

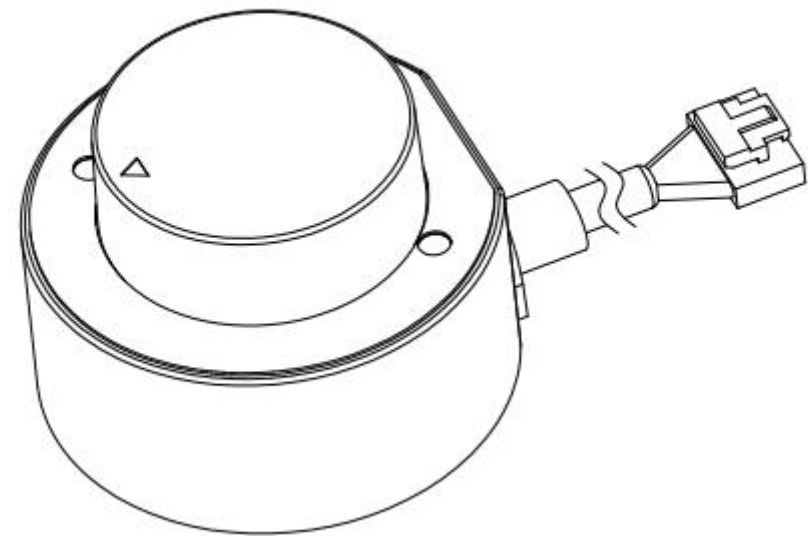


N10

2D TOF Short Range Mechanical LiDAR
User Manual V1.2.0



LeiShen WeChat Official Account



Catalogue

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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 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 N10 LiDAR. The product manual is updated with the product technical upgrade. For the latest version, please contact LeiShen's technical support.

The N10 LiDAR adopts TOF (time of flight) principle to capable of 2 D scanning detection of the surrounding 360 ° environment. N10 uses wireless power supply and optical communication, measuring frequency for 10khz. The accuracy is to reach the $\pm 3\text{cm}$ 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.

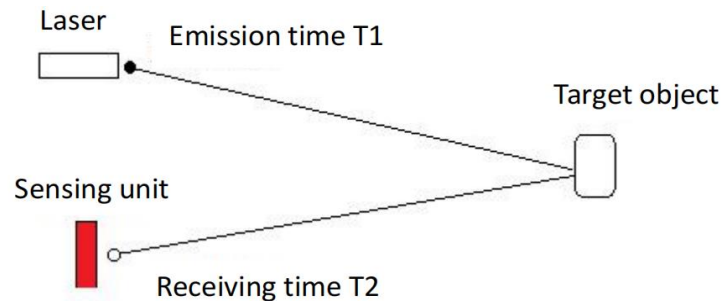
2. Operating Principle

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:

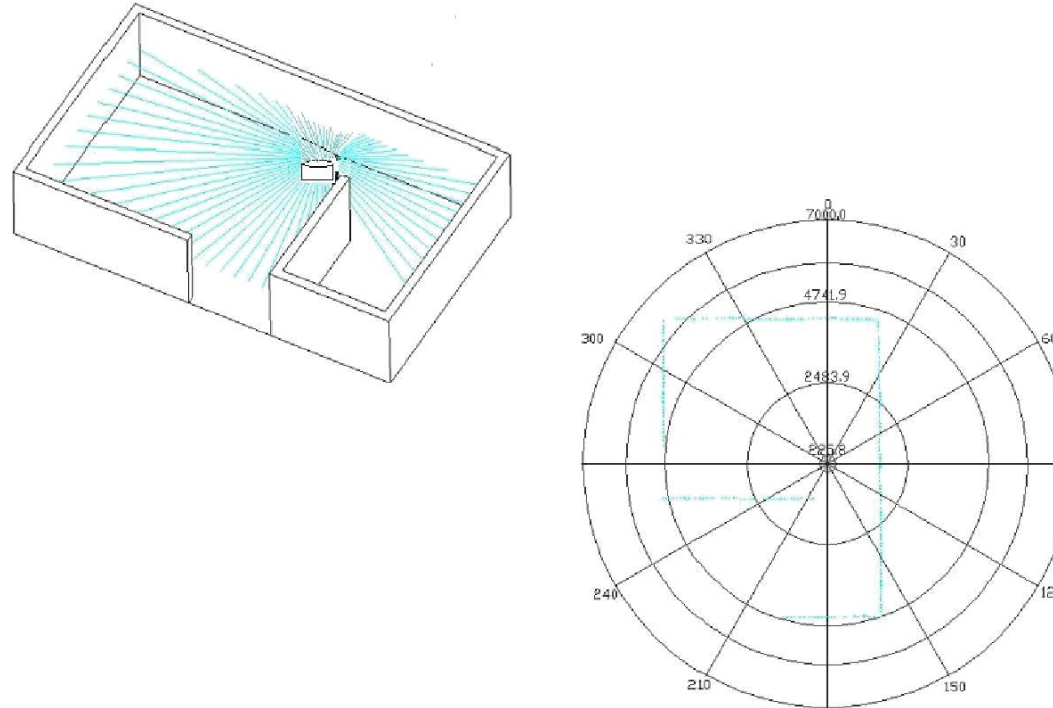


Ranging formula: $D = \frac{1}{2}C(T_2 - T_1)$
(D=distance C=speed of light T1=Emission time T2=Receiving time)

2.2 Two-dimensional Display

The distance value of the detected object is calculated by the signal processing unit inside the N10. 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:

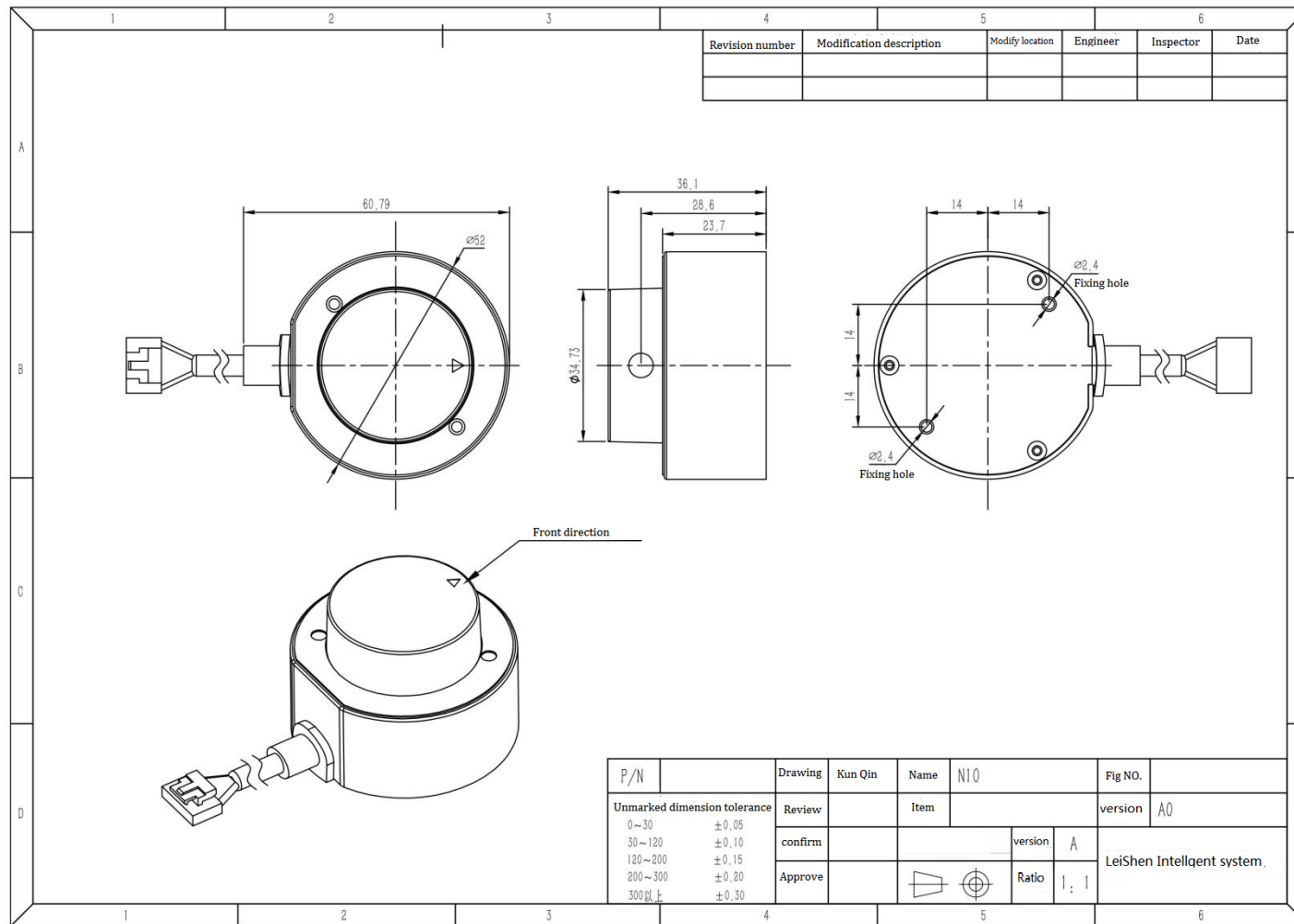


3. Product Parameter

Model	N10
Scanning Angle	360°
Data Rate	4.5KHz
Angular Resolution	0.8°
Scan Frequency	10Hz
Output Data Resolution	15mm
Measurement Accuracy	$\pm 3\text{cm}$ (0~6m); $\pm 4.5\text{cm}$ ($\geq 6\text{m}$) (@70% reflectivity)
Wavelength	905nm
Range	0m~12m (@70% reflectivity)
Data Content	direction, distance, intensity
Power Supply	5VDC (4.75V~5.25V)
Operation Temp.	-10°C~40°C
Storage Temp.	-30°C~70°C
Anti-Glare	30K Lux
Motor	Brushless Motor
Communication Interface	Standard serial port (baud rate: 230400 bps)
Size	$\Phi 52 \times 36.1\text{mm}$
weight	About 80g
IP Grade	IPX-4
Lifetime Span	Min 5000h; Typical 10,000h;

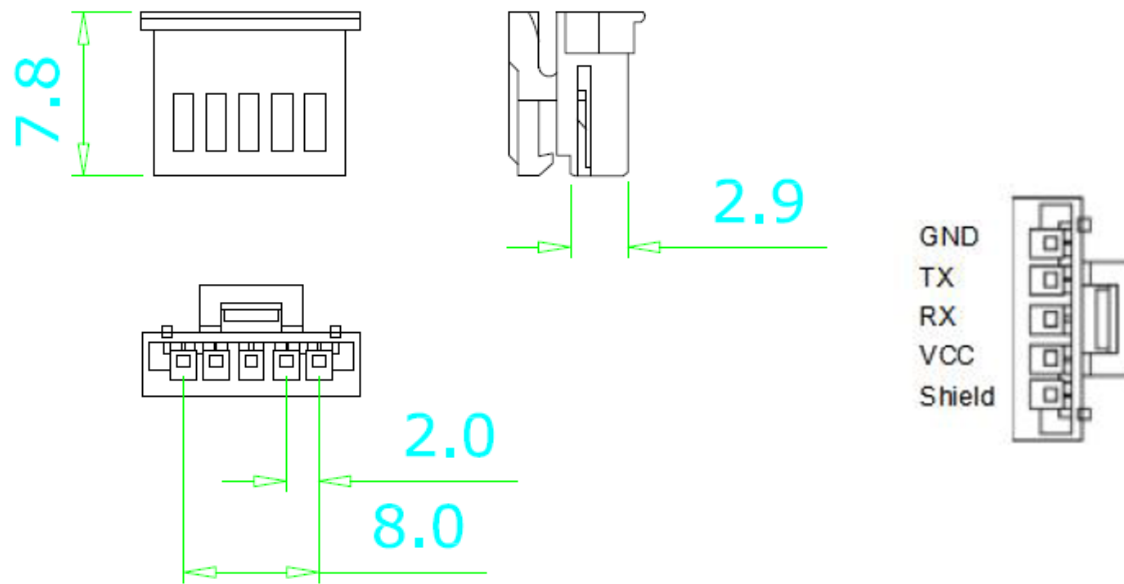
4. Component Connection

4.1 Mechanical Diagram



4.2 Interface Definition

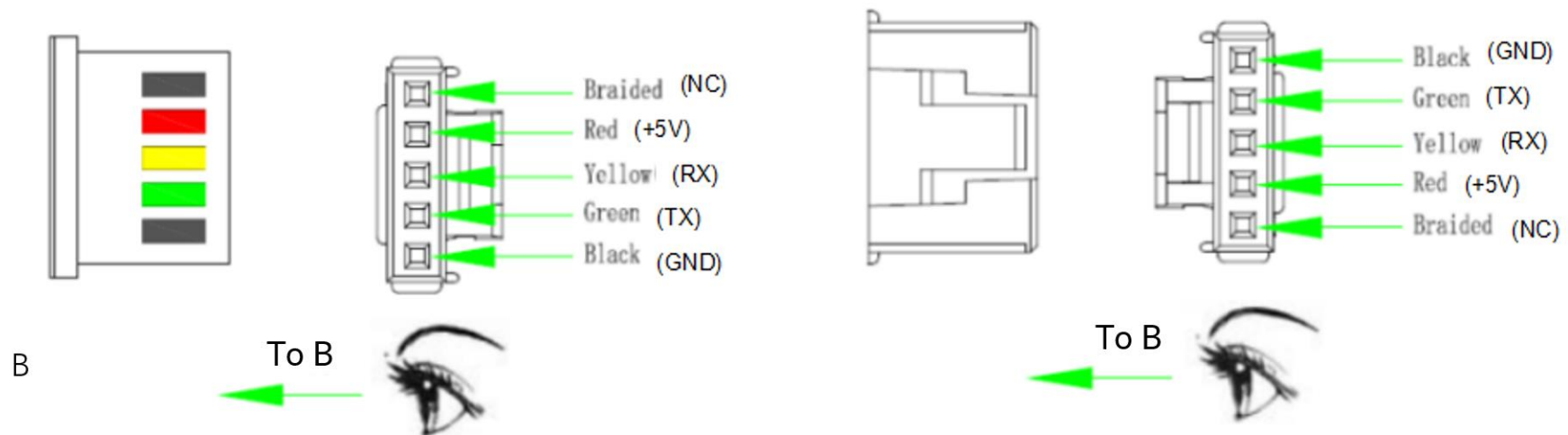
4.2.1. LiDAR Cable Connector Size Specifications



Connector Model: SMH200-05H
Crimp Terminal Model: YST200-CRT

4.2.2. Interface Definition

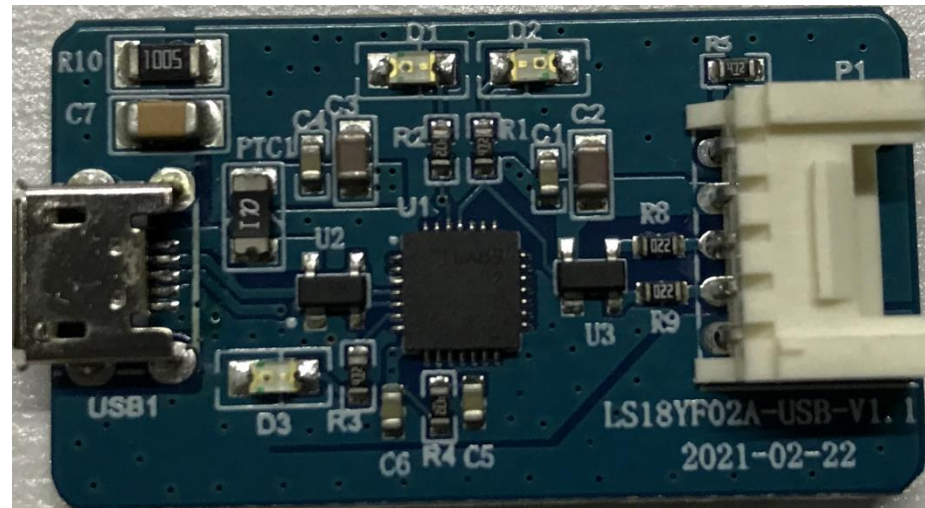
PIN	Color	Description	Min.	Typical	Max.
GND	Black	Supply voltage negative	0V	0V	0V
TX	Green	Lidar data output	0V	3.3V	3.5V
RX	Yellow	Function control	0V	3.3V	3.5V
VCC	Red	Supply voltage positive	4.75V	5V	5.25V
Shield	Braided	-	-	-	-



4.2.3 Adapter Board

The adapter board was offered as accessory, transfer SMH200-05H to USB, which realizes TTL TO USB data conversion. It is to facilitate customers for debugging use.

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



- ① Micro USB: data communication and system power supply;
- ② P1: connect to LiDAR;

5. Electrical Parameter

The N10 LiDAR uses a 3.3V serial port for communication. The N10 LiDAR is mainly composed of a high-frequency ranging core, a wireless transmission system, and a rotating subsystem. The rotating subsystem is driven by the central brushless stepper motor and rotates inside the system. The signal line of N10 can be directly connected to the UART port of FPGA/DSP/ARM/SCM without extra chip conversion such as RS232 and 422. The user connects LiDAR to the external system, and configure working status, obtains scanned point cloud data, device information, and status in real time according to the communication protocol of the system.

Item	Minimum	Typical Value	Maximum	Remarks
Supply Voltage	4.75V	5V	5.25V	If the supply voltage is not within this range, it may cause inaccurate or irreversible damage
Voltage Ripple	-	100mV	-	
Starting Current	-	300mA	-	
Working Current	-	180mA	-	
Signal High Level	2.9V	3.3	3.5V	
Signal Low Level	-0.3V	-	0.4V	
Baud Rate		230400 bps		Square wave signal. Pay attention to the stability of data communication

6. Communication Protocol

When N10 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 N10 Communication Protocol V1.7 data message is required. Please contact LeiShen's Technical Support.

7. Optical Principle

7.1. Laser Properties

N10 uses 905nm laser and adopts high-frequency pulse to emit laser light. The optical parameters of N10 LiDAR are as follows:

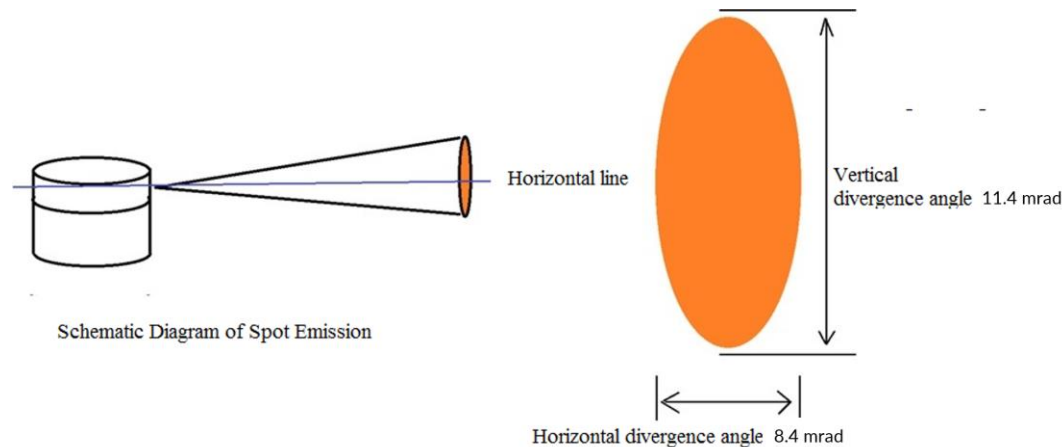
7.2. Light Spot Property

Item	Minimum	Typical Value	Maximum	Remarks
Laser Wavelength	895 nm	905nm	915nm	-
Peak Power	-	25W	-	-
Average Power		0.4mW		-
Laser Wavelength	-	2.5ns	-	-
FDA	Class I			IEC 60825-1:2014

The light spot of N10 LiDAR is an oval shape placed vertically, and the divergence angle is 11.4 mrad in vertical direction and 8.4 mrad 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 10 m as follow::

Vertical direction at 10 m: $10 * 11.4 * 10^{-3} = 0.114 \text{ m}$

Horizontal direction at 10 m: $10 * 8.4 * 10^{-3} = 0.084 \text{ m}$

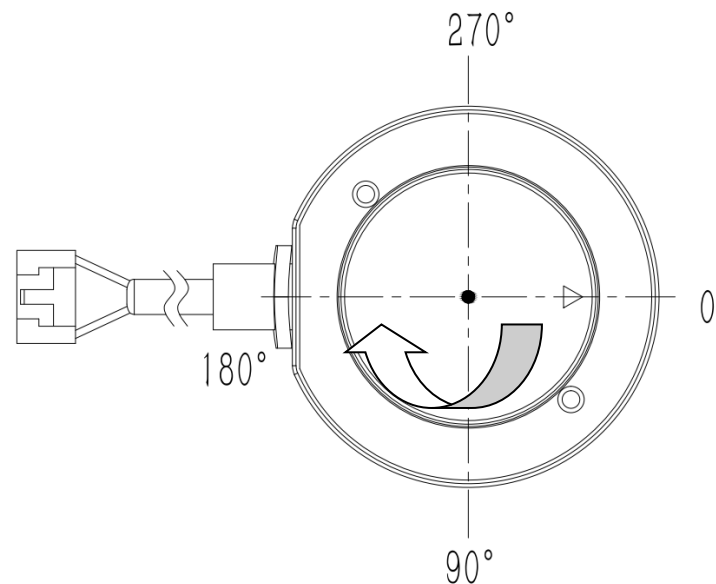


7.3. Optical structure

The N10 LiDAR adopts a telescope-type optical structure that receives and launches horizontally. It is necessary to focus on the optical structure of the LiDAR when installing the LiDAR and the integrated design of the robot system, so that the effective detection angle of the LiDAR can be accurately designed. In order to facilitate the usage of customers, especially the calculation of geometric relations, we define the polar coordinate system, define the center point of the structure of N10 as the pole, and define the clockwise as positive.

Below triangle mark is a zero degree angle.

The internal optical structure (in mm) and polar coordinates of the N10 LiDAR are as follows (top view):



8. Development Tool and Supports


LeiShen provides customers with SDK development kit of N10 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.

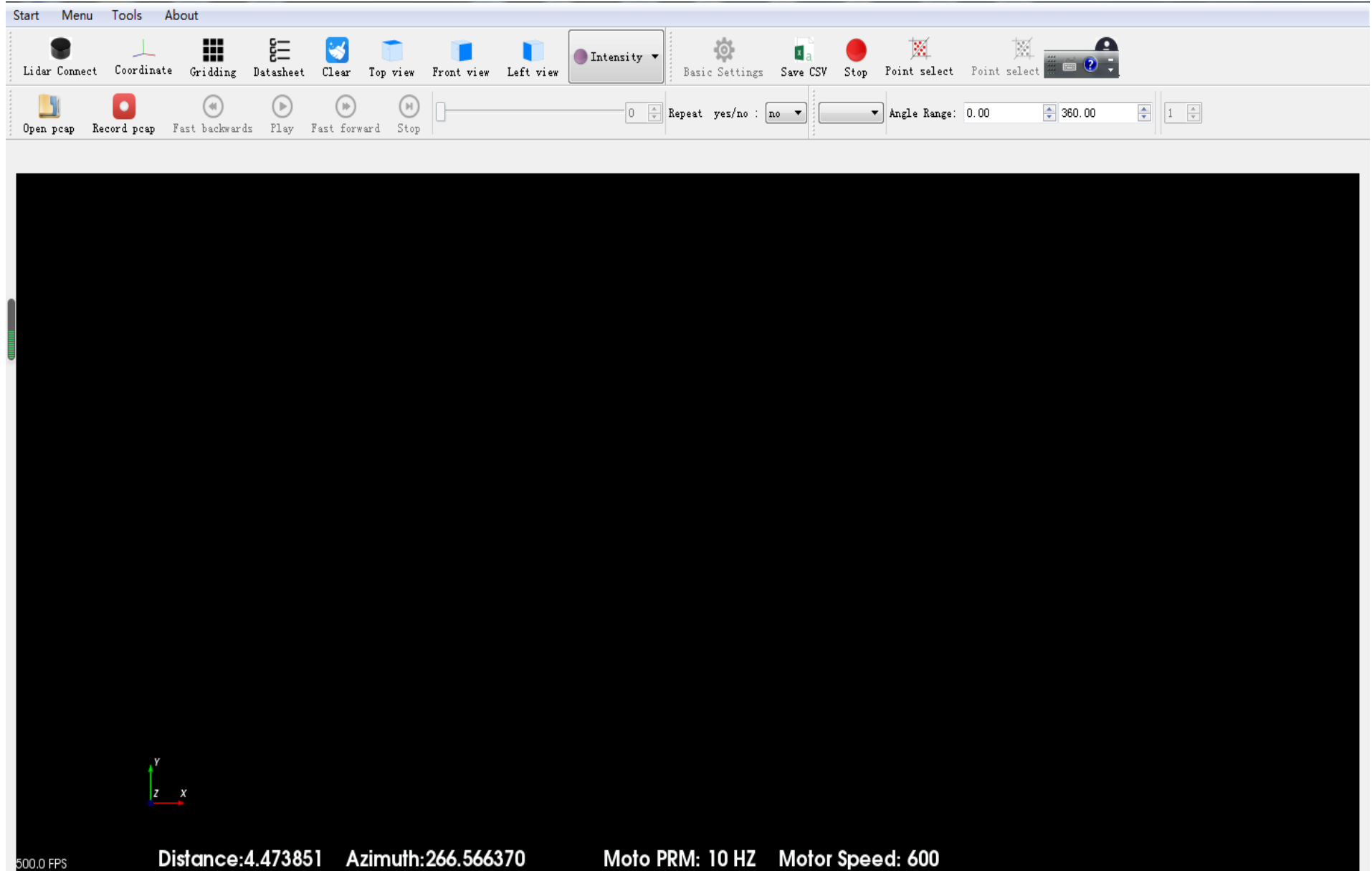
8.1. Point Cloud Display Software under Windows

The Windows point cloud display software of N10 LiDAR are introduced here, including the point cloud display software, parameter configuration, LiDAR test, etc.

8.1.1. Software Interface Introduction


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

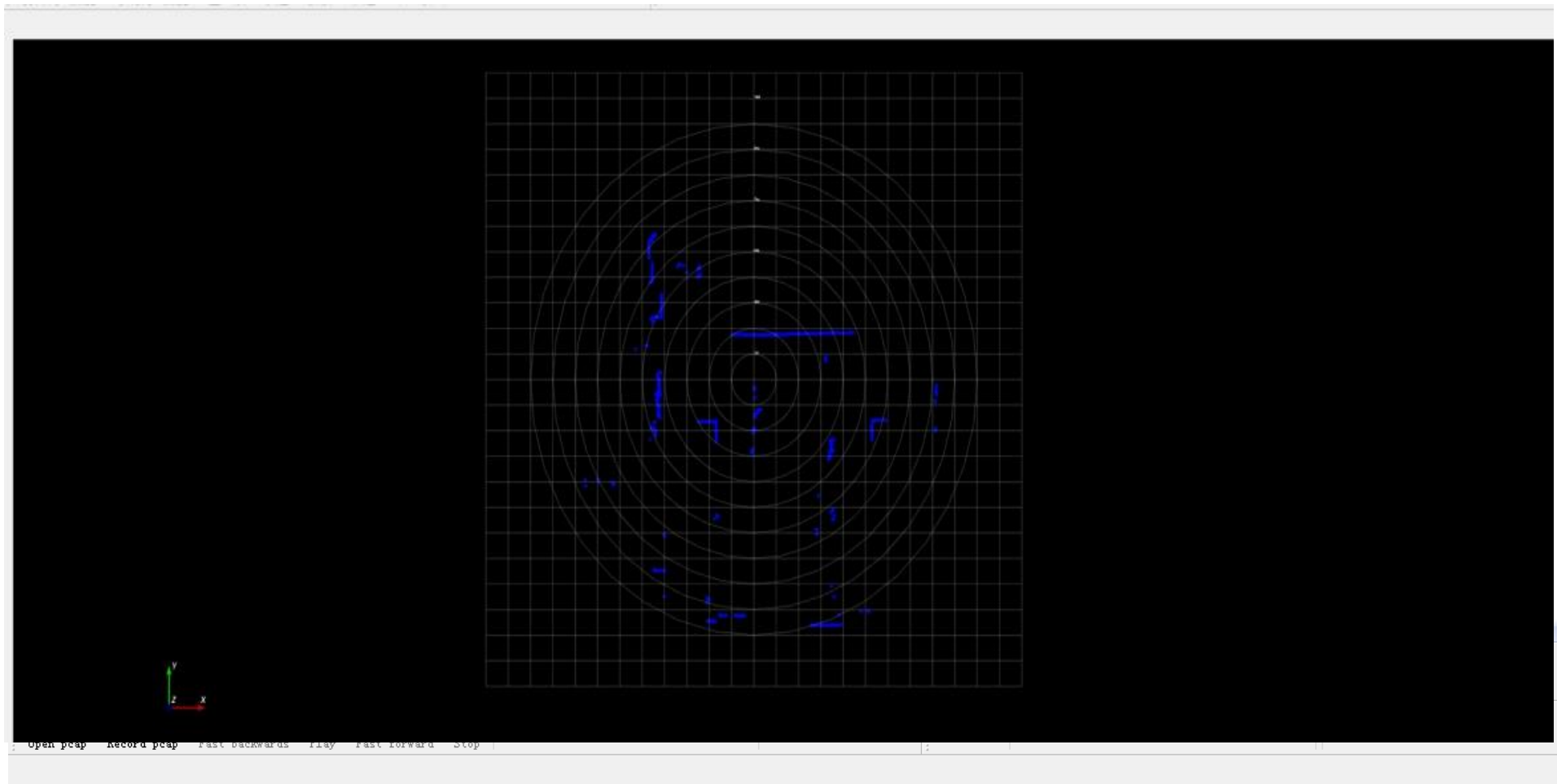
Double-click the shortcut icon  on the desktop. The initial interface is shown below:















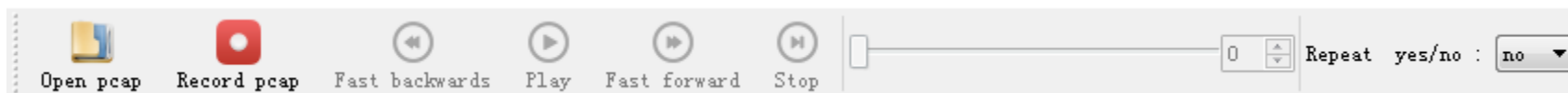
8.1.2. LiDAR Data Reception, Point Cloud Display

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.



- (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  to 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  to view windows software and company logo.
- (13) Offline data saving, opening, playing, stopping, multiples, etc.



8.1.4. 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					

8.1.5. 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.

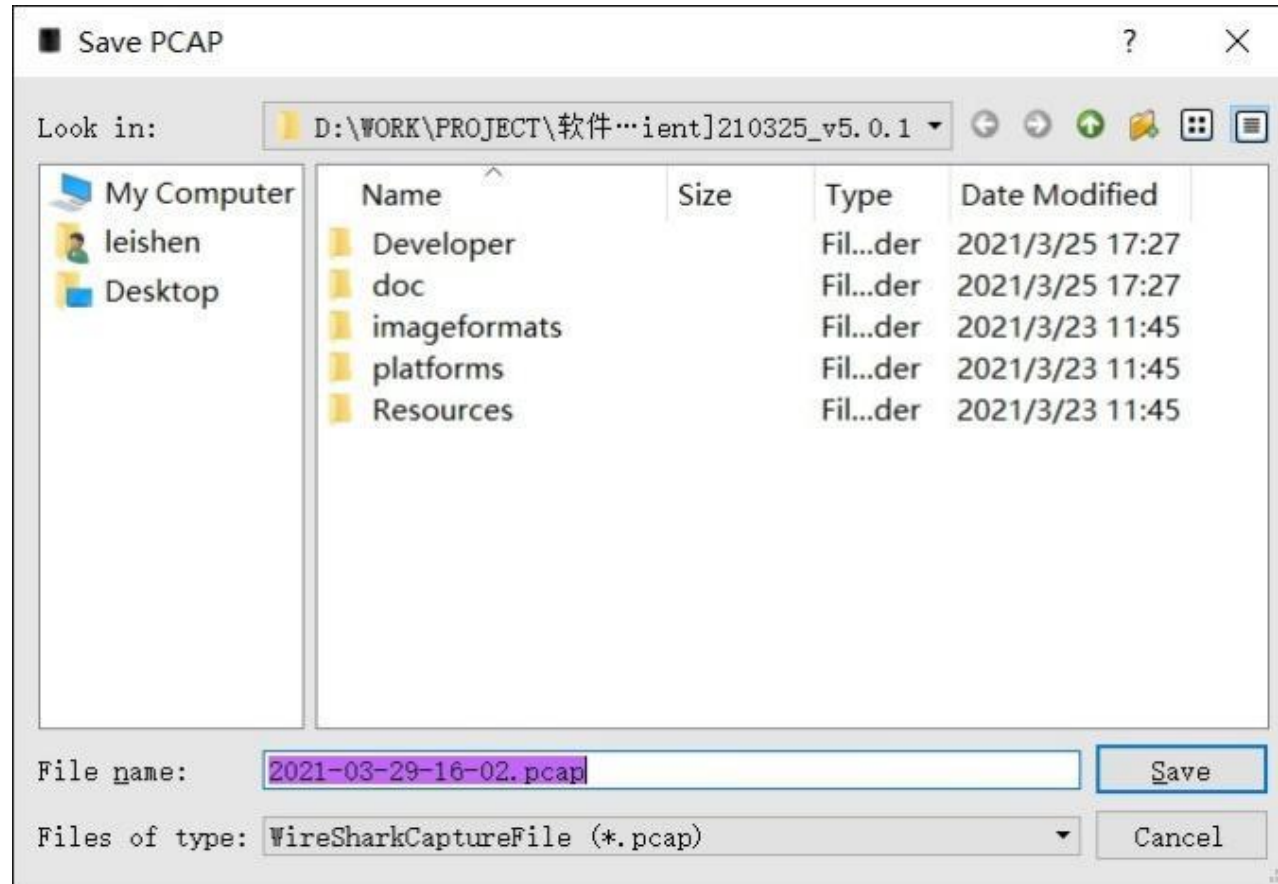
(2) Dragging while holding down the right mouse button helps to adjust the perspective of the display interface.

(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.

8.1.6. Offline Data Display



(1) Offline data saving

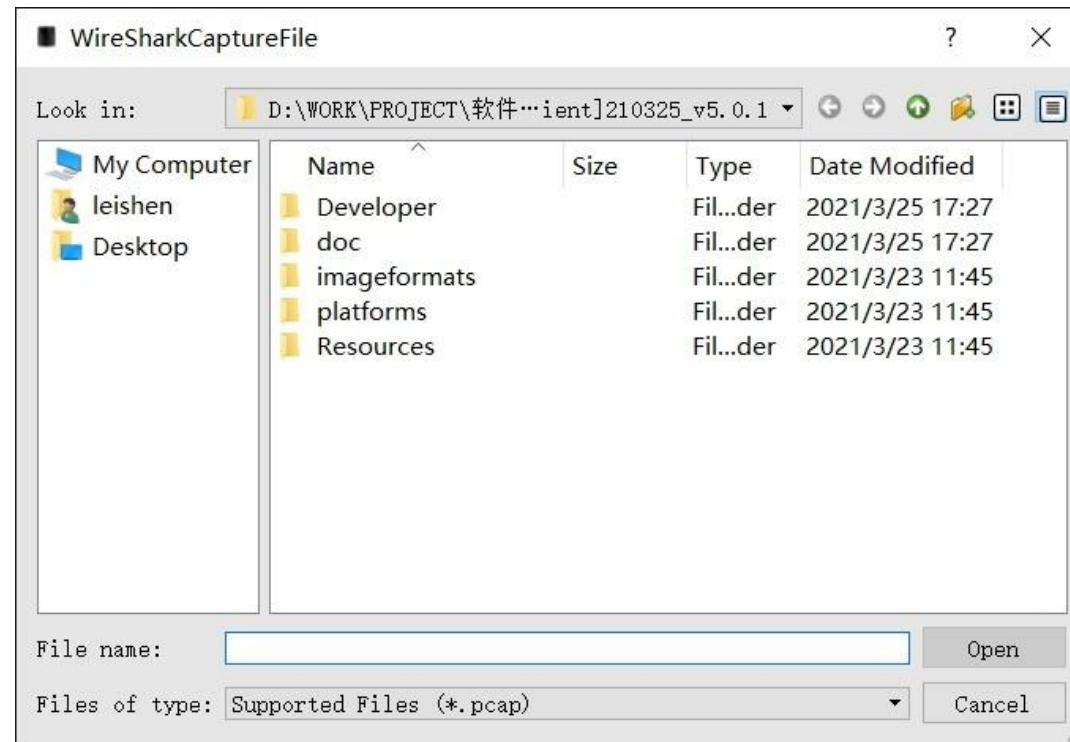
Select the button  to start saving the offline data. The LiDAR saves the real-time data. Select the save name and path, click "Save" and start recording. Click the button  again to end the recording.。








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

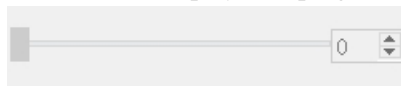
(2) Offline data play

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.



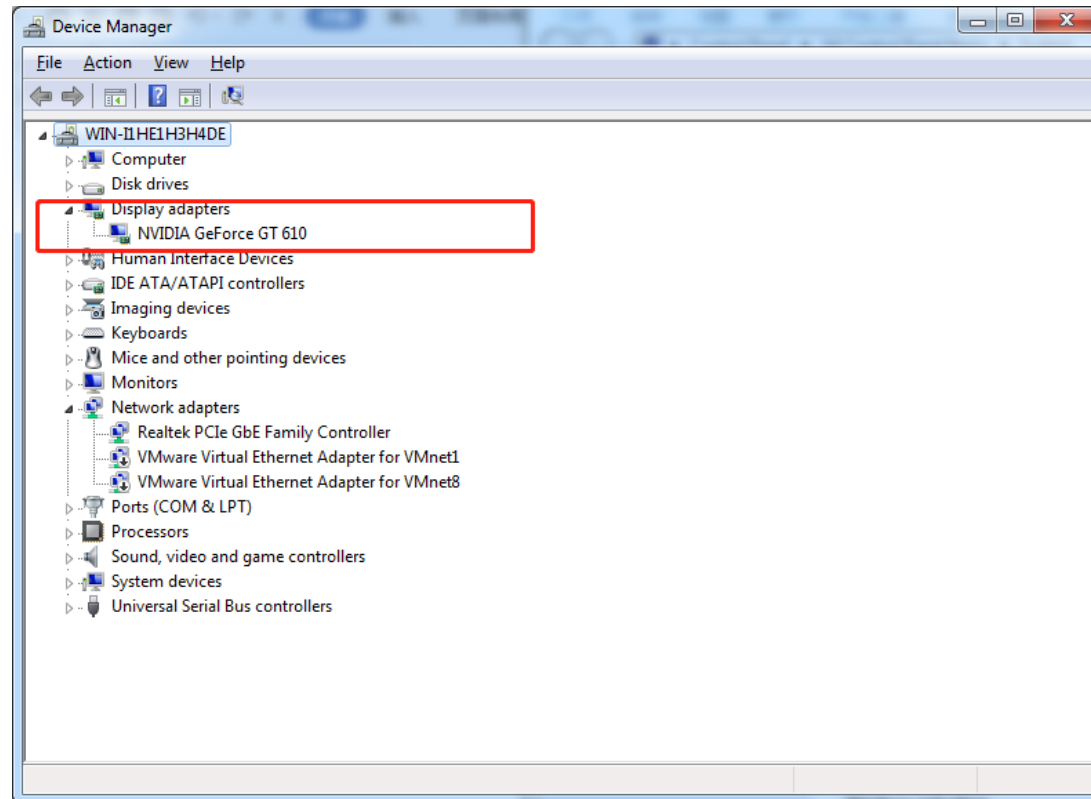
8.1.7. Windows Software and Supporting Software Information

Click  to view the company logo and Windows version information.

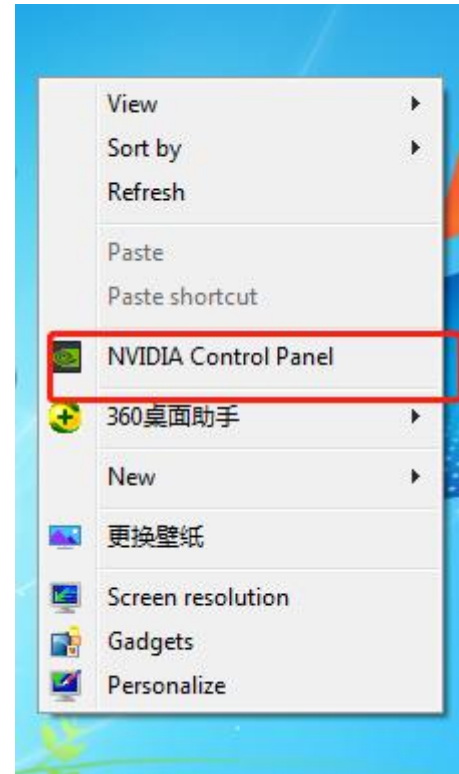


8.1.8. Problems of LiDAR Settings

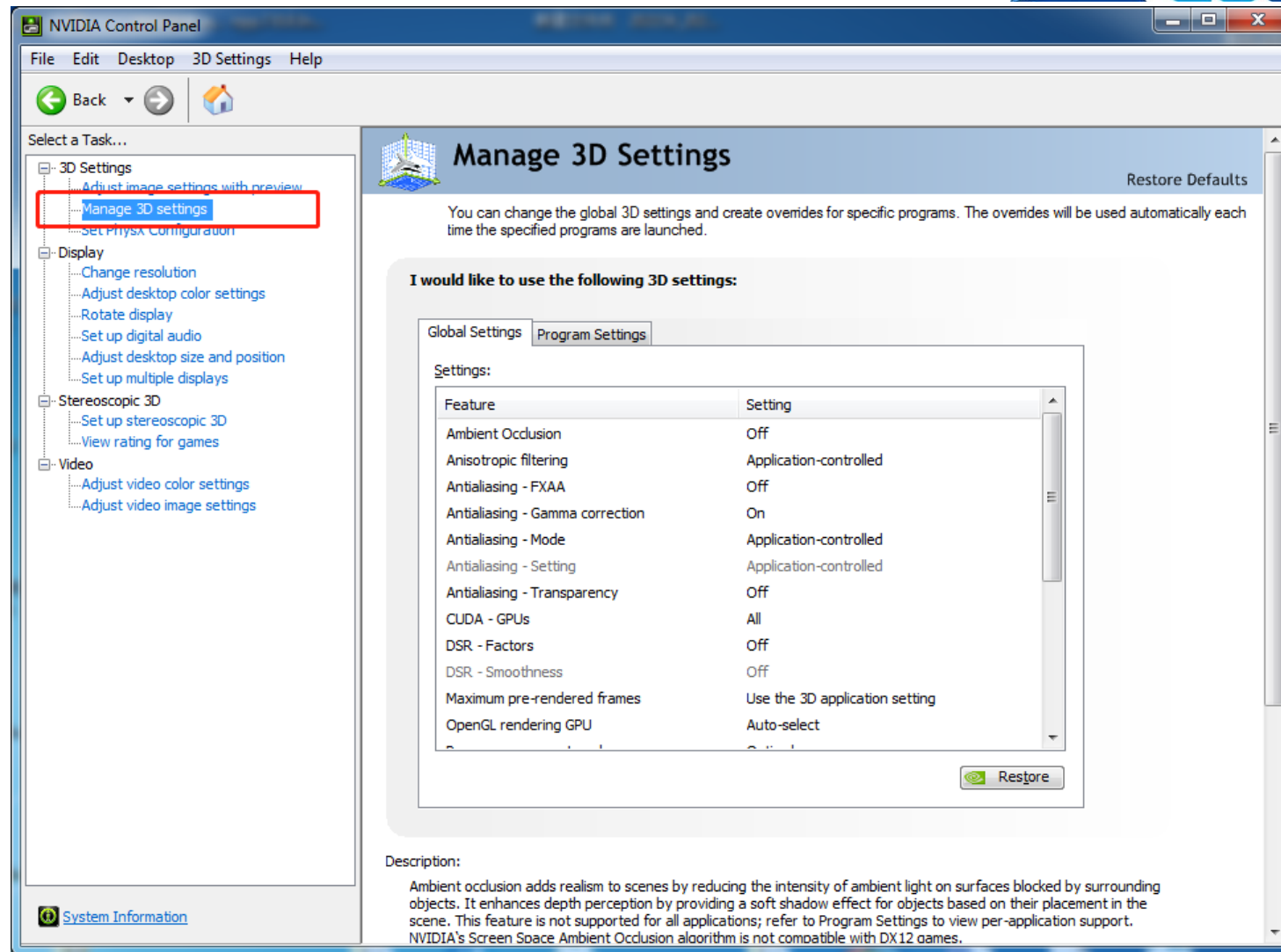
The LiDAR display software is running based on a PC with dual display cards. However, under global settings, the computer operating system's default is Integrated Graphics. Please set it into dual display card mode. Following the instruction: my PC-> Right-> Properties-> Device Manager:



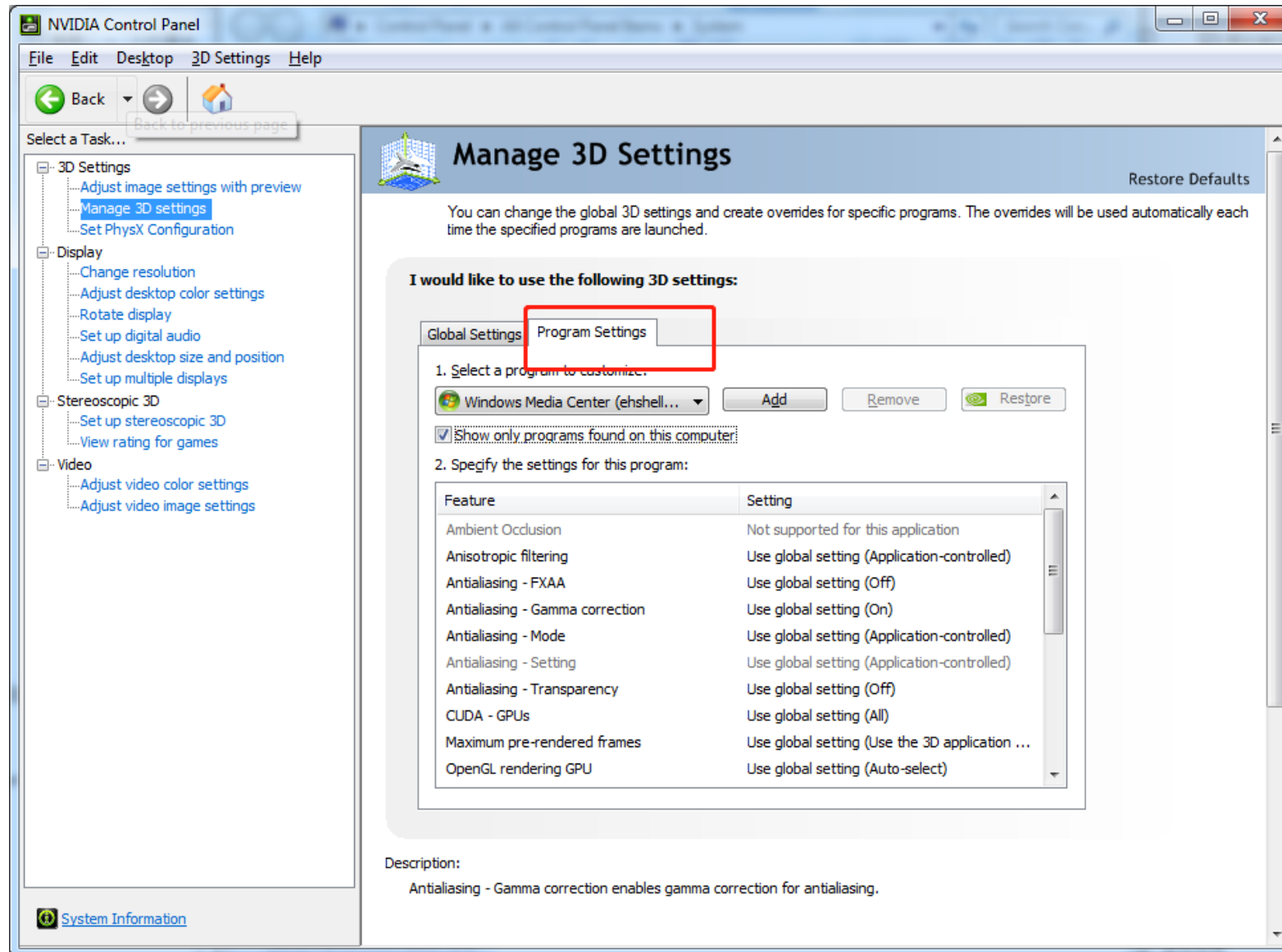
(1) Take the dual display cards for example, click the right mouse button on the desktop to pop up the right menu and select the NVIDIA control panel.



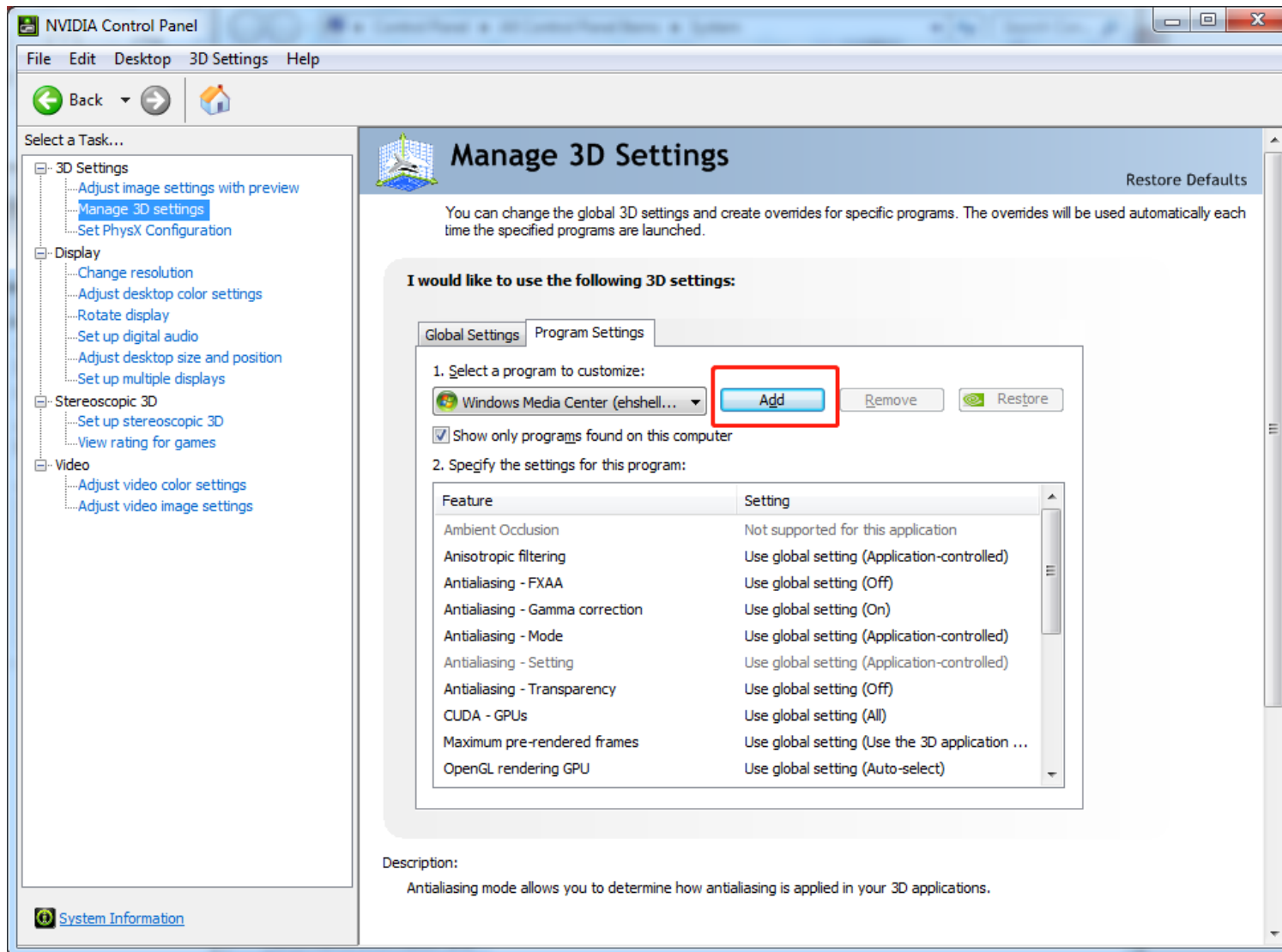
(2) Select the pop-up NVIDIA control panel program interface, select the Manage 3D Settings button, as shown in the figure below.



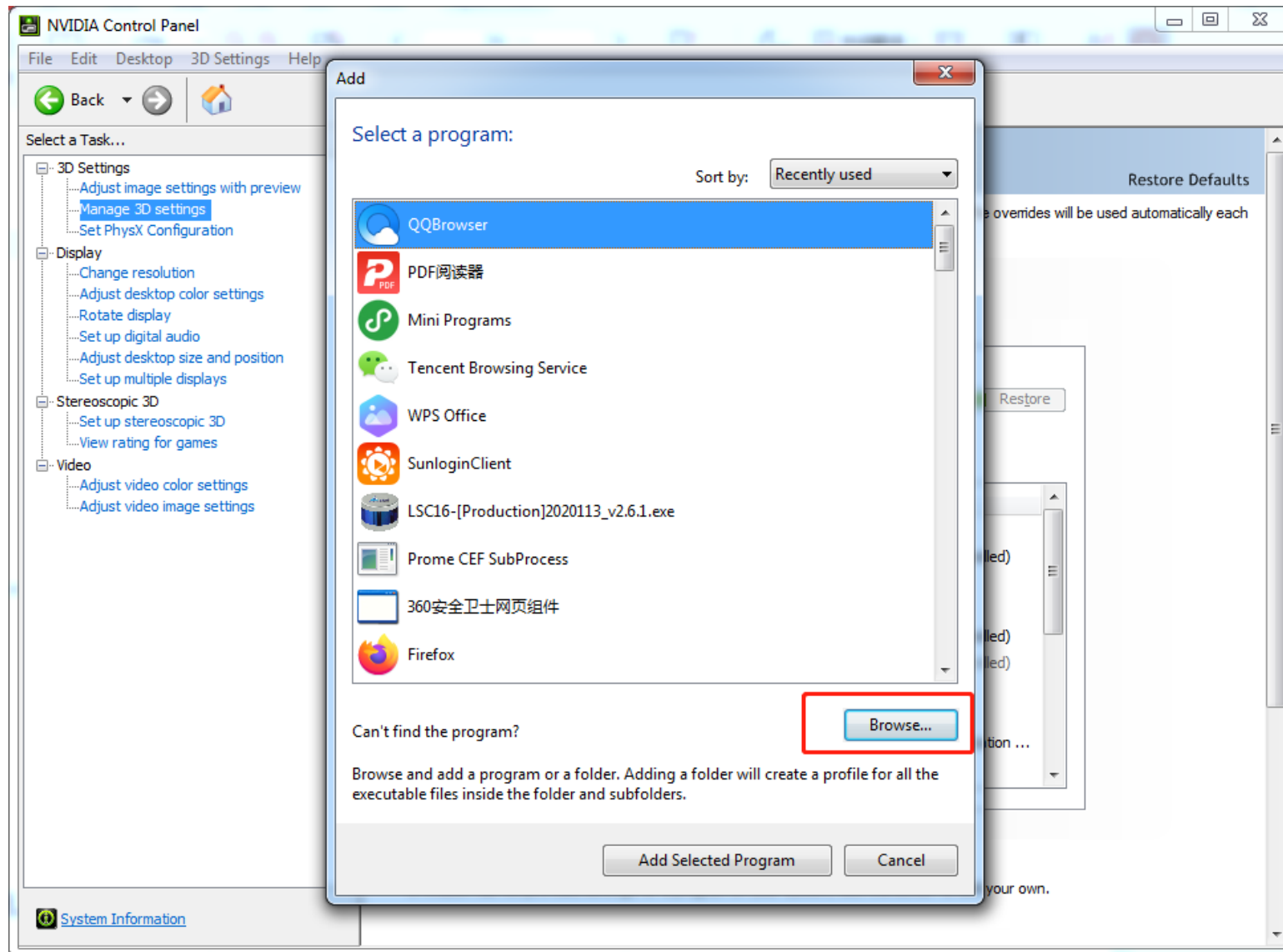
(3) Select the program settings button in the management 3D settings interface as shown in the figure below.














(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.



8.2. ROS Driver

This chapter introduces the point cloud display and driver use of N10 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.

8.2.1. 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
```

8.2.2. 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 lsn10_v2 lsn10_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[lsn10_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/lsn10_ros/launch/lsn10_V2.launch file, the corresponding serial device name, topic and other information can be set.

9. Instrument Maintenance

9.1. Transportation requirement

N10 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.

9.2. 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.

9.3. Storage Conditions

N10's storage temperature is $-30^{\circ}\text{C}\sim 70^{\circ}\text{C}$. 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.

9.4. 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.

10. Remark History



Version Number	Revision Date	Revised Content	Fiction
V1.0	2021.8.23	Initial Version	LeiShen
V1.0.1	2022.2.20	Revise typo mistakes, lifetime span added.	LeiShen
V1.2.0	2022.04.06	Baud rate; Interface Definition; Adapter Board; Light Spot Property	LS1286