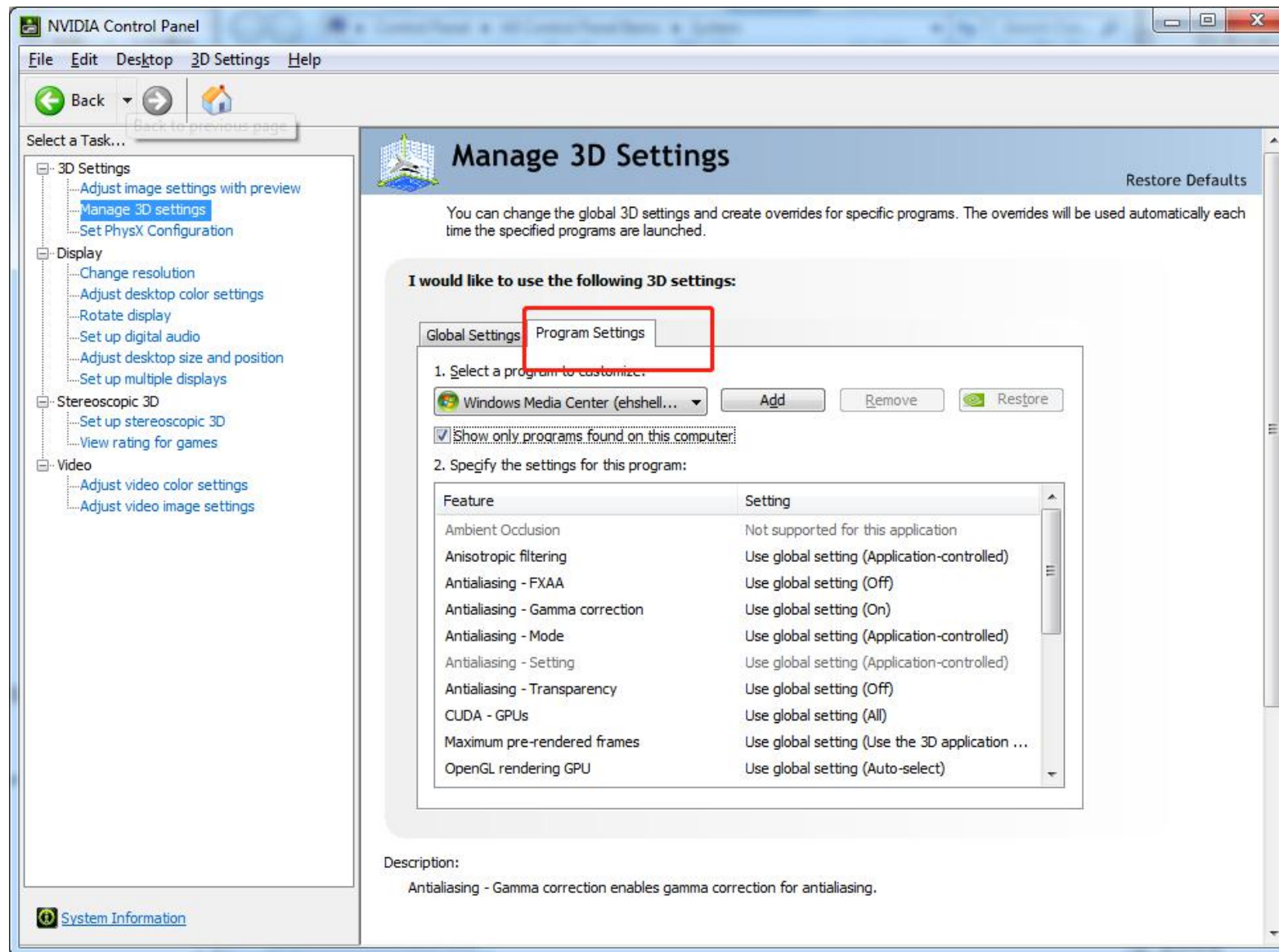
(1) Take the dual display cards for example, click the right mouse button on the desktop to pop up the right menu and select the NVIDIA control panel.



(2) Select the pop-up NVIDIA control panel program interface, select the Manage 3D Settings button, as shown in the figure below.

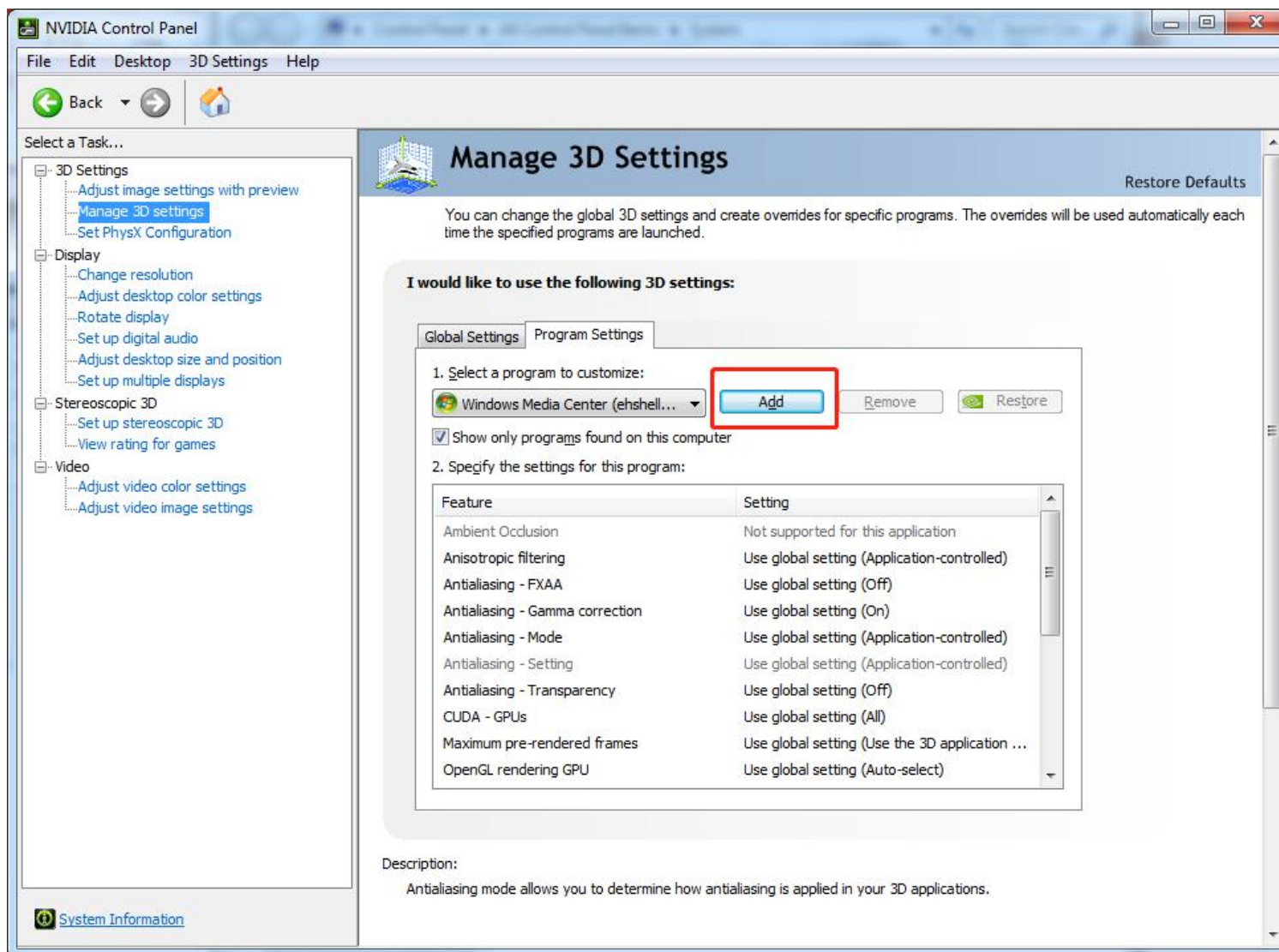


(3) Select the program settings button in the management 3D settings interface as shown in the figure below.

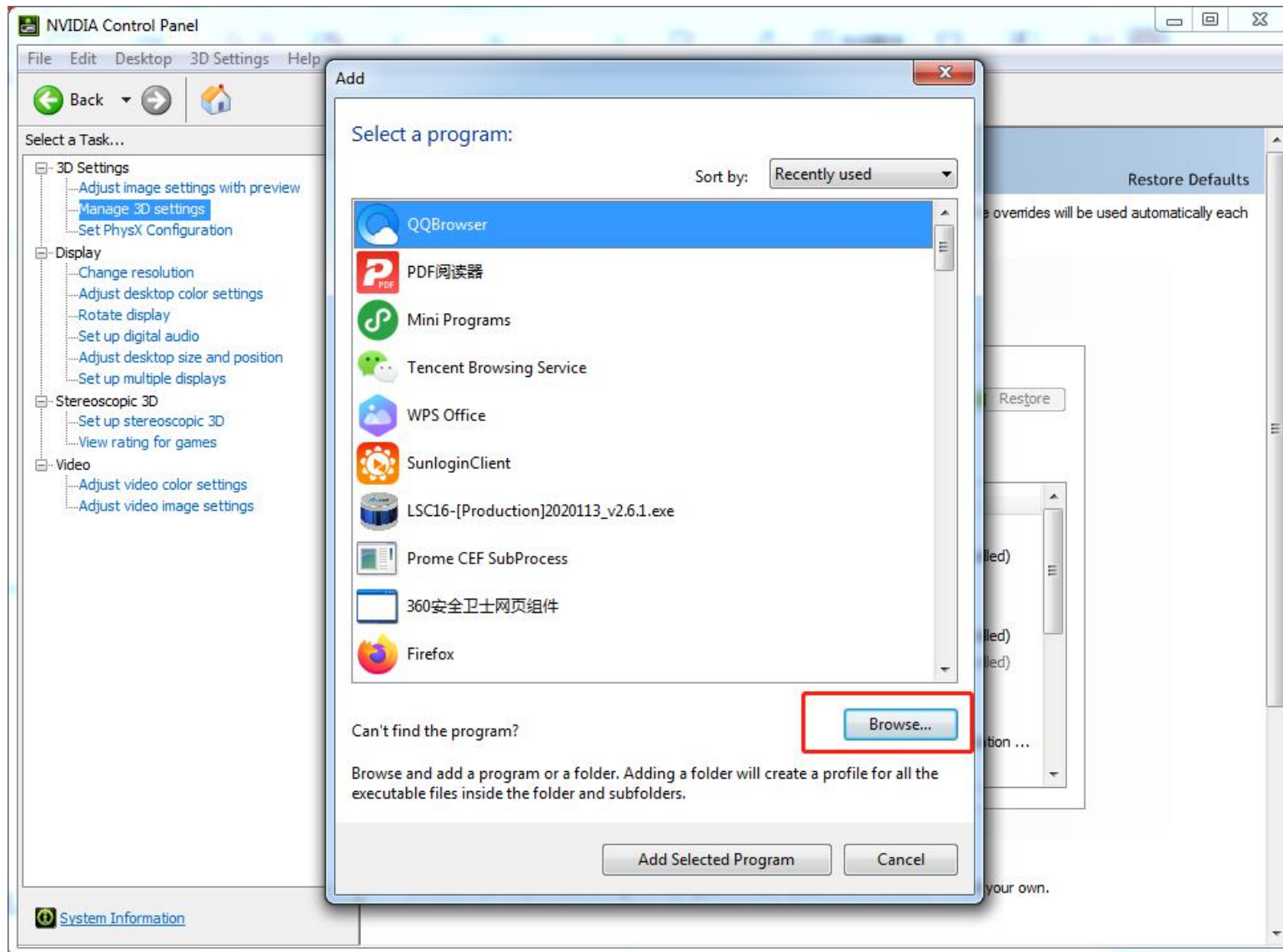




(4)Click the Add button on the management 3D setup interface as shown in the figure below.



(5) Click the browse button in the pop-up add interface, as shown in the figure below.



(6) In the pop-up browse interface, locate the application file (.exe file) of the software according to the installation path of the software:

名称	修改日期	类型	大小
bin	2017/8/26 17:37	文件夹	
doc	2017/9/13 11:01	文件夹	
iconengines	2017/9/9 15:45	文件夹	
image	2017/9/13 11:48	文件夹	
imageformats	2017/9/9 15:45	文件夹	
include	2017/9/9 15:45	文件夹	
lib	2017/9/9 15:45	文件夹	
platforms	2017/9/13 10:58	文件夹	
system32	2017/9/9 17:05	文件夹	
SysWOW64	2017/9/9 17:05	文件夹	
icudt53.dll	2014/9/3 16:42	应用程序扩展	21,025 KB
icuin53.dll	2014/9/3 16:42	应用程序扩展	2,412 KB
icuuc53.dll	2014/9/3 16:42	应用程序扩展	1,675 KB
LSLidar.exe	2017/9/29 10:37	应用程序	817 KB

(7) Select the high-performance NVIDIA processor in the drop-down box of Option-2 and click Apply in the lower right corner. After setting, close the NVIDIA control panel and complete the setting as shown in the figure below.



## 7.2 ROS Driver

This chapter introduces the point cloud display and driver use of N301-P series LiDAR under Linux operating system. The ROS driver is used for point cloud display, parameter configuration and so on. It can be obtained by contacting our technical support.

### 7.2.1 Hardware Connection and Testing

Check whether there is a corresponding USB device connected under the /dev directory, and give the device read and write permissions at the same time.

```
ls-yy@lsyy-All-Series:~$ ls /dev/ | grep ttyU
ttyUSB0
ls-yy@lsyy-All-Series:~$ sudo chmod 777 /dev/ttyUSB0
```

### 7.2.2 Software Operation Example

- (1) Create a workspace and build a compilation environment `mkdir -p ~/leishen_ws/src`

Remarks:

The workspace can be named arbitrarily, for example, `leishen_ws` can be changed to any name.

- (2) LiDAR Drive download and unzip

copy the obtained `rosdriver.tar` to the newly created working space `XXX_ws / src`, and extract the `.tar` file.

- (3) Compile Package

```
cd~/leishen_ws
```

```
catkin_make
```

#### (4)Running Program

```
source devel/setup.bash
```

```
roslaunch lsm10_v2 lsm10_v2.launch
```

```
auto-starting new master
process[master]: started with pid [1527]
ROS_MASTER_URI=http://localhost:11311

setting /run_id to 2df2895c-885c-11eb-973c-88d7f6424ca2
process[rosout-1]: started with pid [1540]
started core service [/rosout]
process[lsm10_v2-2]: started with pid [1543]
port = /dev/ttyUSB0, baud_rate = 460800
open_port /dev/ttyUSB0 ERROR !
```

Note: If `open_port /dev/ttyUSB0 ERROR!` appears, it means that the USB device cannot be opened. Please check whether the USB device is connected and whether the read and write permissions are granted.

#### (5) Display the data detected by LiDAR in the pop-up displays window

Please change the value of "Fixed Frame" to "laser\_link", click the "add" button, and click "pointcloud2" under "by topic" to add the multi-lines point cloud.

#### (6)Parameter setting

In the `/src/lsm10_ros/launch/lsm10_V2.launch` file, the corresponding serial device name, topic and other information can be set.

## 8. Instrument Maintenance

### 8.1 Transportation requirement

M10 uses specially customized packaging materials , which can resist certain vibration and impact. Special packaging materials must be used for long-distance transportation to avoid irreversible damage during transportation.

### 8.2 Installation

Secure to the base with screws to specifications, paying attention to heat dissipation of the base. Wear powder-free clean gloves during installation to avoid dirt and mechanical damage of the mask.

### 8.3 Storage Conditions

M10's storage temperature is  $-40^{\circ}\text{C}\sim 85^{\circ}\text{C}$ . It is recommended to store the products in a ventilated and dry place, at normal temperature ( $23\pm 5^{\circ}\text{C}$ ) and relative humidity (30~70%). The products are not waterproof, and cannot be stored in humid environment malaise of pH.

### 8.4 Clean

If the enclosure is dirty during use, it will directly affect the LiDAR ranging effect, such as finger marks, muddy water lumps, dried leaves or insect corpses .Please clean as follow:

Tools: PVC gloves, dust free cloth, absolute alcohol (99%)

Environment: ventilated and dry, away from fire source

- Wear PVC gloves to secure the LiDAR base ; If it is not a stubborn stain, use a dust-free cloth or dry air to gently brush away the dirt;
- For stubborn stains, spray evenly with ethanol spray where cleaning is required. After dissolving the stain, use a dust-free cloth to dip in ethanol solvent and gently wipe the enclosure. If the dust-free cloth is contaminated, replace it in time. After cleaning , use a new dust-free cloth to remove the remaining liquid.

## 9. Remark History

Version Number	Revision Date	Revised Content	Fiction
V1.0	2021.6.22	Initial Version	LeiShen
V1.1	2021.8.15	Ranging distance, laser properties, Scan frequency revised.	LeiShen