# Robin W1G LiDAR

# User Manual

# Preface

## Product

Robin W LiDAR

## Manufacturer

SEYOND

## Legal Disclaimer



## Overview

This manual provides instructions for the installation, usage, maintenance, and diagnostic evaluation of Robin W LiDAR (hereinafter referred to as "Robin W" or "LiDAR"). The contents of this manual cover different phases of the LiDAR life cycle, including the installation, configuration, operation, and maintenance of the LiDAR.

The intended users of this manual include project developers (R&D personnel and designers), installers, electrical professionals, safety professionals, and service personnel.

## Original document

This document is the original document owned by Seyond.

## Manual description

Although this document covers instructions to handle typical problems, it is not guaranteed to resolve all problems. If you encounter issues not covered in the manual, please contact Seyond staff in a timely manner. This manual will be updated when new information becomes available.

Tel : (650)963-9573
E-mail: info@seyond.com

## Precautions

This user manual covers Robin W introduction, installation, transferring, usage, maintenance, diagnostic evaluation, disposal, etc., and software instructions.

Considering Robin W is a laser product, please thoroughly read and comprehend all information within this manual before operating the LiDAR and follow all precautions to avoid danger. Please strictly follow the instructions and steps described in the manual during operation.

## Safety notices

Before using the product, please read this manual carefully and strictly follow the relevant instructions.

Please contact Seyond staff to obtain detailed specifications.

To reduce the risk of electric shock and avoid violating the warranty, please do not disassemble or modify the LiDAR without permission. This product does not contain the user's serviceable parts. Please consult Seyond's certified service personnel for maintenance and repair.

Caution

Use of controls, adjustments, or performance of procedures other than those specified for this product may result in hazardous radiation leakage.

Caution

➤ Class 1 laser product.

➤ Failure to use, control, adjust or operate LiDAR as specified herein may result in serious radiation hazards.

➤ This device incorporates a protective housing and a scan failure safeguard in the machine design such that there is no direct exposure or human access to laser radiation generated by the laser component during operation or maintenance.

➤ UNDER NO CIRCUMSTANCE shall attempts be made to operate the laser with protective housing removed or the scan failure safeguards overridden.

➤ When the laser is powered up, service procedures are only intended to be operated by Seyond service personnel or persons trained and certified by Seyond.

CLASS 1
LASER PRODUCT

Caution

This product meets the following standards:

IEC 60825-1:2014

21 CFR 1010.2. No. 56

Complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.

## Device maintenance

This product is made of metal, glass, plastic, and contains sensitive electronic components.

- Do not misuse the product by dropping, burning, piercing, bumping, squeezing, etc.
- Shut off the product immediately once it is hit or dropped. Please contact Seyond staff for technical support.

- If there is any possibility that the product may have been damaged, please stop using it immediately to prevent injury to personnel.
- Do not touch the LiDAR window with your hands to avoid performance degradation.
- If the LiDAR window is stained, please clean the product following the requirements.
- It is strictly prohibited for users to disassemble or convert the device without permission. Dismantling this product may result in product damage, loss of waterproof performance, or personal injury.

### Electrical safety

- Always use the connecting cable and power adapter provided or specified by Seyond.
- Using damaged cables or adapters in a humid environment may lead to fire, electric shock, personal injury, product damage, or other property losses.

### Heat dissipation

- Long-time contact with the hot surface of the product may cause personal discomfort or injury.
- To avoid heat accumulation, please ensure the device is in well-ventilated environment.
- LiDAR may generate a high amount of heat after prolonged operations. It is recommended to shut off the power for a few minutes before touching it.

### Operating environment

- Do not subject the product to intense vibration.
- Do not look directly at the transmitting laser through a magnifying device (such as a microscope and magnifying glass).
- Do not look directly at the transmitting laser through an electronic device.
- Do not place this product near flammable and explosive materials.
- Do not expose this product to areas with explosive air, such as areas with a high concentration of flammable chemicals or saturated vapor.
- Do not expose this product to an environment with high-density industrial chemicals, such as easily vaporized liquefied gas (e.g., helium), to avoid performance degradation.

### Radio frequency interference

Before the operation, please read the product label's certification and safety information. Although the product's design, testing, and manufacturing comply with the relevant provisions of RF energy radiation, the radiation from the product may still lead to the failure of other electronic equipment.

### Medical device interference

Some components and radio devices contained in this product will emit electromagnetic fields that may

interfere with medical equipment, such as cochlear implants, pacemakers, and defibrillators. Consult your doctor and medical equipment manufacturer for specific information, e.g., whether you need to keep a safe distance from this product. If there's any possibility that this product is interfering with your medical equipment, please stop using it immediately.

# 1 Product description

## 1.1 Product introduction

Robin W1G(hereinafter referred to as "Robin" or "LiDAR") is an automotive-grade LiDAR system developed by Seyond. Robin offers an ultra-wide 120° x 70° (HxV) field-of-view(FOV) and a distance range twice that of similar products on the market while achieving a 10cm minimum distance. Robin W1G is able to withstand harsh environmental conditions while continuing to deliver a high quality point cloud, delivering superior reliability and product lifetime. Robin W1G is used in automotive (AD/ADAS) sectors, off-road vehicles, robotics, Intelligent Transportation Systems and Smart Infrastructure.

## 1.2 System principles

Robin W is a semi-solid-state LiDAR with a laser light source wavelength of 905 nm.

Distance is calculated based on the time-of-flight (ToF) methodology.

1. The LiDAR emits a light pulse of short duration and narrow divergence.
2. Upon hitting an object, the emitted light will undergo scattered reflection.
3. Some of the reflected light will return to the unit and be detected by the LiDAR's optical sensor.
4. The object's distance is calculated by measuring the time between the emission of the light pulse and the detection of the reflected light. The object's location is known since the angular direction of the emitted light pulse is known.
5. The LiDAR emits light pulses in multiple directions sequentially, thereby constructing a 3-dimensional map of the system's surroundings.

The distance is expressed as:

$$d = \frac{ct}{2}$$

d: distance c: speed of flight t: flight time of the laser pulse

## 1.3 LiDAR coordinate system

The three-dimensional coordinate system is defined as follows.

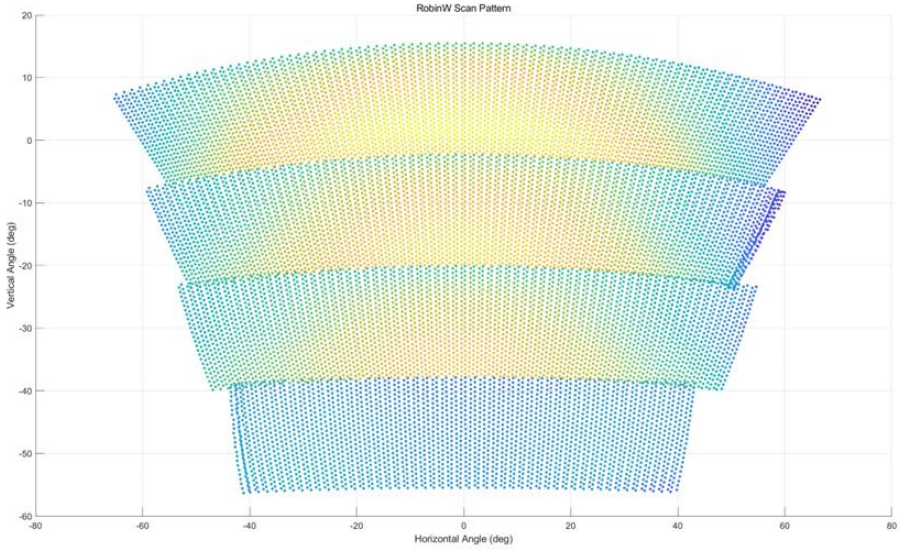
- X-axis is perpendicular to the ground, pointing up.
- Y-axis is parallel to the ground, pointing right.
- Z-axis is parallel to the ground, pointing forward.
- The origin in this coordinate is the optical origin and can be used for calibration reference.

## 1.4 Scanning pattern

Robin W employs signal axis scanning.

The Field of View (FOV) is the angular extent of the region observable by the LiDAR. The FOV of Robin W is 120°×70° (H x V). Angular resolution is 0.15°×0.36° (H x V).

An example of the LiDAR scanning pattern is shown in the figure below.




## 1.5 Specifications

*Table 1 Specifications*

| **LiDAR PERFORMANCE** | |
|---|---|
| Laser Wavelength | 905 nm |
| FOV (H*V) | 120°*70° |
| Angular Resolution (H*V) | 0.15°*0.36° |
| Detection Range | 70 m, POD>90% (10% Lambertian reflectivity @ 10 Hz) |
| Detection Range (Maximum) | 150 m |
| Detection Range (Minimum) | 0.1 m |
| Detection Precision | Upto 1 cm @1σ |
| Detection Accuracy | ± 2 cm |
| Frame Rate | 10 to 20 FPS |
| **OPERATIONAL/ELECTRICAL** | |
| Operating Voltage | 9 to 34 V DC |
| Operating Temperature | -40 °C to +85 °C |
| Rated Power | 6 W |
| Operating Current | 0.5 A@12 V |
| Ingress Protection | IP67(body), IP69K(window) |
| Laser safety | Class 1 (IEC-60825) |
| **MECHANICAL** | |
| Dimensions (H × W × D) | 85 mm × 104.8 mm × 106.7 mm |
| Weight | 800 g |
| Connector | Proprietary pluggable connector (Power + Automotive Ethernet |

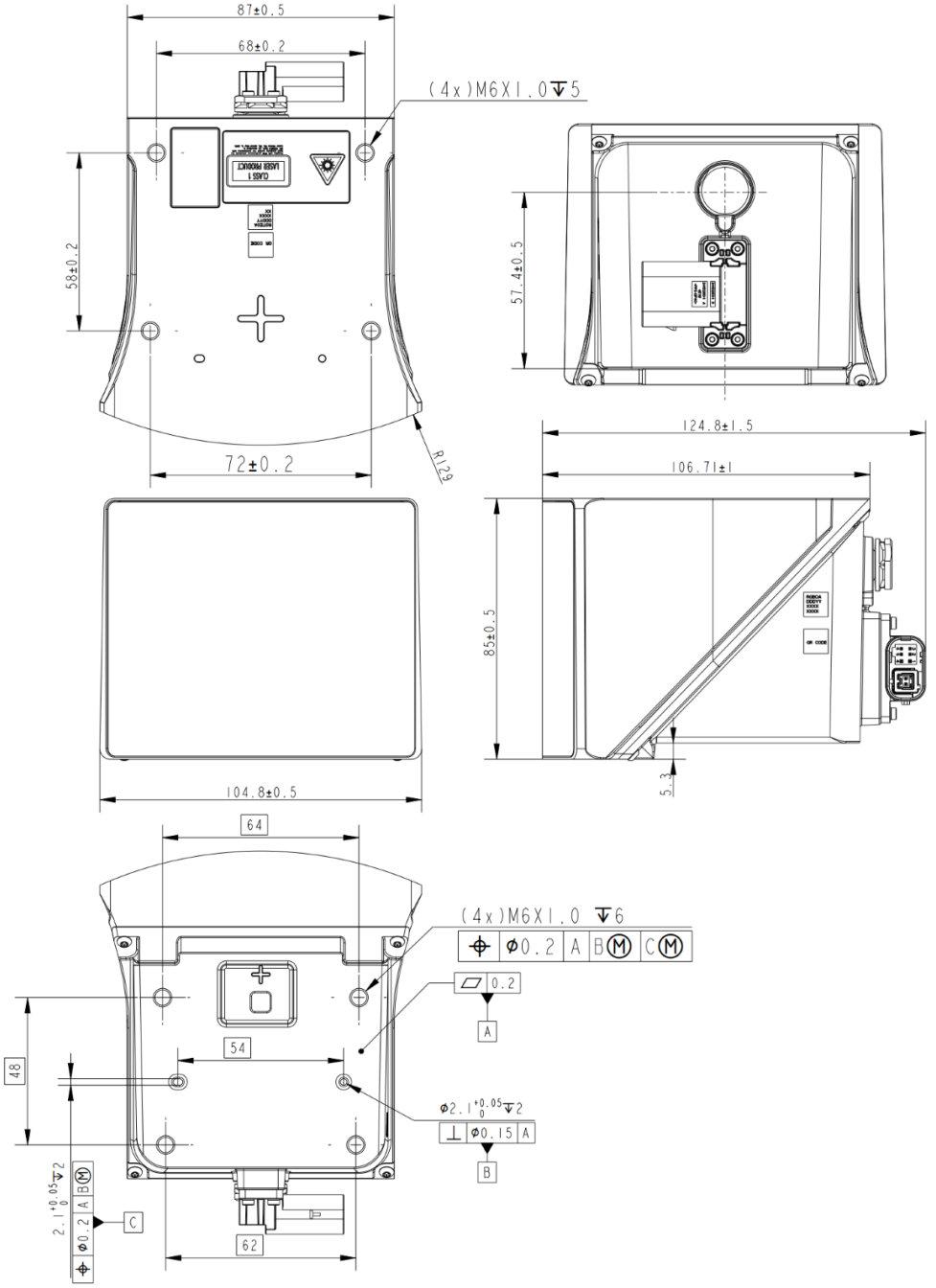
| | |
|---|---|
| | + CAN-FD) |
| **TRANSMISSION** | |
| Data Interface | 1000BASE-T1 (Data: UDP, Control: TCP) |
| Data Output | Distance, Calibrated reflectivity, Azimuth & Elevation Angle, Timestamp |
| Points Per Second | 1.20 M (single return@10Hz) |
| Communication bandwidth | 60 Mbps (single return) |
| Time Synchronization | gPTP / PTP / NTP |
| Echo Mode | Single/Dual returns |

Note

Specifications are subject to change without notice.

# 2 Installation

# 3 Dimensions (Unit:mm)



## 3.1 Cable description

Please note that if the Robin must connect to industrial Ethernet with an RJ45 connector, it is necessary to adopt a media converter for the switch from the 1000Base-T1 interface to an RJ45 interface.

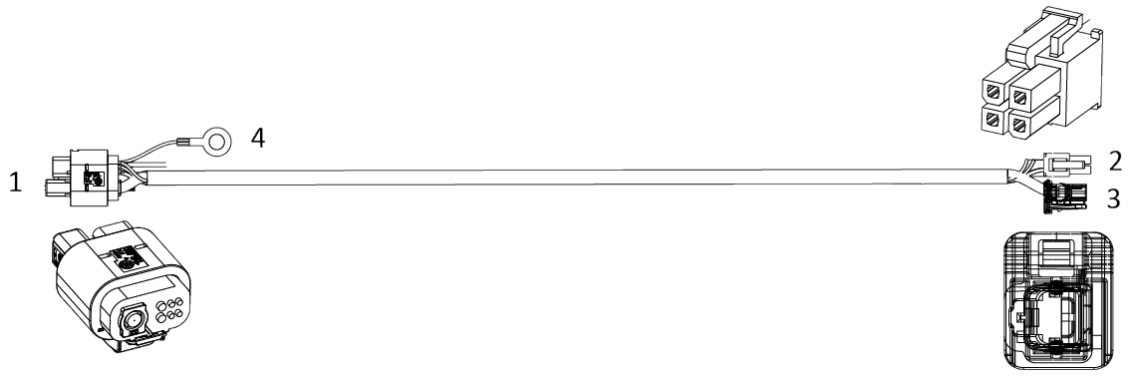
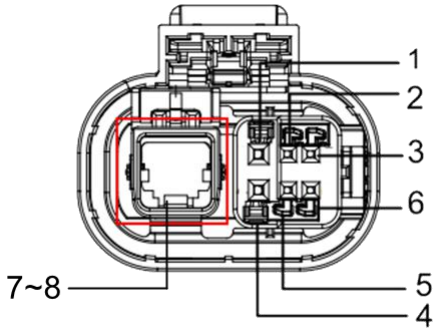
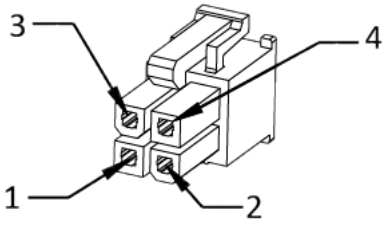
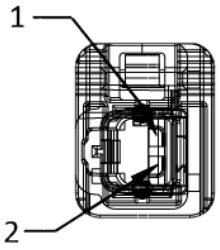



*Table 2 Interface description of cable*

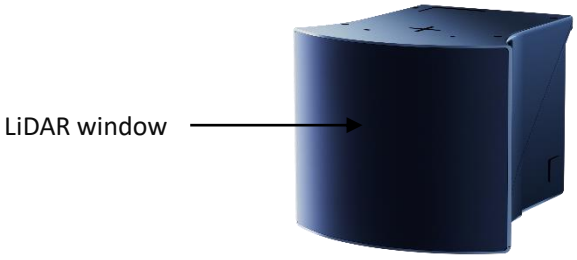
| NO. | Name | Description |
|---|---|---|
| 1 | Interface for connecting the LiDAR | 8-pin interface. Pins are defined as follows.<br>  <br><br>[1]: Grounding<br>[2]: Empty pin<br>[3]: Shield grounding<br>[4]: Power supply<br>[5]: CAN high<br>[6]: CAN low<br>[7] and [8]: Gigabit Ethernet |
| 2 | Power supply | 4-pin interface. Pins are defined as follows.<br>  <br><br>[1]: Power supply- |

| | | |
|---|---|---|
| | | [2]: Empty pin<br>[3]: Power supply+<br>[4]: Empty pin |
| 3 | 1000Base-T1<br>automotive Ethernet | 1000Base-T1 automotive Ethernet. Pins are defined as follows.<br>  <br><br>[1]: Ethernet sender<br>[2]: Ethernet receiver |
| 4 | Grounding | Shield grounding |

## 3.2 Cleaning

For optimal performance of LiDAR, please keep the front window of the sensor clean and free of dirt, bugs, and other debris. The steps to clean the optical window are as follows.

1. Prepare a clean microfiber cloth, soak it in the ethyl alcohol, and wring it out.
2. Loosen the debris from the LiDAR window with the clean, dust-free wiper for 1 minute. Do not wipe dirt directly off the LiDAR window glass without loosening it sufficiently.




3. Please wait 1 minute, gently wipe the window with the clean microfiber cloth and dry it.
4. Wipe the window with a high-quality paper towel or mirror paper. Do not apply excessive force to avoid damaging the optical coating.

Note

- Please wash your hands or wear PVC powder-free clean gloves before touching the product.
- Do not use solvents since they may damage the window coating.
- Please use a new dust-free wiper to wipe the LiDAR window.

- The LiDAR window is made of special plastic material. Please pay attention to the following items when cleaning: Avoid direct skin contact with the optical window. Do not use corrosive cleaners and solvents. Do not use paper towels to clean the window to avoid scratches.

# 4 Change LiDAR parameters

## 4.1 Change the LiDAR IP address

Note

- The LiDAR does not have a power switch. It will become operational when power is applied.
- In the following steps, <package.tgz> refers to the name of the LiDAR SDK package.
- Please obtain the latest version of the SDK package by contacting Seyond support.
- The initial IP address of the LiDAR is 172.168.1.10. The initial subnet mask is 255.255.255.0. The initial gateway is 172.168.1.1.

1. Connect the power supply to start the LiDAR.
2. The LiDAR completes initialization and generates data after powering on for 11 to 18 seconds.
3. Connect the computer to LiDAR and ensure the Ethernet connection.
4. Unzip the SDK tgz file.

```
tar -xzvf ..<package.tgz>
```

5. Enter the innovusion_lidar_util path.

```
cd /<SDK package path>/apps/lidar_util    // Go to the path of innovusion_lidar_util
```

6. Execute the following command to change the LiDAR network information. The IP address, netmask address, and gateway address of the LiDAR can be changed according to user needs.

```
./innovusion_lidar_util <ip of LIDAR> set_network <new_ip_address> <new_netmask_address>
[new_gateway_address]
```

7. Reboot the LiDAR. The LiDAR can be rebooted with either the soft reboot command or the hard reboot (power reboot).

```
./innovusion_lidar_util <ip of LIDAR> soft_reboot   //<ip of LIDAR> is the original IP
address
```

## 4.2 Change the LiDAR port

Note

- The LiDAR does not have a power switch. It will become operational when power is applied.
- In the following steps, <package.tgz> refers to the name of the LiDAR SDK package.
- Please obtain the latest version of the SDK package by contacting Seyond support.

1. Connect the computer to LiDAR and ensure the Ethernet connection.
2. Unzip the SDK tgz file.

```
tar -xzvf ..<package.tgz>
```

3. Execute the sudo su command to run as the administrator. Enter the innovusion_lidar_util path.

```
sudo su
cd /<SDK package path>/apps/lidar_util
```

4. Download the **PCS_ENV** file.

```
./innovusion_lidar_util <ip of LIDAR> download_internal_file PCS_ENV <filename>
//<filename> is the name of the downloaded file
```

```
root@sza0287:/home/demo/Robin util# ./innovusion_lidar_util 172.168.1.10 download_internal_file
PCS_ENV pcs.env
root@sza0287:/home/demo/Robin util#
```

5. Install Vim.

```
sudo apt install vim
```

6. Enter the PCS_ENV file.

```
sudo vim <filename>
```

```
root@sza0287:/home/demo/Robin util# vim pcs.env
```

7. Press “i” key to edit the PCS_ENV file and change the LiDAR port.

```
TCP_SERVICE_PORT=8010
UDP_IP=239.0.0.91
UDP_PORT_DATA=8100
UDP_PORT_MESSAGE=8010
UDP_PORT_STATUS=8010
#UDP_PORT_STATUS_LOCAL=8009
STATUS_INTERVAL_MS=50
REFLECTANCE=2
MULTIRETURN=1
LOG_OPTION="--log-filename /tmp/inno_pc_server.txt --log-file-rotate-number 3 --log-file-max-siz
e-k 2000"
MIN_RUN_TIME=5
MIN_RUN_TIME_SLEEP=5
~
```

8. Press key combination of “:wq” to save the settings and exit the PCS_ENV file.
9. Upload the PCS_ENV file.

```
./innovusion_lidar_util <ip of LIDAR> upload_internal_file PCS_ENV <filename>  //<filename>
is the name of the uploaded file
```

```
root@sza0287:/home/demo/Robin util# ./innovusion_lidar_util 172.168.1.10 upload_internal_file PC
S_ENV pcs.env
before upload_internal_file PCS_ENV, need to verify parameters
2023-07-27 17:24:19.405 [ INFO] 28804 utils.cpp:440 open pcs.env
upload_internal_file PCS_ENV pcs.env succeed.
root@sza0287:/home/demo/Robin util#
```

10. Power off and on again to reboot the LiDAR, and the LIDAR port change is in effect.

# 5 Software operation

## 5.1 Operate in ROS1 environment

The operations in this chapter are based on the Ubuntu 18.04. The version of ROS is melodic.

### 5.1.1 Start the LiDAR

1. Connect the power supply to start the LiDAR.
2. The LiDAR completes initialization and generates data after powering on for 11 to 18 seconds.

Note

The LiDAR does not have a power switch. It will become operational when power is applied.

### 5.1.2 Obtain point cloud data

Note

- The ROS driver needs to be restarted after the LiDAR is shut down or the software is restarted.
- For the installation method of ROS, please refer to http://wiki.ros.org/.

1. Connect the computer to the LiDAR.
2. Change the computer IP address to the same subnet with the LiDAR.

Note

- The default LiDAR IP address is 172.168.1.10.
- It is recommended to check the access to the LiDAR IP address via the ping command. The return value is shown in the figure below.

```
demo@demo-OMEN-by-HP-Laptop-16-b0xxx:~$ ping 172.168.1.10
PING 172.168.1.10 (172.168.1.10) 56(84) bytes of data.
64 bytes from 172.168.1.10: icmp_seq=70 ttl=64 time=0.448 ms
64 bytes from 172.168.1.10: icmp_seq=71 ttl=64 time=0.222 ms
64 bytes from 172.168.1.10: icmp_seq=72 ttl=64 time=0.200 ms
64 bytes from 172.168.1.10: icmp_seq=73 ttl=64 time=0.208 ms
64 bytes from 172.168.1.10: icmp_seq=74 ttl=64 time=0.200 ms
64 bytes from 172.168.1.10: icmp_seq=75 ttl=64 time=0.219 ms
64 bytes from 172.168.1.10: icmp_seq=76 ttl=64 time=0.255 ms
64 bytes from 172.168.1.10: icmp_seq=77 ttl=64 time=0.212 ms
64 bytes from 172.168.1.10: icmp_seq=78 ttl=64 time=0.206 ms
64 bytes from 172.168.1.10: icmp_seq=79 ttl=64 time=0.170 ms
64 bytes from 172.168.1.10: icmp_seq=80 ttl=64 time=0.207 ms
64 bytes from 172.168.1.10: icmp_seq=81 ttl=64 time=0.207 ms
64 bytes from 172.168.1.10: icmp_seq=82 ttl=64 time=0.145 ms
64 bytes from 172.168.1.10: icmp_seq=83 ttl=64 time=0.168 ms
64 bytes from 172.168.1.10: icmp_seq=84 ttl=64 time=0.316 ms
64 bytes from 172.168.1.10: icmp_seq=85 ttl=64 time=0.192 ms
64 bytes from 172.168.1.10: icmp_seq=86 ttl=64 time=0.309 ms
64 bytes from 172.168.1.10: icmp_seq=87 ttl=64 time=0.295 ms
^C
--- 172.168.1.10 ping statistics ---
87 packets transmitted, 18 received, 79% packet loss, time 88040ms
rtt min/avg/max/mdev = 0.145/0.232/0.448/0.069 ms
demo@demo-OMEN-by-HP-Laptop-16-b0xxx:~$
```

3. View the system information and obtain the corresponding driver. Copy the driver to the root directory of the system. Execute the following command to install the driver.

```
sudo dpkg -i <package.deb>
```

Note

package.deb is the driver's name of the LiDAR. Obtain the latest driver version based on the actual conditions.

*Table 3 Available system*

| System Version | CPU |
|---|---|
| Ubuntu 16.04 | ARM |
| | X86 |
| Ubuntu 18.04 | ARM |
| | X86 |
| Ubuntu 20.04 | ARM |
| | X86 |

4. Start ROS. The return value is shown in the figure below.

```
roscore
```


5. Obtain the point cloud data via the UDP port. The return value is shown in the figure below.

```
source /opt/ros/melodic/setup.bash
roslaunch innovusion_pointcloud innovusion_points.launch device_ip:= <device_ip> udp_port:=
<UDP_port> processed:= <Processed_number>
```

Note

- The default value of device_ip is 172.168.1.10. By default, the UDP port number is 8010.

- The value of processed_number can be 0 or 1. When the process_number is set to 1, the point cloud data is obtained from the ROS client. When the process_number is set to 0, the point cloud data is obtained from the external PCS.

```
[ INFO] [1683612957.197820085]:  8942 mem_pool_manager.cpp:40 MemPoolManager [DeliverMessageJobPool] 0x7efdb83c2ca0 created pool=0x7efdb8091960, unit_size=65632, unit_count=50, allocator=DefaultMemAllocator
[ INFO] [1683612957.197831095]:  8942 mem_allocator.cpp:313 DefaultMemAllocator calloc start
[ INFO] [1683612957.197842536]:  8942 mem_pool_manager.cpp:40 MemPoolManager [DeliverStatusJobPool] 0x7efdb83c47e0 created pool=0x7efdb83c2da0, unit_size=608, unit_count=10, allocator=DefaultMemAllocator
[ INFO] [1683612957.197863371]:  8942 mem_allocator.cpp:313 DefaultMemAllocator calloc start
[ INFO] [1683612957.197886594]:  8942 mem_pool_manager.cpp:40 MemPoolManager [Deliver2JobPool] 0x7efdb8414f80 created pool=0x7efdb83c4900, unit_size=8032, unit_count=40, allocator=DefaultMemAllocator
[ INFO] [1683612957.198506714]: [ INFO] level=6, code=9, message=innovusion_nodelet_manager started
[ INFO] [1683612957.198553878]:  8946 inno_thread.cpp:74 thread frame-sync starts. pid=8946 target_priority=80
[ WARN] [1683612957.198601451]:  8946 utils.cpp:79 strerror: 'Operation not permitted' setschedparam(80)
[ INFO] [1683612957.198637616]:  8948 consumer_producer.cpp:196 thread deliver2 starts. pid=8948 target_priority=2
[ WARN] [1683612957.198664855]:  8948 utils.cpp:79 strerror: 'Operation not permitted' setschedparam(2)
[ INFO] [1683612957.198670907]:  8942 lidar.cpp:2213 innovusion_nodelet_manager started
[ INFO] [1683612957.198678769]:  8942 ../sdk_common/lidar_base.h:255 message_callback: name=innovusion_nodelet_manager level=6, code=9, message=innovusion_nodelet_manager started
[ INFO] [1683612957.198693545]:  8947 inno_thread.cpp:74 thread status starts. pid=8947 target_priority=41
[ WARN] [1683612957.198699501]:  8947 utils.cpp:79 strerror: 'Operation not permitted' setschedparam(41)
[ INFO] [1683612957.198706525]:  8950 consumer_producer.cpp:196 thread read starts. pid=8950 target_priority=40
[ WARN] [1683612957.198714097]:  8950 utils.cpp:79 strerror: 'Operation not permitted' setschedparam(40)
[ INFO] [1683612957.198720613]:  8949 consumer_producer.cpp:196 thread robin starts. pid=8949 target_priority=35
[ WARN] [1683612957.198728499]:  8949 utils.cpp:79 strerror: 'Operation not permitted' setschedparam(35)
[ INFO] [1683612957.198736692]:  8947 status_report.cpp:112 Will send status message every50ms.
[ INFO] [1683612957.199053520]:  8950 stage_read.cpp:500 innovusion_nodelet_manager send stop command
[ INFO] [1683612957.199078930]:  8950 lidar.cpp:2532 before_read_start
[ INFO] [1683612957.218710309]:  8950 params.cpp:244 Use YAML file init=1
[ INFO] [1683612957.218788922]:  8950 params.cpp:245 YAML file content:
alpha:
  - 0
```

### 5.1.3 View LiDAR point cloud data

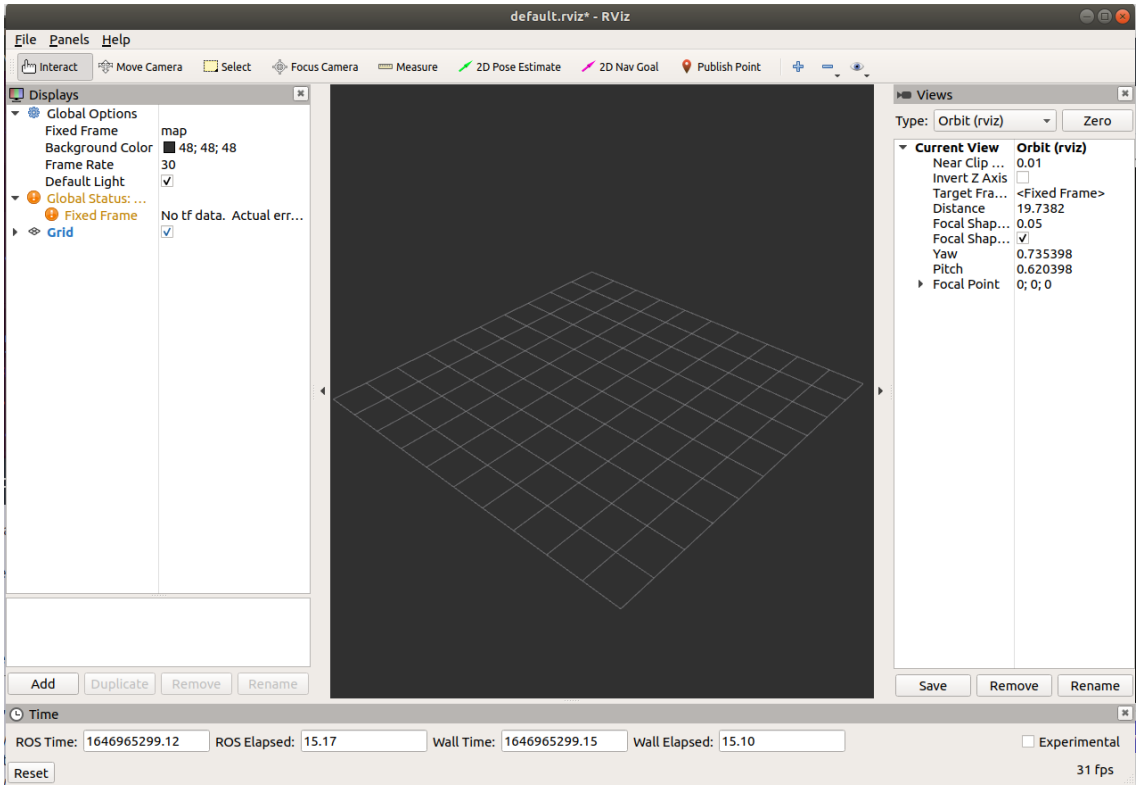
Note

Before viewing the point cloud data, please confirm that the point cloud data has been obtained.

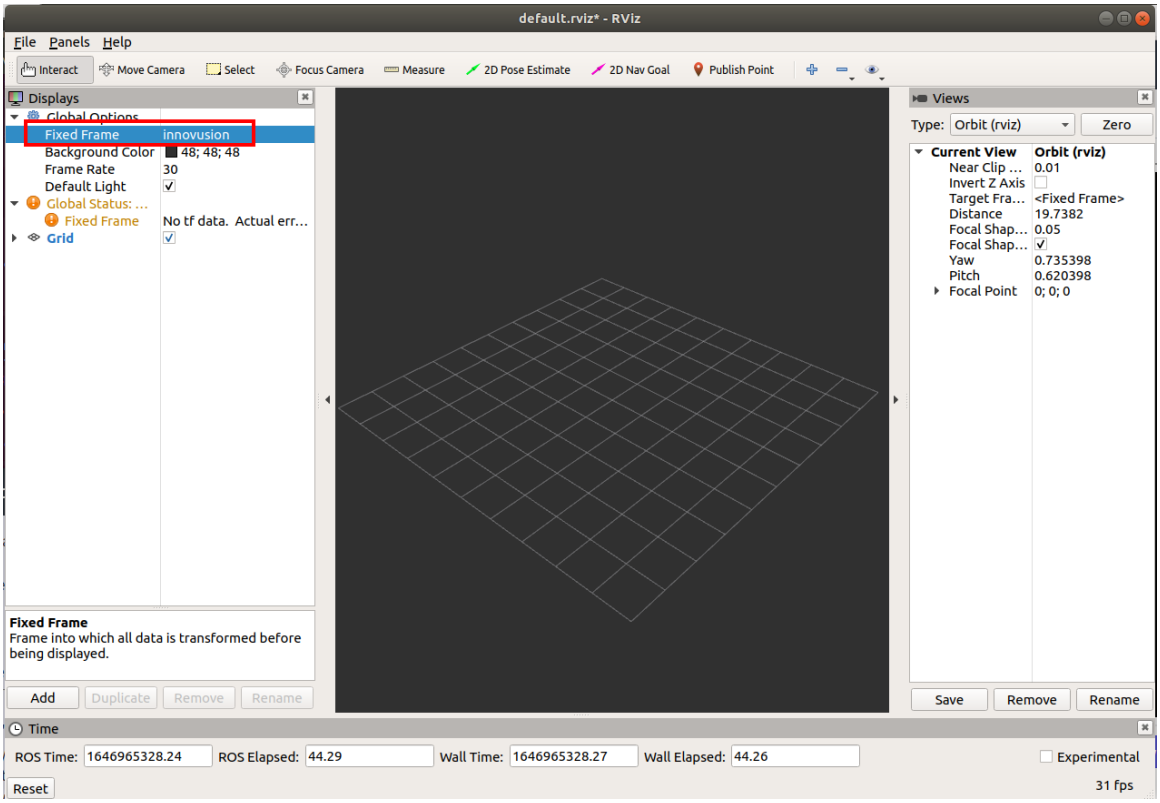
1. Start the graphical tool **rviz**. The return value and **rviz** interface are shown below.

```
rviz
```

```
demo@demo-OMEN-by-HP-Laptop-16-b0xxx:~$ rviz
[ INFO] [1683623488.155039559]: rviz version 1.13.29
[ INFO] [1683623488.155083418]: compiled against Qt version 5.9.5
[ INFO] [1683623488.155088595]: compiled against OGRE version 1.9.0 (Ghadamon)
[ INFO] [1683623488.157945269]: Forcing OpenGl version 0.
[ INFO] [1683623488.247322120]: Stereo is NOT SUPPORTED
[ INFO] [1683623488.247384307]: OpenGL device: llvmpipe (LLVM 10.0.0, 256 bits)
[ INFO] [1683623488.247416829]: OpenGl version: 3.1 (GLSL 1.4).
QObject::connect: Cannot queue arguments of type 'QVector<int>'
(Make sure 'QVector<int>' is registered using qRegisterMetaType().)
QObject::connect: Cannot queue arguments of type 'QVector<int>'
(Make sure 'QVector<int>' is registered using qRegisterMetaType().)
```




2. Select **Global Options** > **Fixed Frames**. Set the **Fixed Frames** value to **innovusion**.



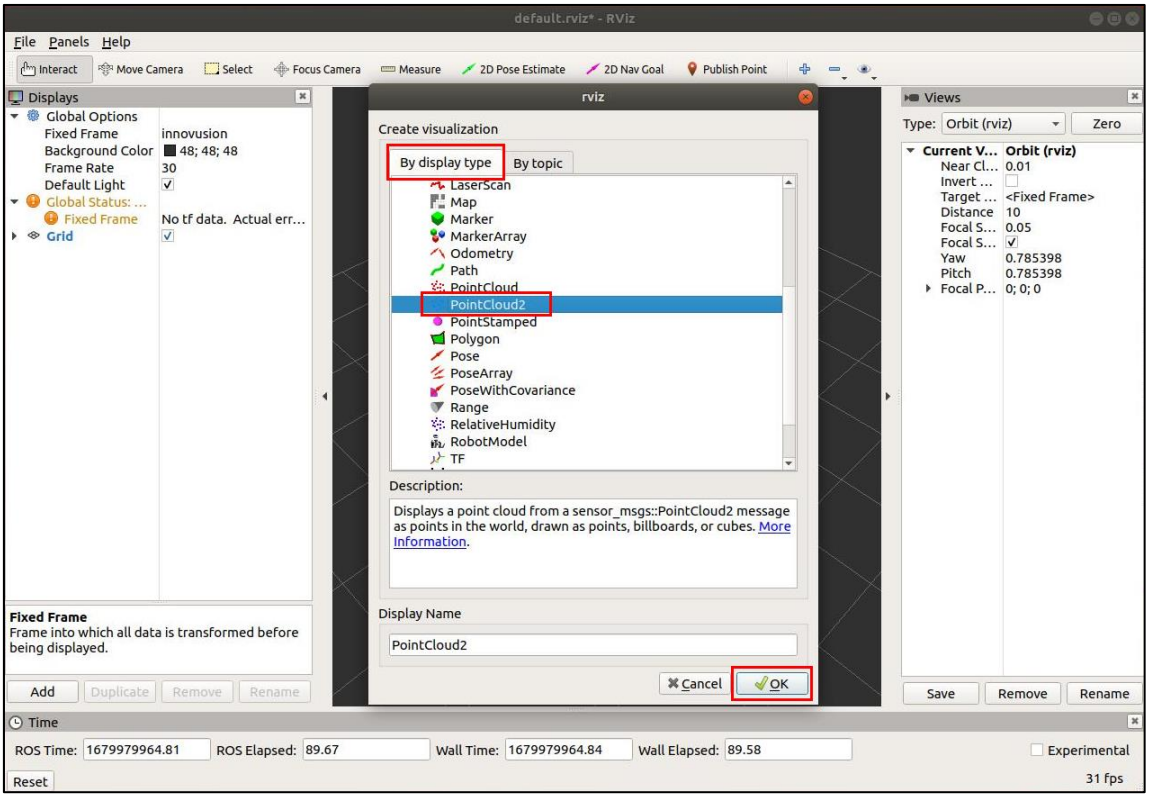

3. Add and Adjust **PointCloud2**.

i. Add PointCloud2 to Displays.

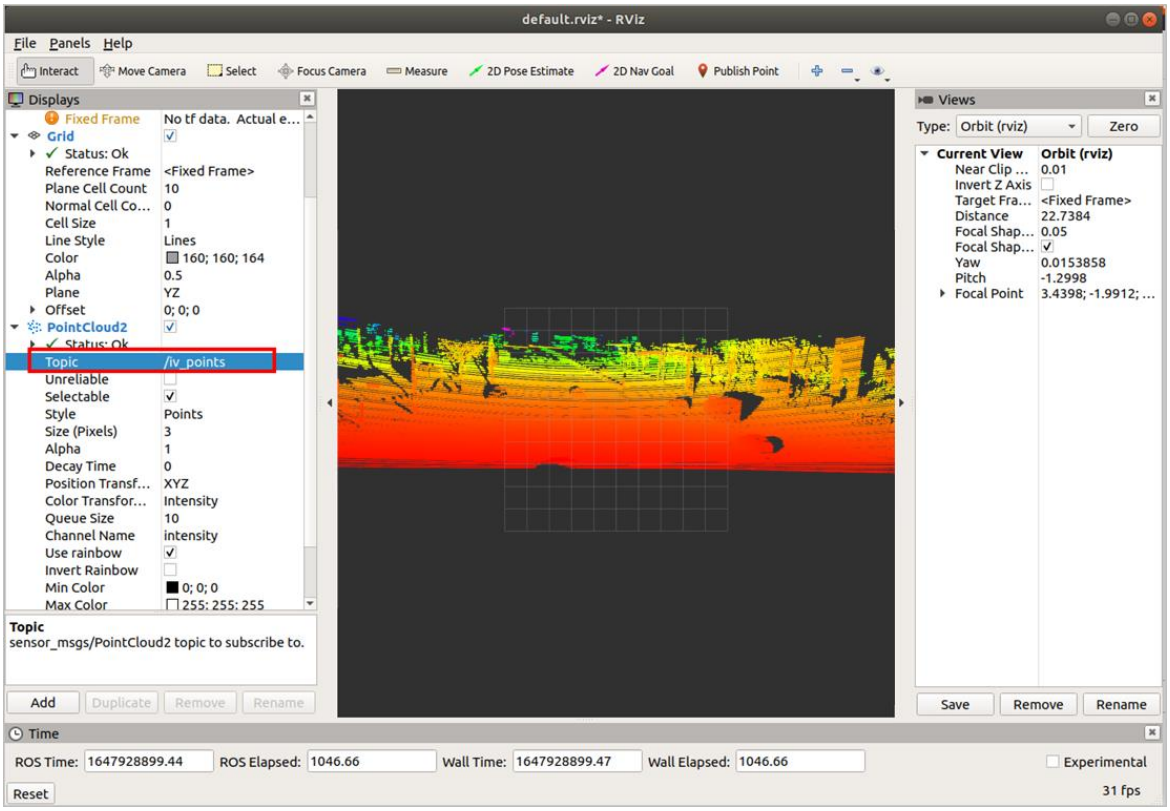
a. Click **Add.**

b. Select By display type > PointCloud2.

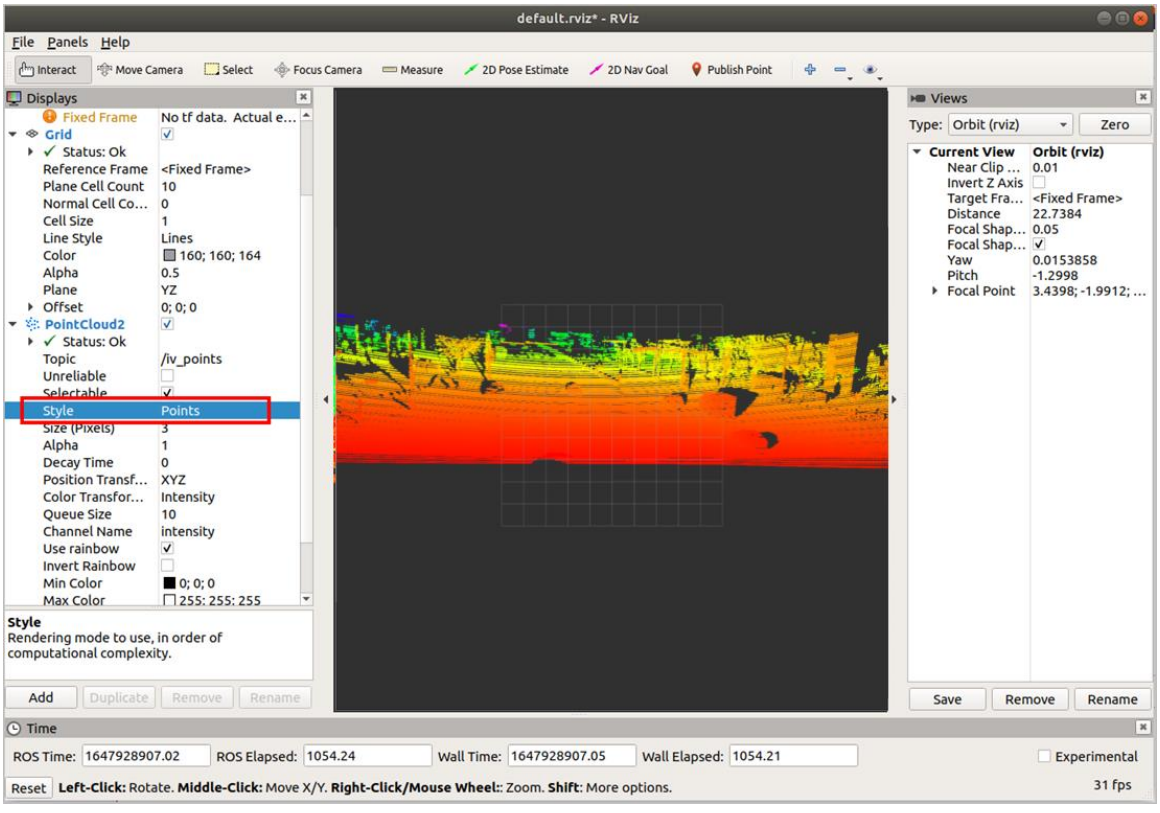
c. Click **OK**.




ii. Select PointCloud2 > Topic. Set the Topic value to /iv_points.




iii. Select **PointCloud2** > **Style**. Set the **Style** value to **Points**.



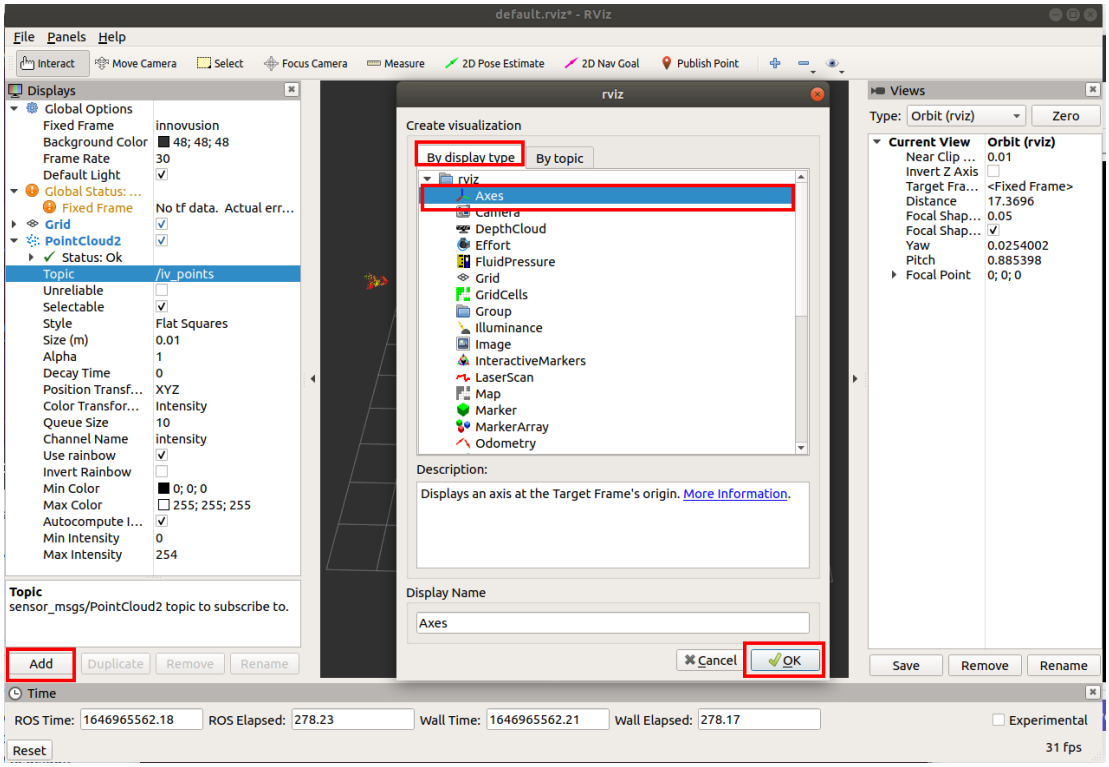
4. (Optional) It is possible to change the angle and distance of the real-time point cloud status to get more information as needed.

- Select **Axes** to add the coordinate system to the diagram as a reference.

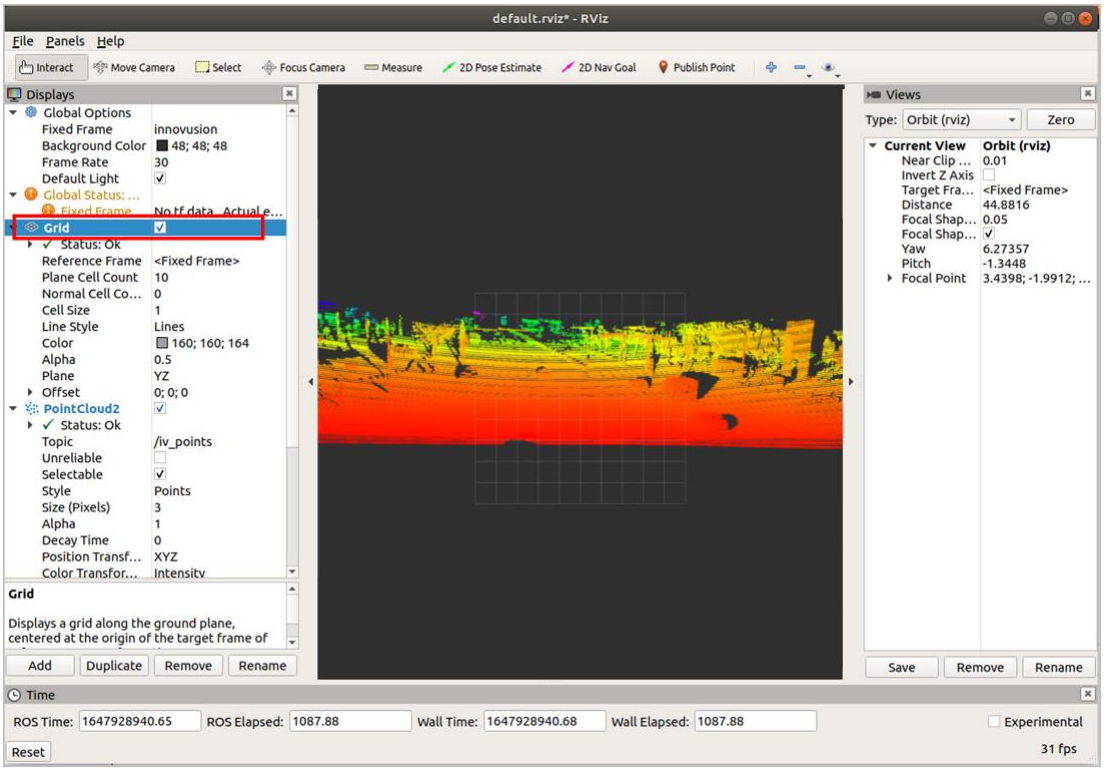
  a. Select **Add** > **By display type** > **Axes**.

  b. Click **OK**.

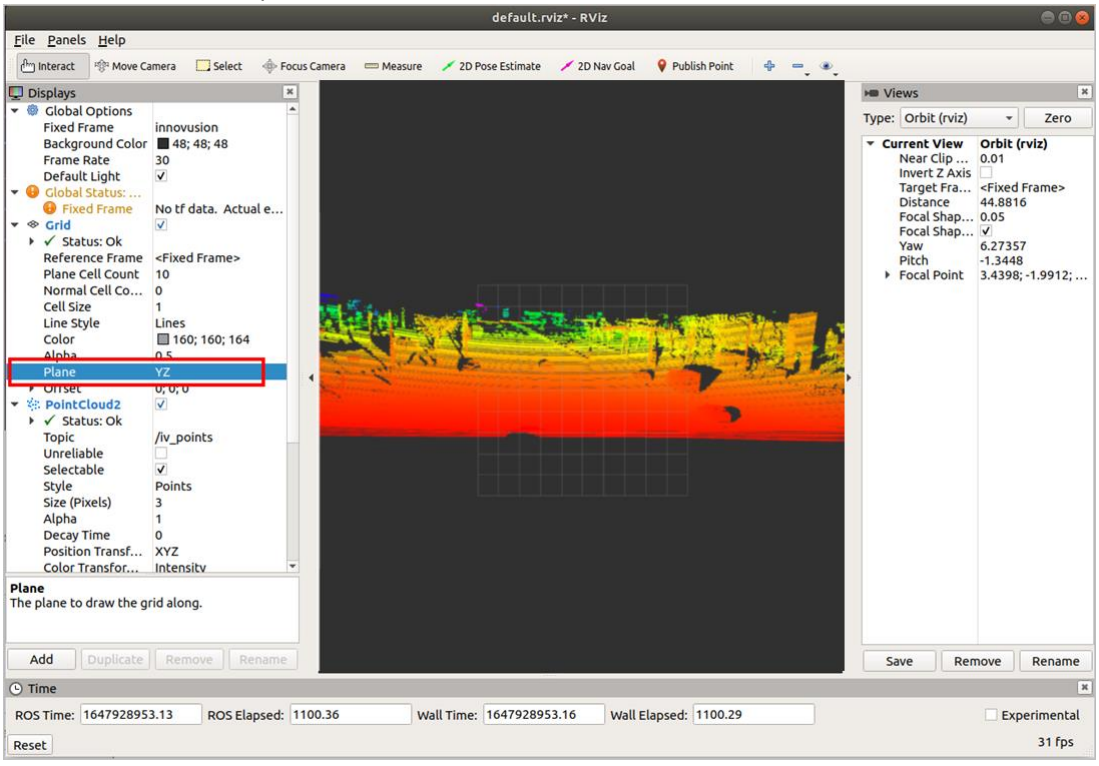
  c. Select **Axes**.




- Select **Grid** to add the grid to the diagram as a reference. **Grid** is enabled by default when rviz is started.




- Set the **plane** value to view the point cloud status under different coordinate systems. There are three options: **XY**, **XZ**, and **YZ**.



### 5.1.4 Record LiDAR point cloud data

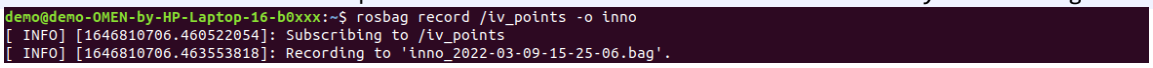
ROS can be used to record the point cloud data of the LiDAR in bag format.

Note

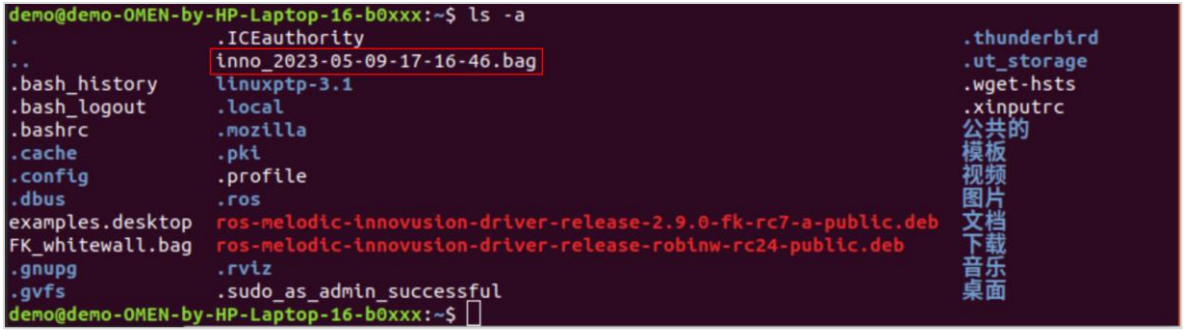
Before recording the point cloud data of the LiDAR, please confirm that the point cloud data has been obtained correctly in ROS. For information on how to get the point cloud data, see 5.1.2 Obtain point cloud data.

1. Record point cloud data in bag format. Recording starts at the execution time.

```
rosbag record /iv_points -o inno //Start to record the point cloud data in bag format. The file is saved in the current path and the file name is "inno-Year-Mon-Day-Hr-Min.bag"
```




2. Press **Ctrl+C** to stop recording point cloud data.
3. (Optional) Execute ls - a command to check the directory of recorded point cloud data.




### 5.1.5 Replay LiDAR point cloud data

Replay the point cloud data in bag format in ROS environment.

Note

Before replaying LiDAR point cloud data, please confirm that the recorded point cloud data file has been obtained.

1. Run ROS. The return value is shown in the figure.

```
roscore
```

```
demo@demo-OMEN-by-HP-Laptop-16-b0xxx:~$ roscore
... logging to /home/demo/.ros/log/a09b36de-9f71-11ec-874a-c85acfaa1d16/roslaunch-demo-OMEN-by-HP-Laptop-16-b0xxx-9812.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://demo-OMEN-by-HP-Laptop-16-b0xxx:42677/
ros_comm version 1.14.12


SUMMARY
========

PARAMETERS
 * /rosdistro: melodic
 * /rosversion: 1.14.12

NODES

auto-starting new master
process[master]: started with pid [9822]
ROS_MASTER_URI=http://demo-OMEN-by-HP-Laptop-16-b0xxx:11311/

setting /run_id to a09b36de-9f71-11ec-874a-c85acfaa1d16
process[rosout-1]: started with pid [9833]
started core service [/rosout]
```

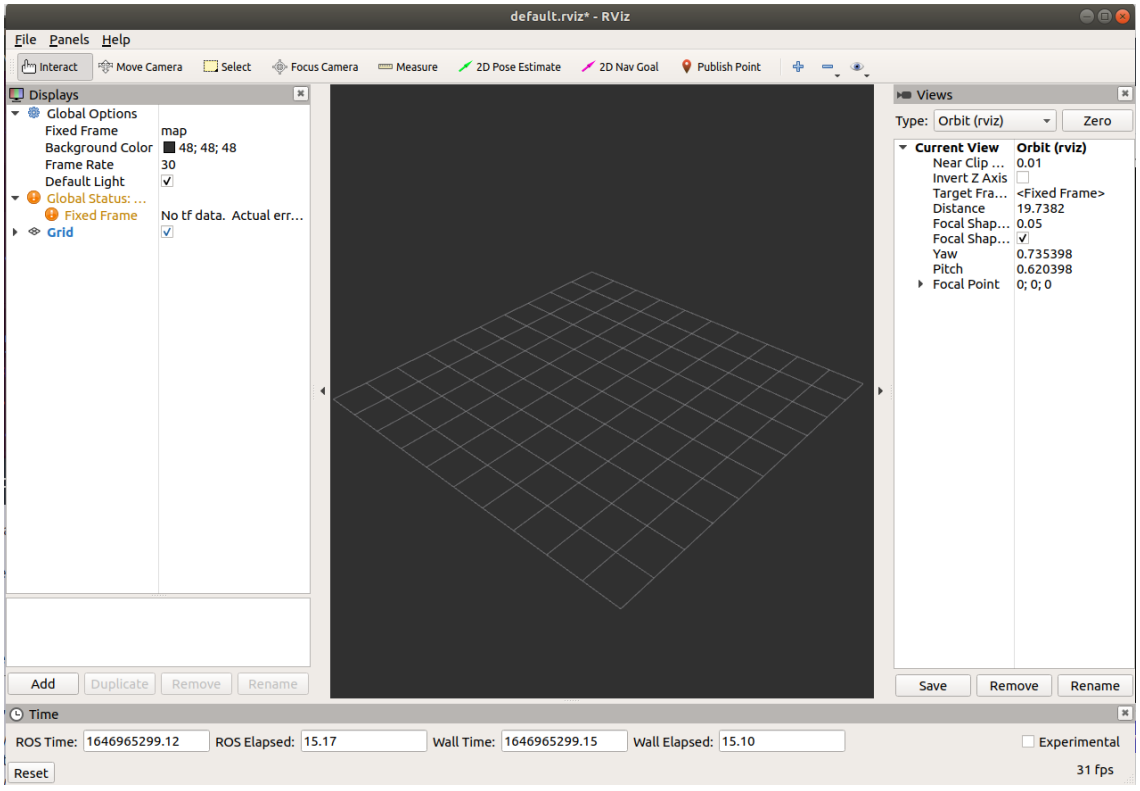
2. Start the graphical tool **rviz**. The return value and **rviz** interface are shown below.

```
rviz
```

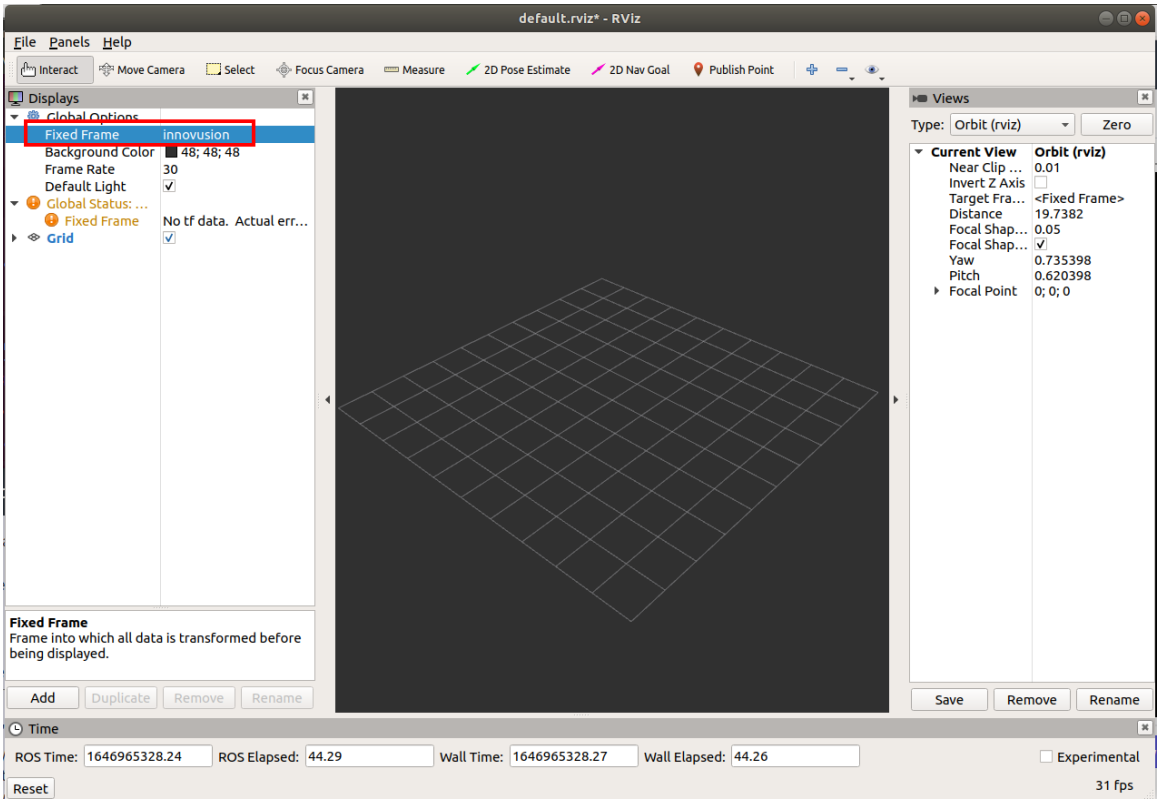
```
demo@demo-OMEN-by-HP-Laptop-16-b0xxx:~$ rviz
[ INFO] [1683623488.155039559]: rviz version 1.13.29
[ INFO] [1683623488.155083418]: compiled against Qt version 5.9.5
[ INFO] [1683623488.155088595]: compiled against OGRE version 1.9.0 (Ghadamon)
[ INFO] [1683623488.157945269]: Forcing OpenGl version 0.
[ INFO] [1683623488.247322120]: Stereo is NOT SUPPORTED
[ INFO] [1683623488.247384307]: OpenGL device: llvmpipe (LLVM 10.0.0, 256 bits)
[ INFO] [1683623488.247416829]: OpenGl version: 3.1 (GLSL 1.4).
QObject::connect: Cannot queue arguments of type 'QVector<int>'
(Make sure 'QVector<int>' is registered using qRegisterMetaType().)
QObject::connect: Cannot queue arguments of type 'QVector<int>'
(Make sure 'QVector<int>' is registered using qRegisterMetaType().)
```

3. Replay LiDAR point cloud data in **rviz**.

```
rosbag play <filename.bag>
```




4. Select **Global Options** > **Fixed Frames**. Set the **Fixed Frames** value to **innovusion**.



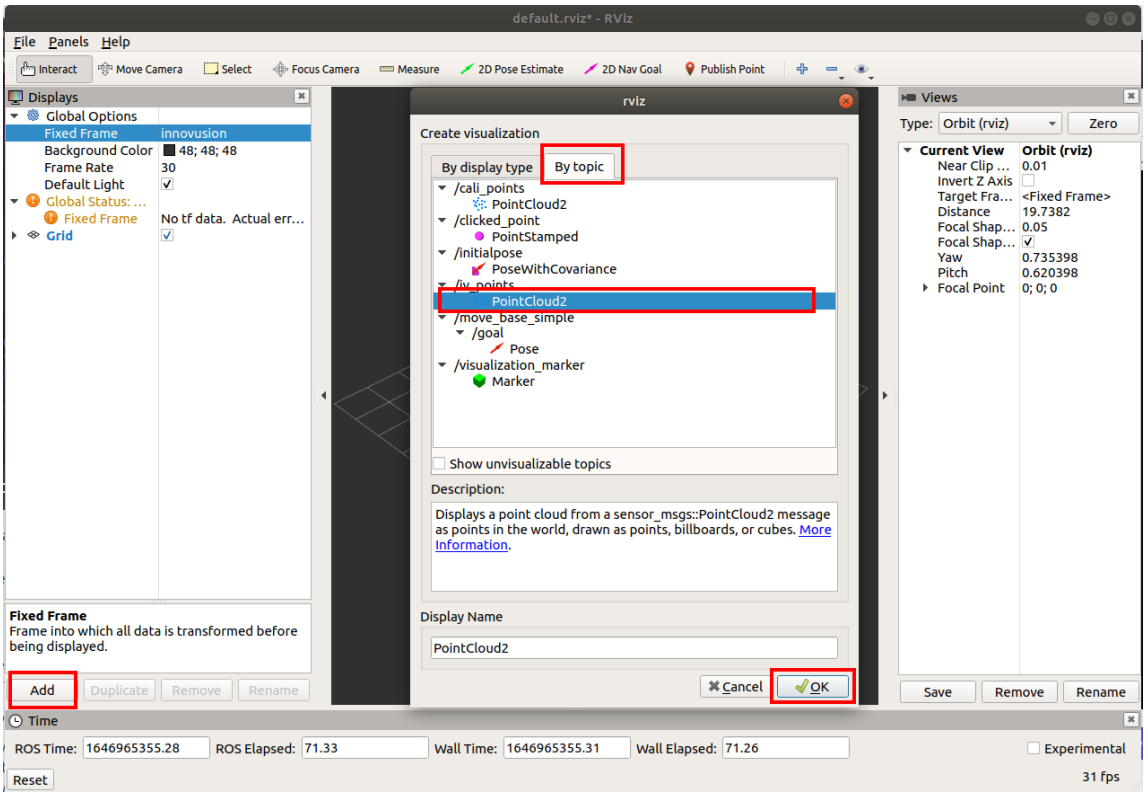

5. Add and configure **PointCloud2**.

i. Add **PointCloud2** to the Displays.

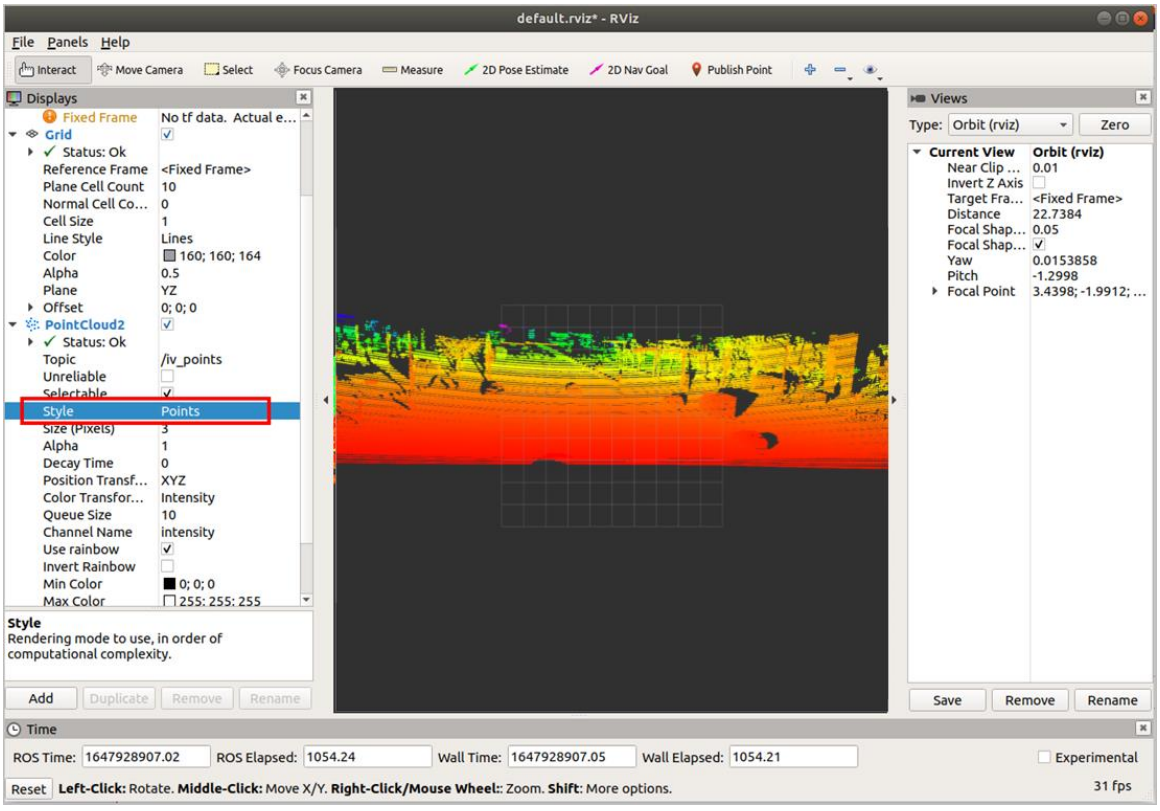
a. Click **Add.**

b. Select By topic > iv_points> PointCloud2.

c. Click **OK**.




ii. Select **PointCloud2** > **Style**. Set the **Style** value to **Points**.



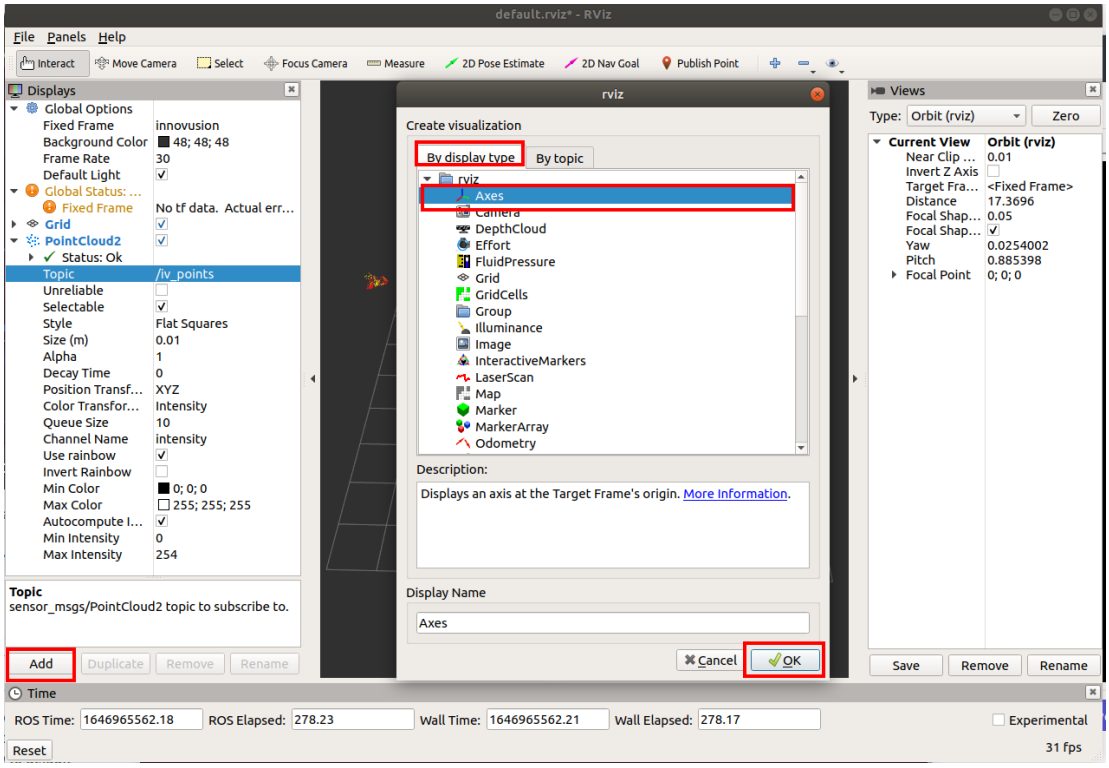

6. (Optional) It is possible to change the angle and distance of the real-time point cloud status to get more information as needed.

   - Select **Axes** to add the coordinate system to the diagram as a reference.

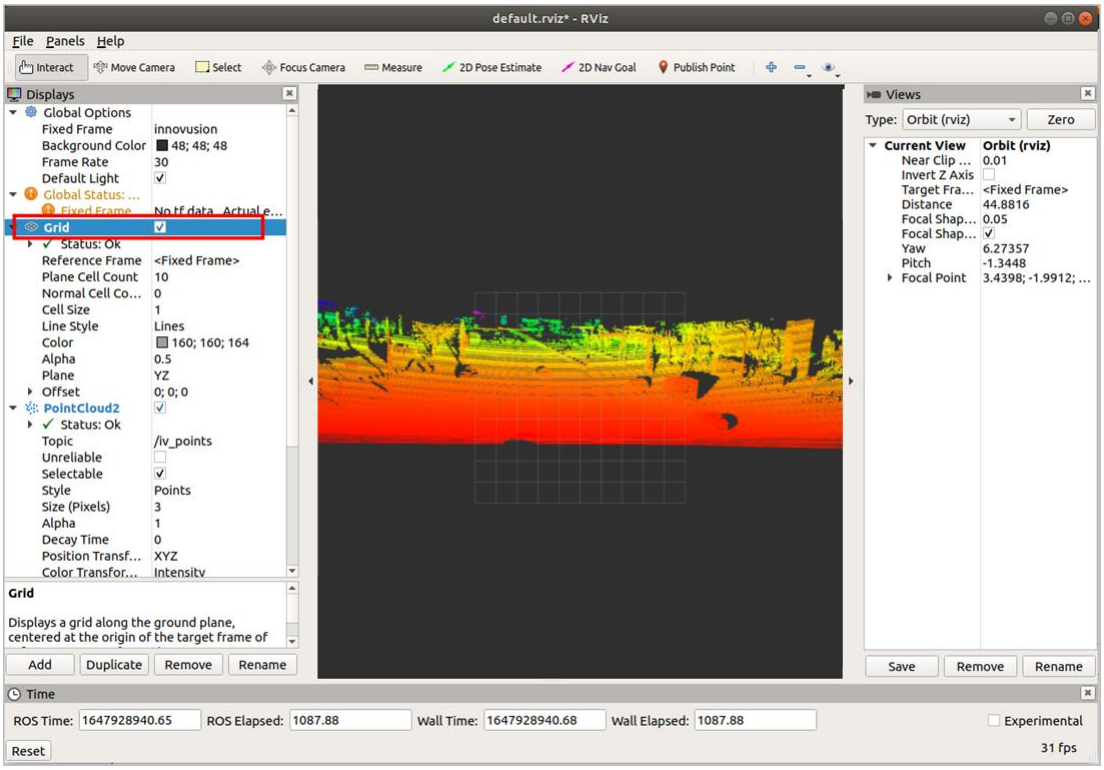
     a. Select **Add** > **By display type** > **Axes**.

     b. Click **OK**.

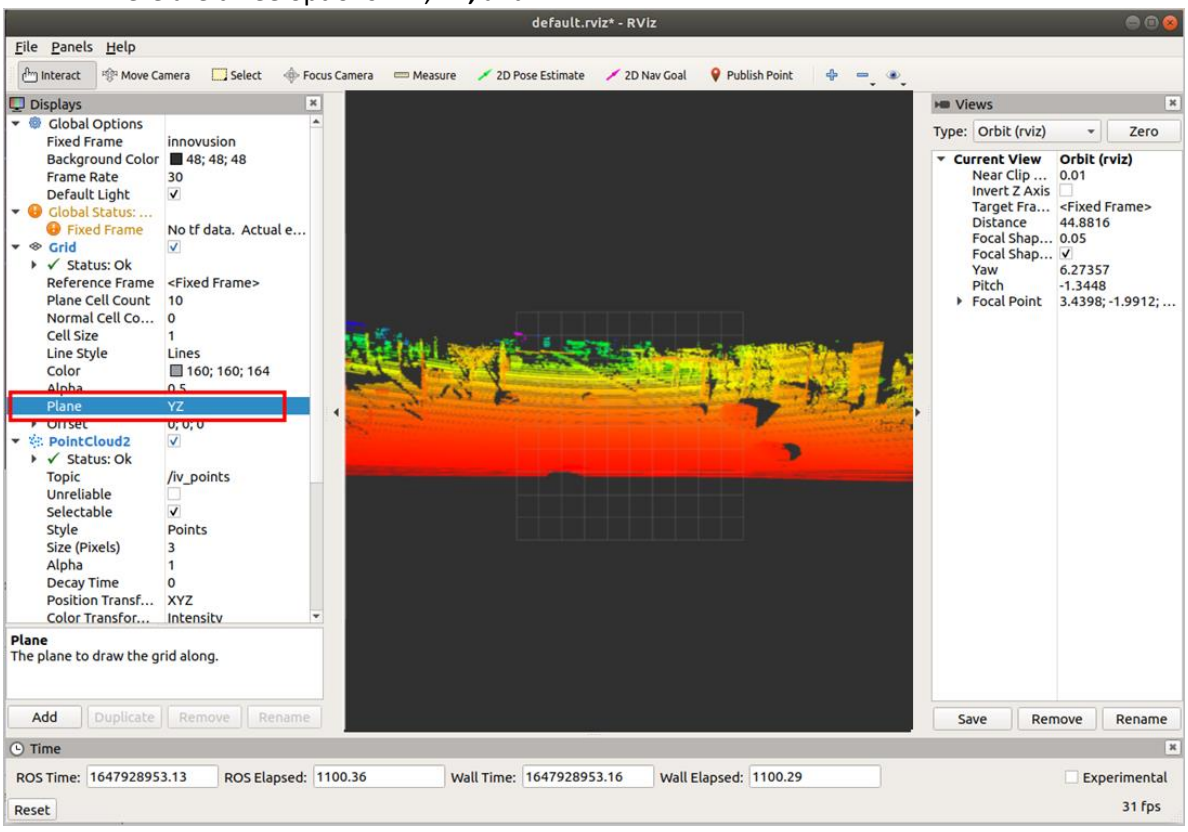
     c. Select **Axes**.




- Select **Grid** to add the grid to the diagram as a reference. Grid is enabled by default when **rviz** is started.



- Set the **plane** value to view the point cloud status under different coordinate systems. There are three options: **XY**, **XZ,** and **YZ**.




7. Press **Space** to pause playback of the point cloud data file.

### 5.1.6 Shut down the LiDAR

Disconnect the power supply to shut down the LiDAR.

## 5.2 Operate in ROS2 environment

The operations in this chapter are based on the Ubuntu 20.04. The version of ROS is foxy.

### 5.2.1 Start the LiDAR

1. Connect the power supply to start the LiDAR.
2. The LiDAR completes initialization and generates data after powering on for 11 to 18 seconds.

Note

The LiDAR does not have a power switch. It will become operational when power is applied.

### 5.2.2 Obtain point cloud data

Note

The ROS driver needs to be restarted after the LiDAR is shut down or the software is restarted.

For the installation method of ROS2, please refer to https://docs.ros.org.

1. Connect the computer to the LiDAR.

   Verify the protocol mode of the lidar for sending data. When the lidar sends data using UDP, it should be ensured that the host and LiDAR are on the same network segment.

Note

The default LiDAR IP address is 172.168.1.10.

It is recommended to check the access to the LiDAR IP address via the ping command. The return value is shown in the figure below.

```
demo@demo-OMEN-by-HP-Laptop-16-b0xxx:~$ ping 172.168.1.10
PING 172.168.1.10 (172.168.1.10) 56(84) bytes of data.
64 bytes from 172.168.1.10: icmp_seq=70 ttl=64 time=0.448 ms
64 bytes from 172.168.1.10: icmp_seq=71 ttl=64 time=0.222 ms
64 bytes from 172.168.1.10: icmp_seq=72 ttl=64 time=0.200 ms
64 bytes from 172.168.1.10: icmp_seq=73 ttl=64 time=0.208 ms
64 bytes from 172.168.1.10: icmp_seq=74 ttl=64 time=0.200 ms
64 bytes from 172.168.1.10: icmp_seq=75 ttl=64 time=0.219 ms
64 bytes from 172.168.1.10: icmp_seq=76 ttl=64 time=0.255 ms
64 bytes from 172.168.1.10: icmp_seq=77 ttl=64 time=0.212 ms
64 bytes from 172.168.1.10: icmp_seq=78 ttl=64 time=0.206 ms
64 bytes from 172.168.1.10: icmp_seq=79 ttl=64 time=0.170 ms
64 bytes from 172.168.1.10: icmp_seq=80 ttl=64 time=0.207 ms
64 bytes from 172.168.1.10: icmp_seq=81 ttl=64 time=0.207 ms
64 bytes from 172.168.1.10: icmp_seq=82 ttl=64 time=0.145 ms
64 bytes from 172.168.1.10: icmp_seq=83 ttl=64 time=0.168 ms
64 bytes from 172.168.1.10: icmp_seq=84 ttl=64 time=0.316 ms
64 bytes from 172.168.1.10: icmp_seq=85 ttl=64 time=0.192 ms
64 bytes from 172.168.1.10: icmp_seq=86 ttl=64 time=0.309 ms
64 bytes from 172.168.1.10: icmp_seq=87 ttl=64 time=0.295 ms
^C
--- 172.168.1.10 ping statistics ---
87 packets transmitted, 18 received, 79% packet loss, time 88040ms
rtt min/avg/max/mdev = 0.145/0.232/0.448/0.069 ms
```

2. View the system details and obtain the corresponding driver. Copy the driver to the root directory of the system. Execute the following command to install the driver.

```
sudo dpkg -i <package.deb>
```

Note

package.deb is the driver's name of the LiDAR. Obtain the latest driver version based on the actual conditions.

*Table 4 Available system*

| ROS2 version | System Version | CPU |
|---|---|---|
| Foxy, Galactic | Ubuntu 20.04 | ARM |
| | | X86 |
| Humble | Ubuntu 22.04 | ARM |
| | | X86 |

3. It is possible to obtain the point cloud data of the LiDAR via either TCP or UDP.

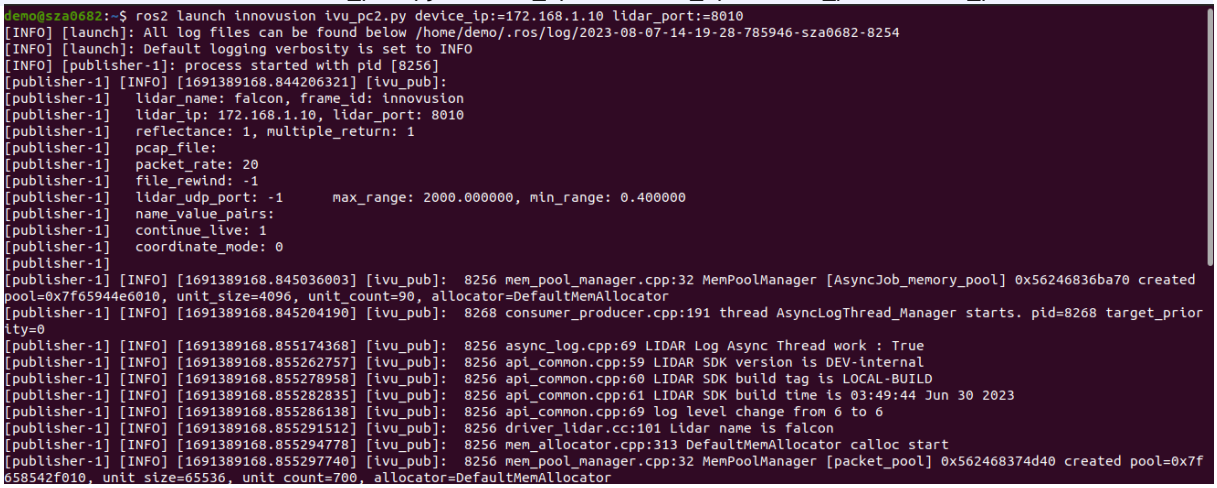
Note

If the point cloud data was not obtained correctly, try to execute the following command and re-run the obtain command.

```
source /opt/ros/foxy/setup.bash
```

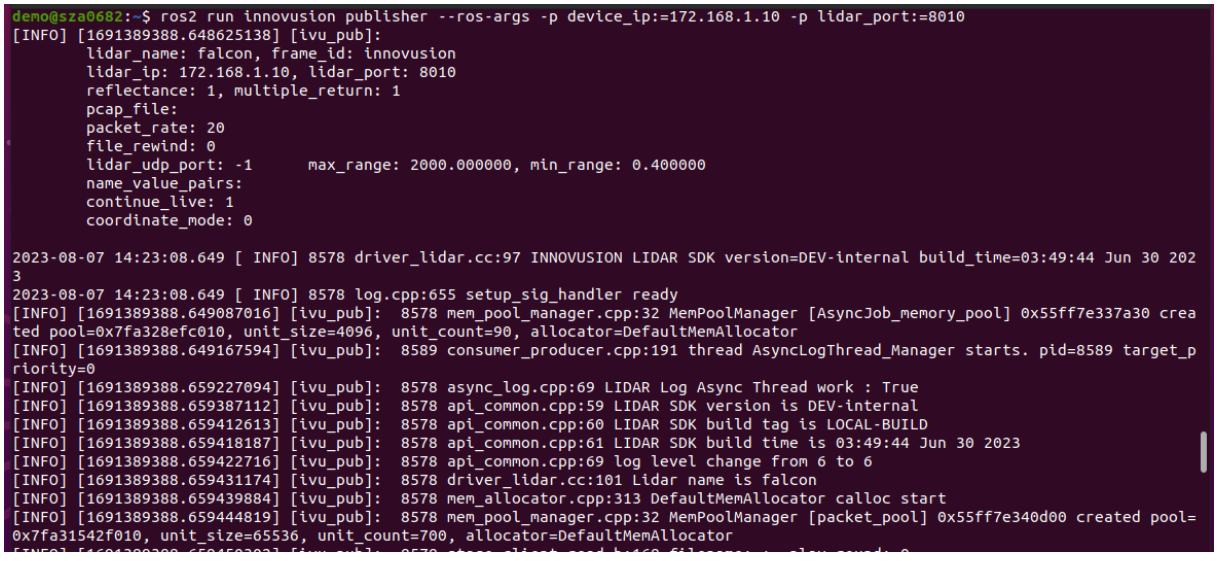
- Obtain the point cloud data via TCP.
  - Method 1

```
ros2 launch innovusion ivu_pc2.py device_ip:=<device_ip> lidar_port:=<TCP_port>
```




  - Method 2

```
ros2 run innovusion publisher --ros-args -p device_ip:=<device_ip> -p lidar_port:=<TCP_port>
```




Note

The default value of device_ip is 172.168.1.10. By default, the TCP port number is 8010.

Run the `ros2 launch innovusion ivu_pc2.py` or `ros2 run innovusion publisher` directly to obtain the point cloud data with the default settings.

- Obtain the point cloud data via UDP.
  - Method 1

```
ros2 launch innovusion ivu_pc2.py device_ip:=<device_ip> udp_port:=<UDP_port>
```

  - Method 2

```
ros2 run innovusion publisher --ros-args -p device_ip:=<device_ip> -p udp_port:=<UDP_port>
```

Note
The default value of device_ip is 172.168.1.10. Please notice that the LiDAR transmits the data via TCP by default.

### 5.2.3 View LiDAR point cloud data

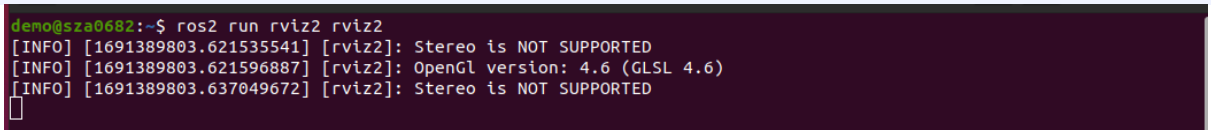
Note
Before viewing the point cloud data, please confirm that the point cloud data has been obtained.

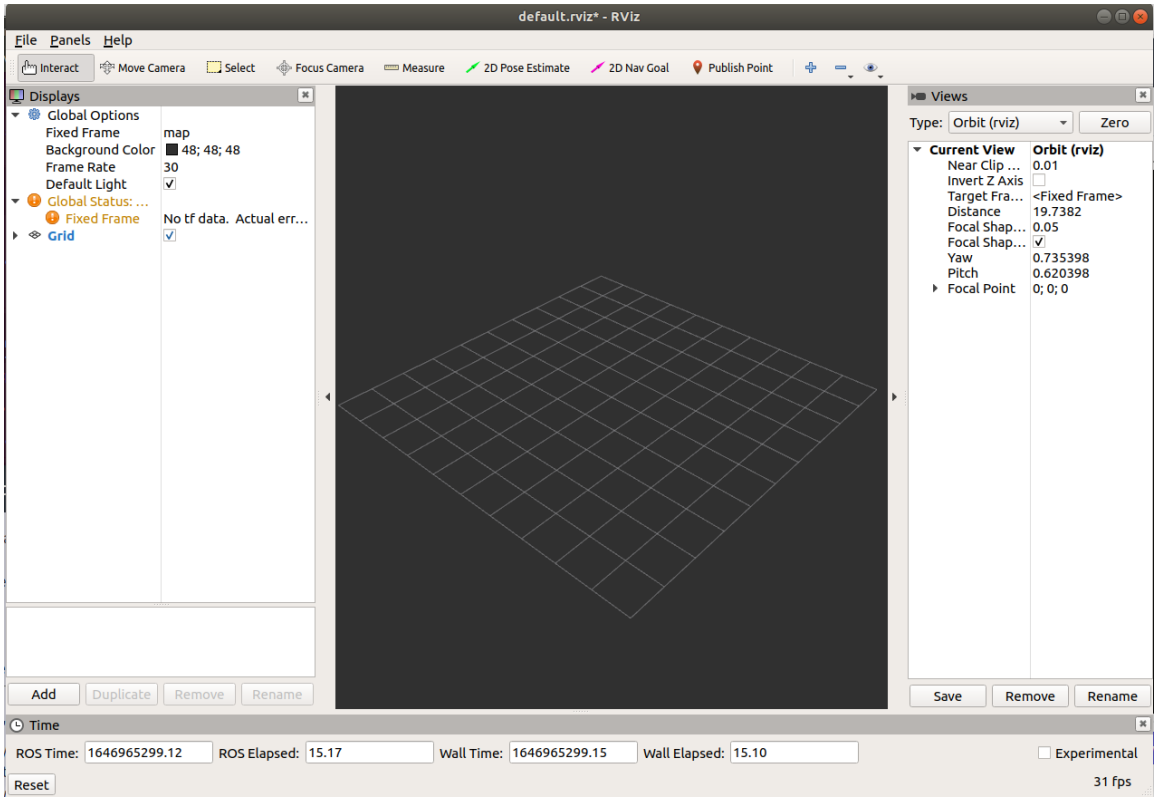
1. Open a new terminal and execute the command to source the setup file.

```
source /opt/ros/foxy/setup.bash
```

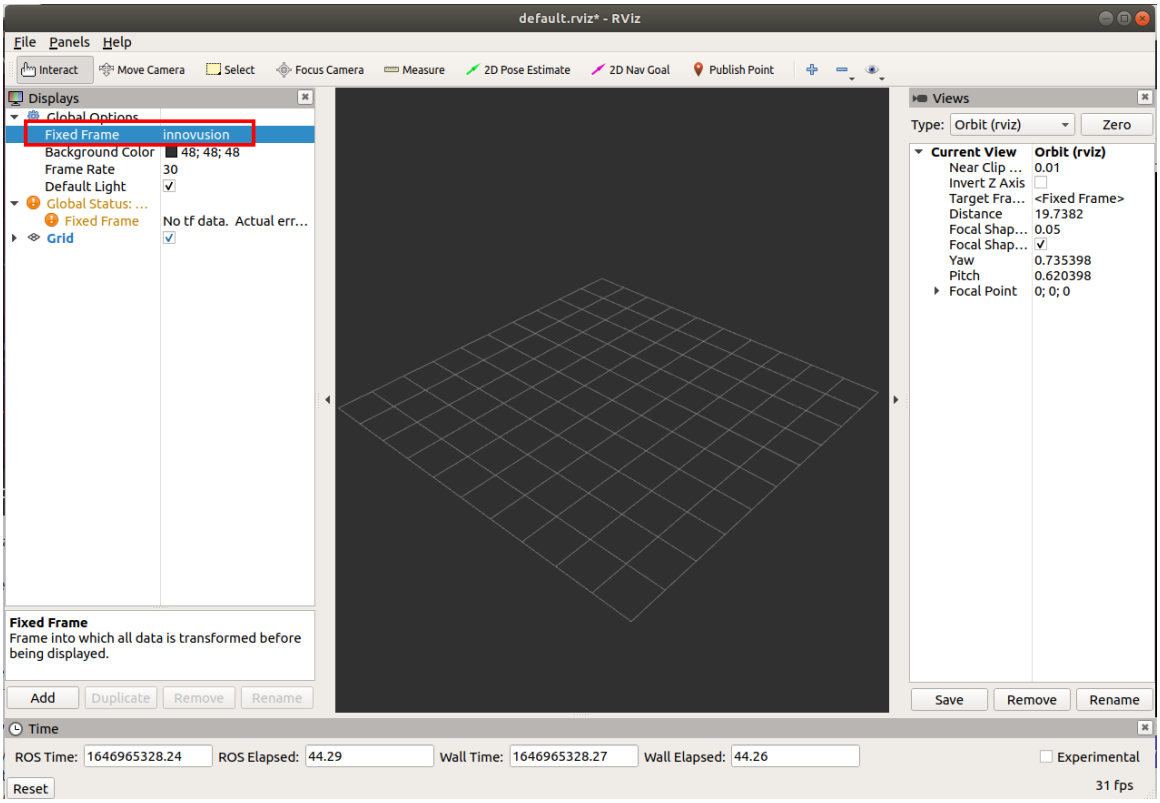
2. Start the graphical tool **rviz**. The return value and **rviz** interface are shown below.

```
ros2 run rviz2 rviz2
```






3. Select **Global Options** > **Fixed Frames**. Set the Fixed Frames value to **innovusion**.



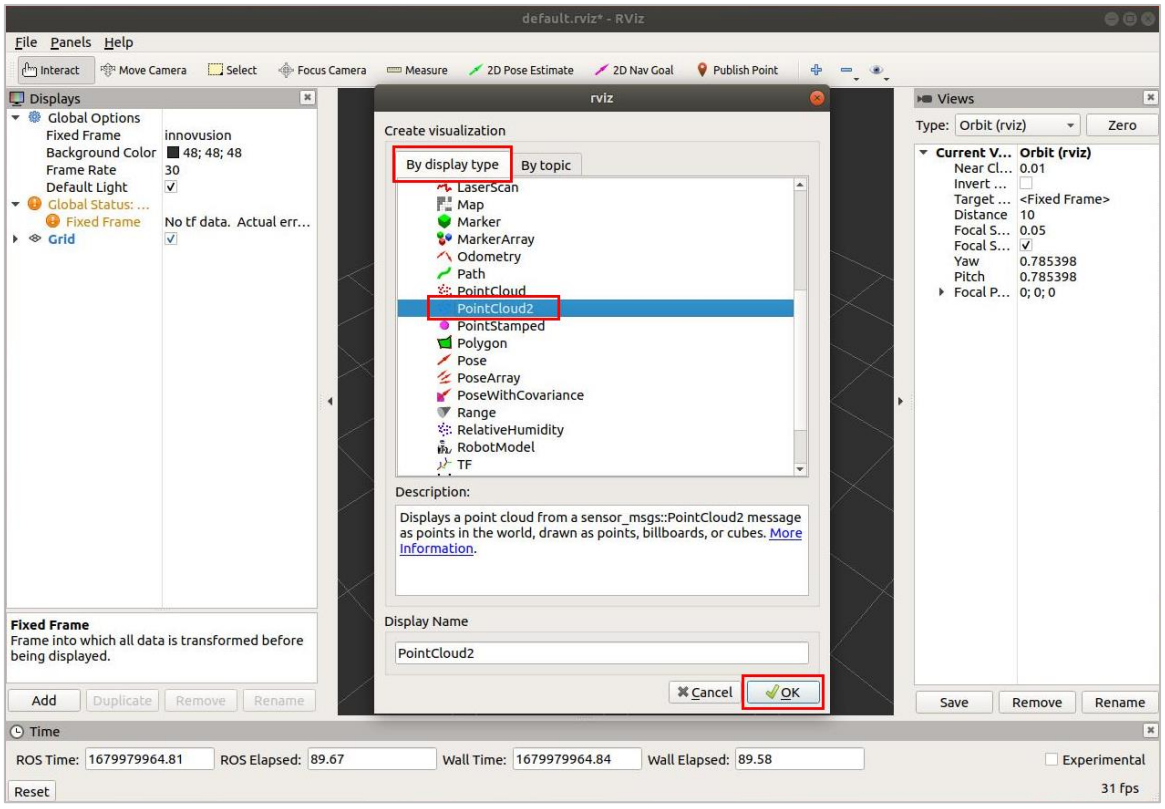
4. Add and adjust **PointCloud2**.

   i. Add PointCloud2 to Displays.

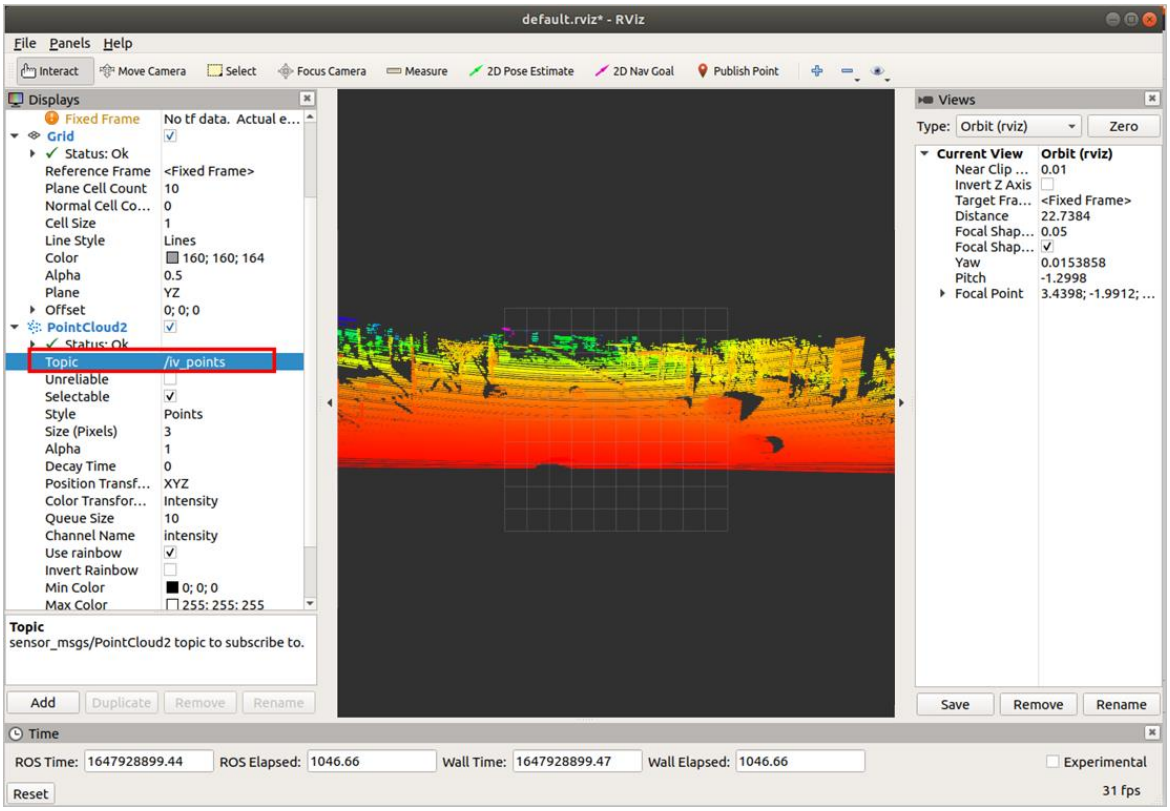
      a. Click **Add.**

      b. Select By display type> PointCloud2.

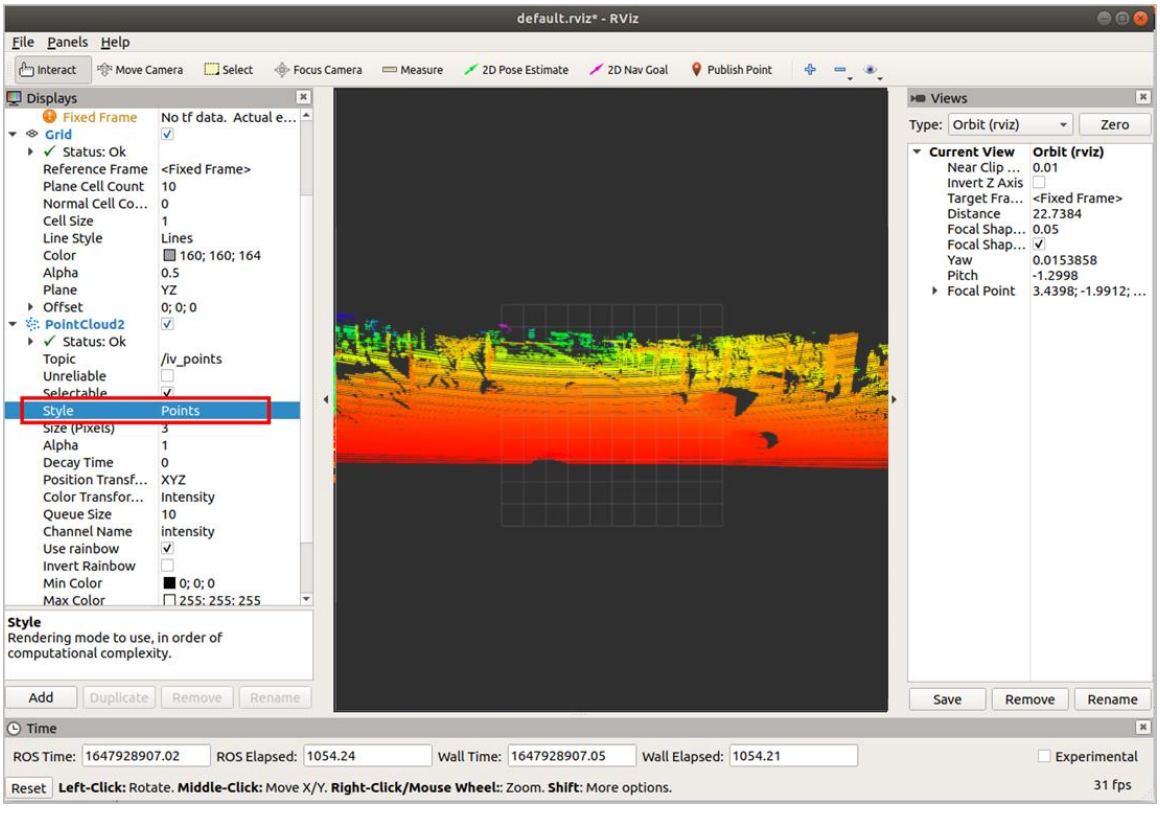
      c. Click **OK**.




   ii. Select **PointCloud2** > **Topic**. Set the Topic value to **/iv_points**.




iii. Select **PointCloud2** > **Style**. Set the Style value to **Points**.

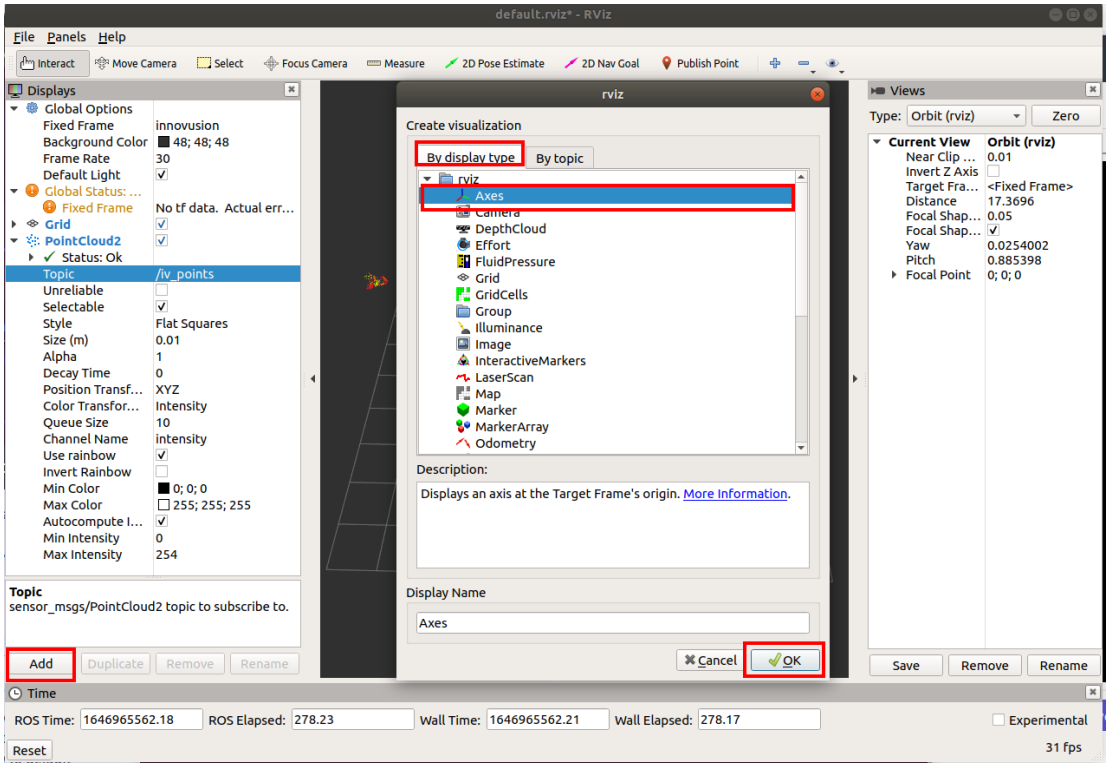


5. (Optional) It is possible to change the angle and distance of the real-time point cloud status to get more information as needed.

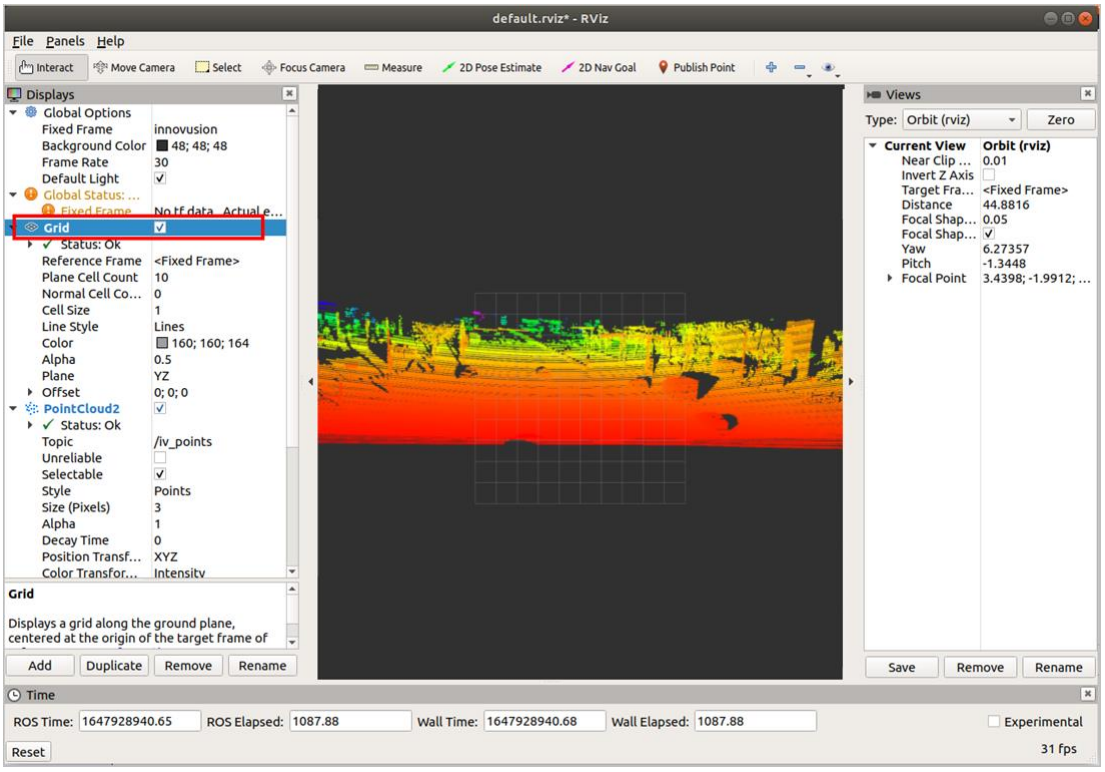
- Select **Axes** to add the coordinate system to the diagram as a reference.

  a. Select **Add** > **By display type** > **Axes**.

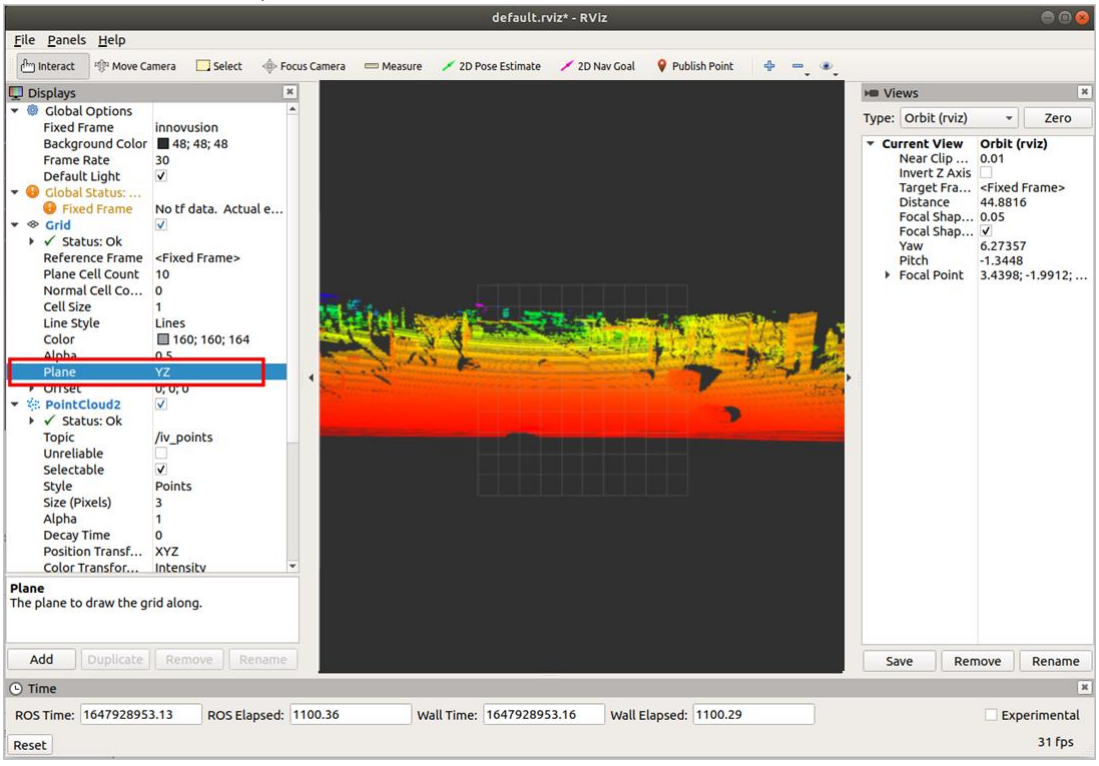
  b. Click **OK**.




- Select **Grid** to add the grid to the diagram as a reference. Grid is enabled by default when rviz is started.




- Set the **plane** value to view the point cloud status under different coordinate systems. There are three options: **XY**, **XZ**, and **YZ**.



### 5.2.4 Replay LiDAR point cloud data

It is possible to replay the point cloud data in pcap format in ROS2 environment.

Note

Before replaying LiDAR point cloud data, please confirm that the recorded point cloud data file has been obtained.

It is possible to capture the pcap data with Wireshark.

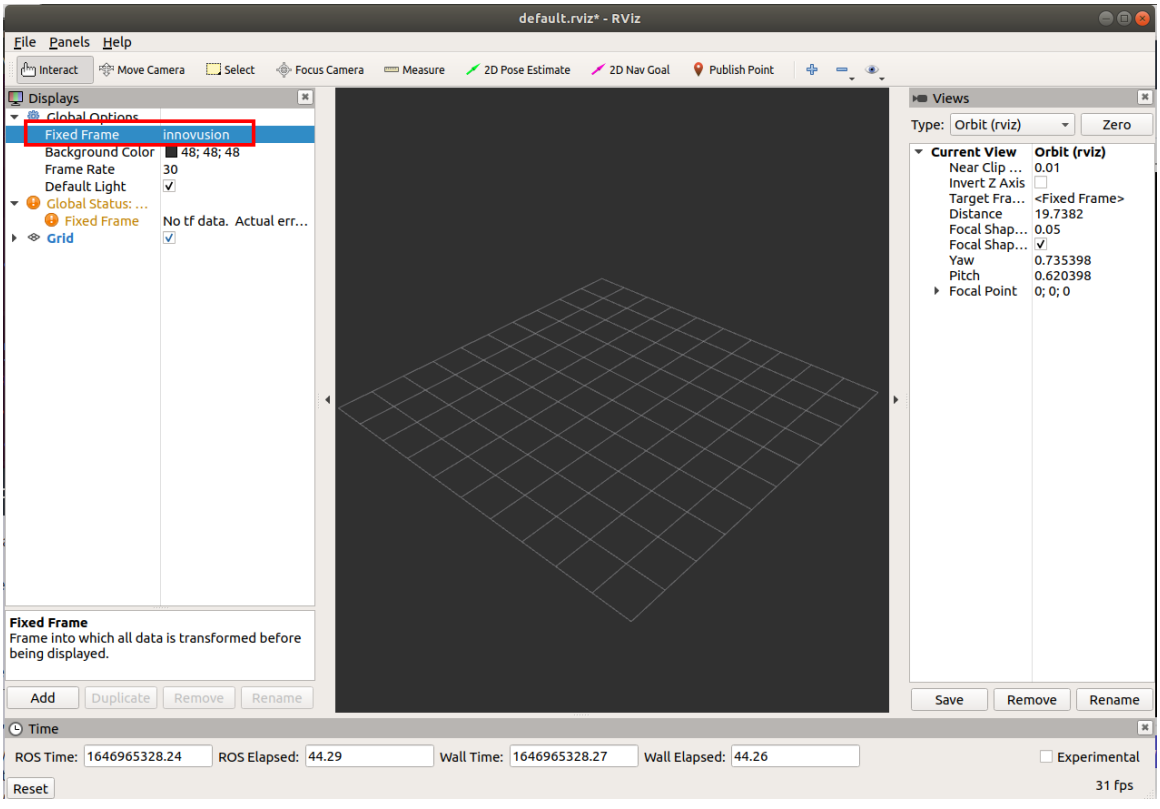
Only data captured in UDP can be replayed.

1. Start the graphical tool **rviz**. The return value and **rviz** interface are shown below.

```
ros2 run rviz2 rviz2
```

```
demo@sza0682:~$ ros2 run rviz2 rviz2
[INFO] [1691389803.621535541] [rviz2]: Stereo is NOT SUPPORTED
[INFO] [1691389803.621596887] [rviz2]: OpenGl version: 4.6 (GLSL 4.6)
[INFO] [1691389803.637049672] [rviz2]: Stereo is NOT SUPPORTED
```

2. Select **Global Options** > **Fixed Frames**. Set the **Fixed Frames** value to **innovusion**.



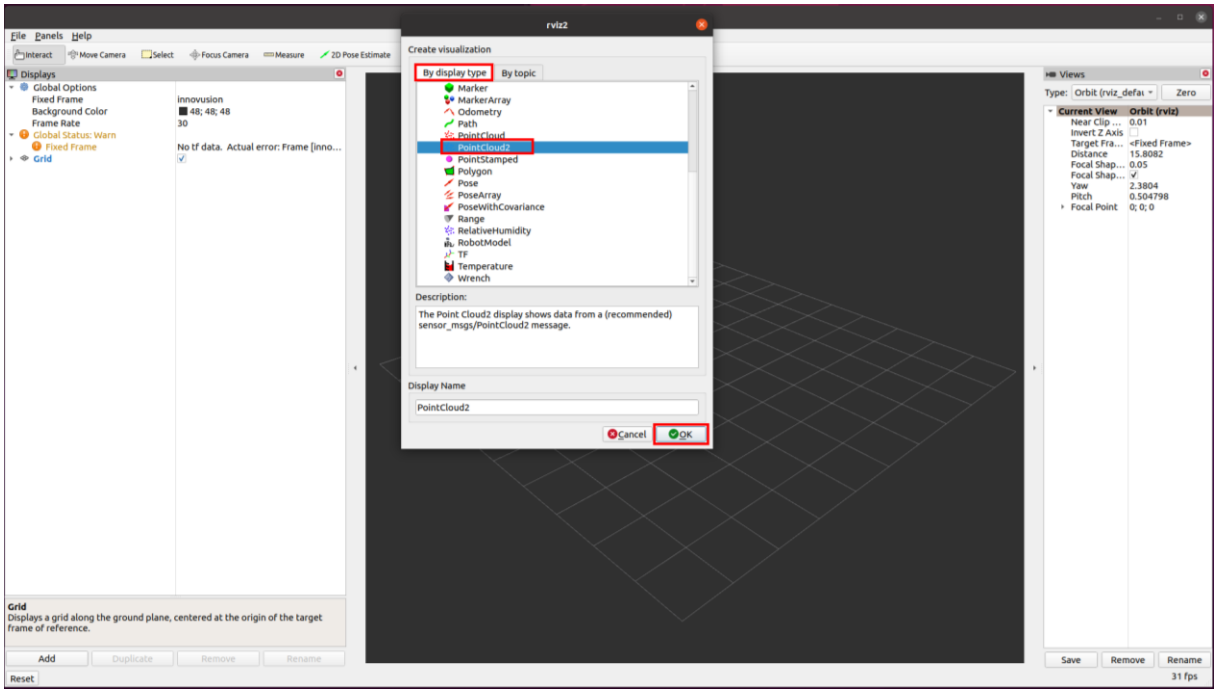

3. Add and configure **PointCloud2**.

   i. Add PointCloud2 to the Displays.

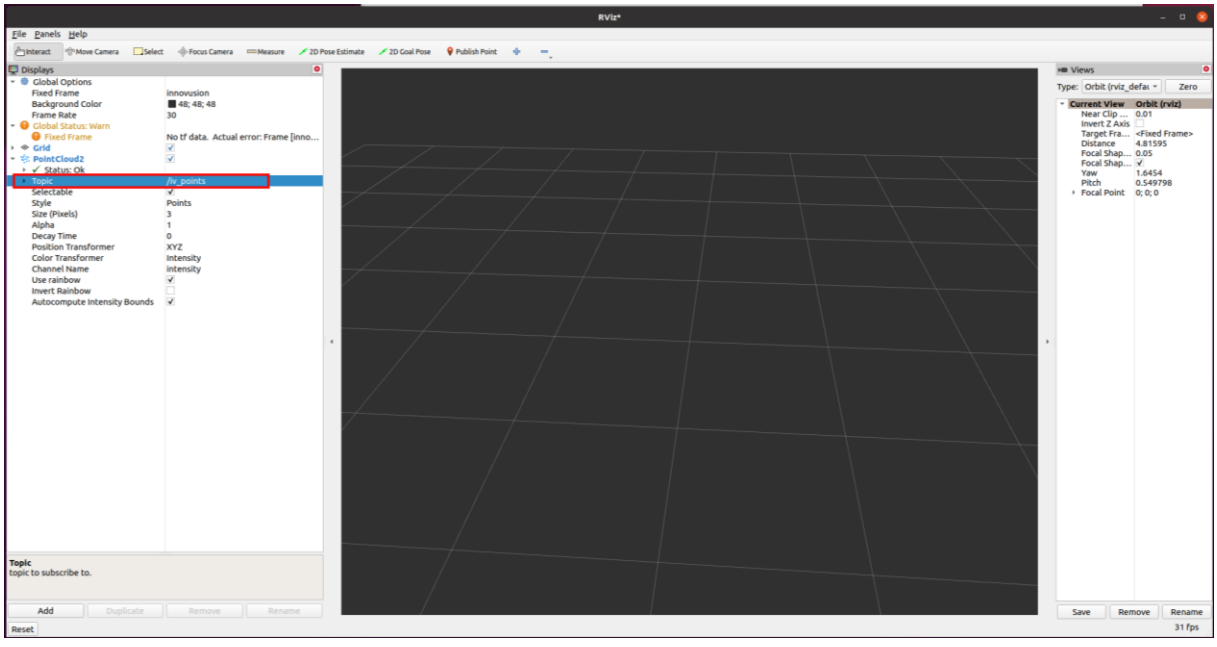
a. Click **Add.**

b. Select By display type > PointCloud2.

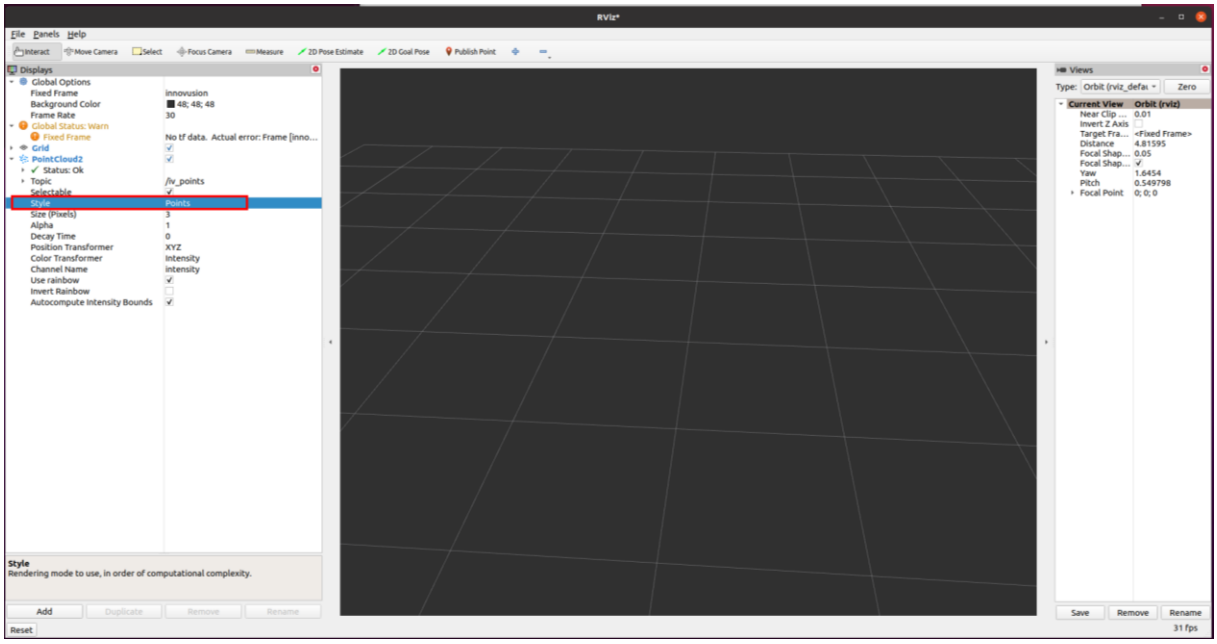
c. Click **OK**.




ii. Select **PointCloud2** > **Topic**. Set the Topic value to **/iv_points**.



iii. Select **PointCloud2** > **Style**. Set the Style value to **Points**.

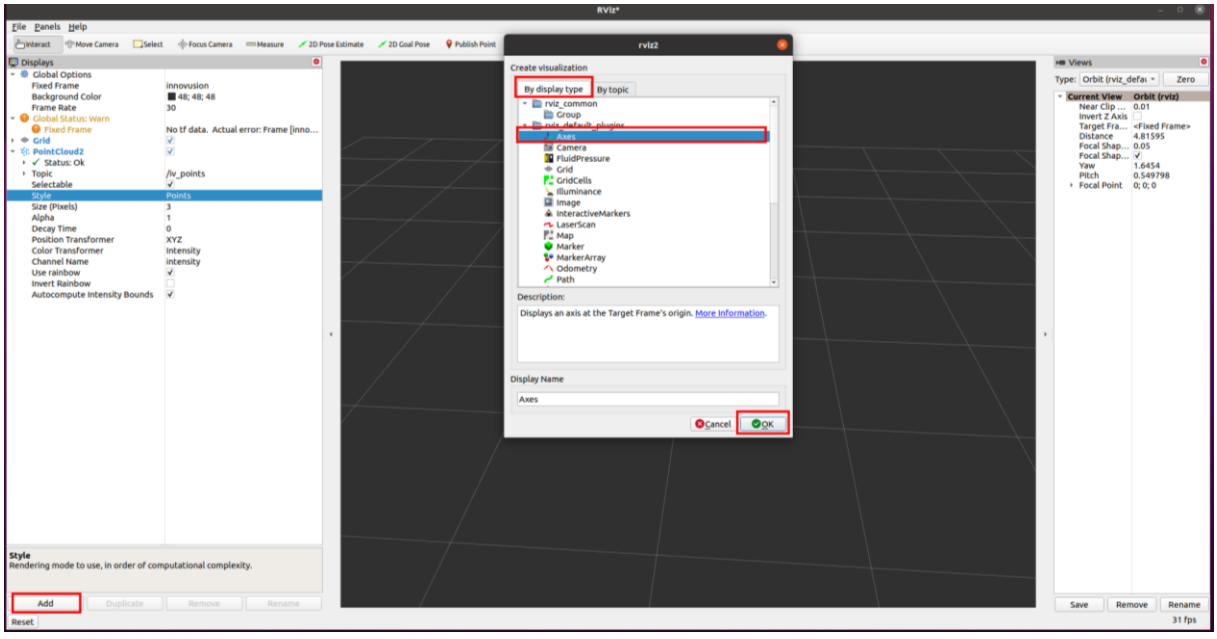


4. (Optional) It is possible to change the angle and distance of the real-time point cloud status to get more information as needed.

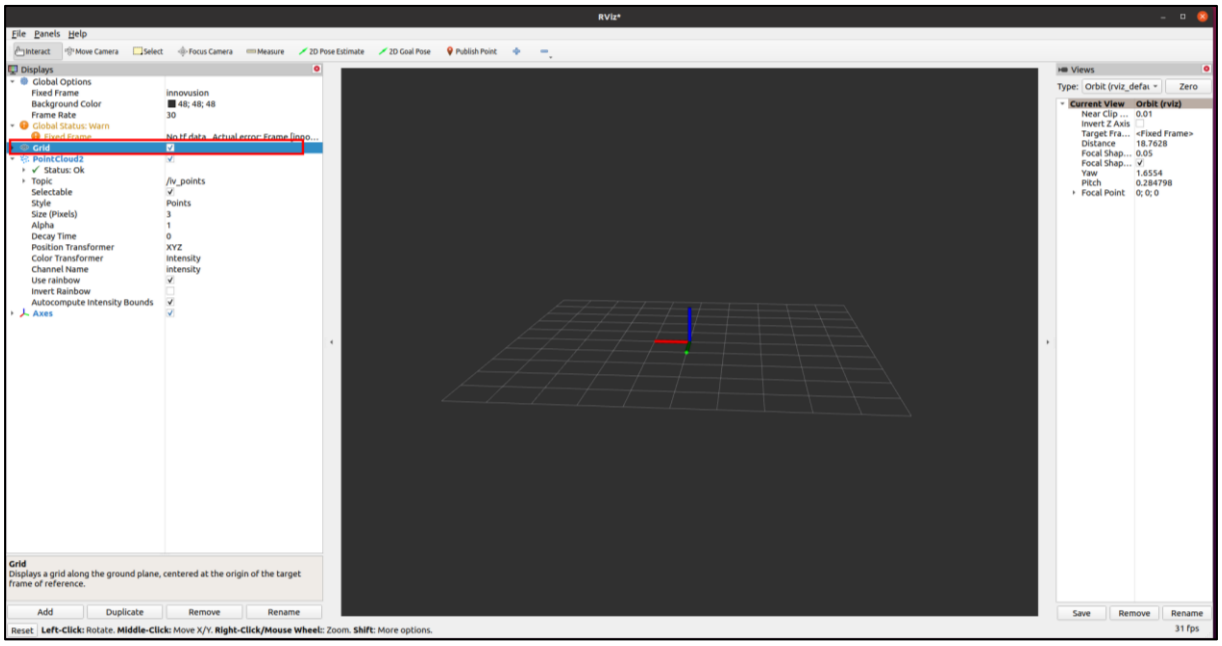
   - Select **Axes** to add the coordinate system to the diagram as a reference.

     a. Select **Add** > **By display type** > **Axes**.

     b. Click **OK**.



- Select **Grid** to add the grid to the diagram as a reference. Grid is enabled by default when **rviz** is started.



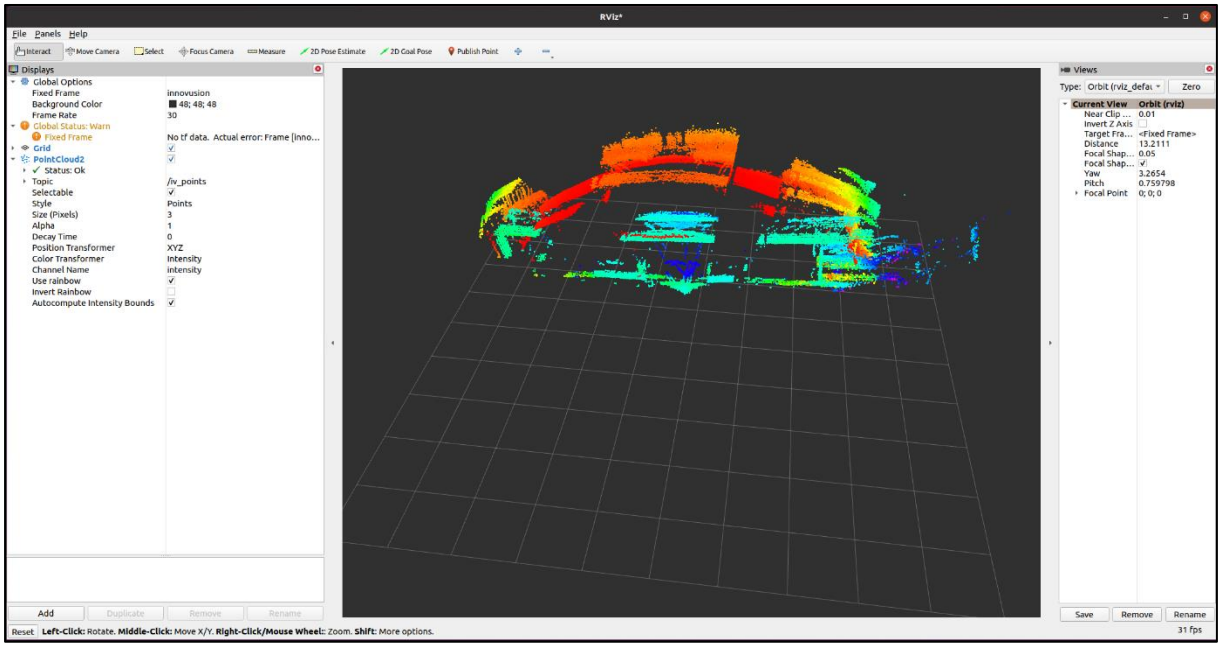

- Set the **plane** value to view the point cloud status under different coordinate systems. There are three options: **XY**, **XZ,** and **YZ**.

5. Replay LiDAR point cloud data in **rviz**.

```
ros2 run innovusion publisher  --ros-args -p device_ip:=<data_ip> -p pcap_file:=<pcap_file>
-p udp_port:=<data_port> [-p packet_rate:=<playback_rate>] | [-p file_rewind:=<file_rewind>]
```

```
demo@sza0682:~/Desktop/ros2 installation$ ros2 run innovusion publisher --ros-args -p device_ip:=172.168.1.10 -p pcap_file:=test_for_ros.pcap
-p udp_port:=8010 -p file_rewind:=-1
[INFO] [1691390060.940374577] [ivu_pub]:
       lidar_name: falcon, frame_id: innovusion
       lidar_ip: 172.168.1.10, lidar_port: 8010
       reflectance: 1, multiple_return: 1
       pcap_file: test_for_ros.pcap
       packet_rate: 20
       file_rewind: -1
       lidar_udp_port: 8010    max_range: 2000.000000, min_range: 0.400000
       name_value_pairs:
       continue_live: 1
       coordinate_mode: 0

2023-08-07 14:34:20.940 [ INFO] 9124 driver_lidar.cc:97 INNOVUSION LIDAR SDK version=DEV-internal build_time=03:49:44 Jun 30 2023
2023-08-07 14:34:20.941 [ INFO] 9124 log.cpp:655 setup_sig_handler ready
[INFO] [1691390060.941026431] [ivu_pub]:  9124 mem_pool_manager.cpp:32 MemPoolManager [AsyncJob_memory_pool] 0x55bf5655d650 created pool=0x7fa
e3c838010, unit_size=4096, unit_count=90, allocator=DefaultMemAllocator
[INFO] [1691390060.941093389] [ivu_pub]:  9135 consumer_producer.cpp:191 thread AsyncLogThread_Manager starts. pid=9135 target_priority=0
[INFO] [1691390060.951170615] [ivu_pub]:  9124 async_log.cpp:69 LIDAR Log Async Thread work : True
[INFO] [1691390060.951279656] [ivu_pub]:  9124 api_common.cpp:59 LIDAR SDK version is DEV-internal
[INFO] [1691390060.951316848] [ivu_pub]:  9124 api_common.cpp:60 LIDAR SDK build tag is LOCAL-BUILD
[INFO] [1691390060.951324099] [ivu_pub]:  9124 api_common.cpp:61 LIDAR SDK build time is 03:49:44 Jun 30 2023
[INFO] [1691390060.951330346] [ivu_pub]:  9124 api_common.cpp:69 log level change from 6 to 6
[INFO] [1691390060.951341801] [ivu_pub]:  9124 driver_lidar.cc:101 Lidar name is falcon
[INFO] [1691390060.951347649] [ivu_pub]:  9124 driver_lidar.cc:206 ## pcap_file is test_for_ros.pcap, device_ip_ is 172.168.1.10, play_rate is
 20, rewind id -1, 8010/8010/8010 ##
[INFO] [1691390060.951353721] [ivu_pub]:  9124 mem_allocator.cpp:313 DefaultMemAllocator calloc start
[INFO] [1691390060.951359799] [ivu_pub]:  9124 mem_pool_manager.cpp:32 MemPoolManager [packet_pool] 0x55bf56566960 created pool=0x7fae1d42f010
, unit_size=65536, unit_count=700, allocator=DefaultMemAllocator
[INFO] [1691390060.951371560] [ivu_pub]:  9124 lidar_base.h:622 Setting play rate to 20
[INFO] [1691390060.951378886] [ivu_pub]:  9124 lidar_base.h:630 Setting play rate to 20 MB/s
[INFO] [1691390060.951386293] [ivu_pub]:  9124 stage_client_read.h:168 filename: test_for_ros.pcap, play_round: 0
[INFO] [1691390060.952968825] [ivu_pub]:  9124 stage_client_read_pcap.h:42 filename: test_for_ros.pcap, play_round: 0
[INFO] [1691390060.953000055] [ivu_pub]:  9124 stage_client_read_pcap.h:43 pcap_filter_str_: src host 172.168.1.10 and udp
[INFO] [1691390060.953007031] [ivu_pub]:  9124 api_common.cpp:385 add lidar 1 (total=1 total_active=1)
[INFO] [1691390060.953020603] [ivu_pub]:  9124 lidar_client.cpp:230 file replay fake set reflectance
[INFO] [1691390060.953026072] [ivu_pub]:  9124 lidar_client.cpp:243 file replay fake set return mode
[INFO] [1691390060.953031237] [ivu_pub]:  9124 driver_lidar.cc:220 Use name_value_pairs
[INFO] [1691390060.953037633] [ivu_pub]:  9124 driver_lidar.cc:56 ## first call for ros2 driver ##
[INFO] [1691390060.953044330] [ivu_pub]:  9124 lidar_base.h:552 message_callback: name=falcon level=6, code=1, message=Header file inno_lidar_
```




**[Parameter description]**

- device_ip: The IP address of the LiDAR from which the data was captured.
- pcap_file: The file name to be replayed.
- UDP port: The UDP port of the LiDAR from which the data was captured.

- packet_rate(Optional): The replay speed of the file. The default value is 20.
  - When the play_rate=0, the play speed is as fast as possible.
  - When the play_rate≤100, the unit of play speed is MB/s. e.g., When play_rate=50, the play speed is at 50 MB/s.
  - When the play_rate>100, the play speed=play_rate/10000.0. e.g., When play_rate=15000, the play speed is at 1.5 times.
- file_rewind(Optional): The number of times file is replayed.
  - A default value of 0 means no repeat.
  - A negative value means the file will be repeated indefinitely until the program is manually stopped.

### 5.2.5 Convert the reference coordinates of the displayed point cloud

Note

Before viewing the point cloud data, please confirm that the point cloud data can be obtained correctly. About how to obtain the point cloud data, see *5.2.2 Obtain point cloud data*.

1. Convert the file reference coordinates of the point cloud displayed in rviz.

```
ros2 run innovusion publisher --ros-args -p coordinate_mode:=<select_mode>
```

```
demo@sza0682:~$ ros2 run innovusion publisher --ros-args -p coordinate_mode:=1
[INFO] [1691394410.745886454] [ivu_pub]:
       lidar_name: falcon, frame_id: innovusion
       lidar_ip: 172.168.1.10, lidar_port: 8010
       reflectance: 1, multiple_return: 1
       pcap_file:
       packet_rate: 20
       file_rewind: 0
       lidar_udp_port: -1      max_range: 2000.000000, min_range: 0.400000
       name_value_pairs:
       continue_live: 1
       coordinate_mode: 1

2023-08-07 15:46:50.746 [ INFO] 9686 driver_lidar.cc:97 INNOVUSION LIDAR SDK version=DEV-internal build_time=03:49:44 Jun 30 2023
2023-08-07 15:46:50.746 [ INFO] 9686 log.cpp:655 setup_sig_handler ready
[INFO] [1691394410.746531844] [ivu_pub]:  9686 mem_pool_manager.cpp:32 MemPoolManager [AsyncJob_memory_pool] 0x5580ec7753f0 created pool=0x7
f27c9bde010, unit_size=4096, unit_count=90, allocator=DefaultMemAllocator
[INFO] [1691394410.746624797] [ivu_pub]:  9697 consumer_producer.cpp:191 thread AsyncLogThread_Manager starts. pid=9697 target_priority=0
[INFO] [1691394410.756736917] [ivu_pub]:  9686 async_log.cpp:69 LIDAR Log Async Thread work : True
[INFO] [1691394410.756776422] [ivu_pub]:  9686 api_common.cpp:59 LIDAR SDK version is DEV-internal
[INFO] [1691394410.756820867] [ivu_pub]:  9686 api_common.cpp:60 LIDAR SDK build tag is LOCAL-BUILD
[INFO] [1691394410.756838896] [ivu_pub]:  9686 api_common.cpp:61 LIDAR SDK build time is 03:49:44 Jun 30 2023
[INFO] [1691394410.756843675] [ivu_pub]:  9686 api_common.cpp:69 log level change from 6 to 6
[INFO] [1691394410.756851173] [ivu_pub]:  9686 driver_lidar.cc:101 Lidar name is falcon
[INFO] [1691394410.756855392] [ivu_pub]:  9686 mem_allocator.cpp:313 DefaultMemAllocator calloc start
[INFO] [1691394410.756860787] [ivu_pub]:  9686 mem_pool_manager.cpp:32 MemPoolManager [packet_pool] 0x5580ec77e710 created pool=0x7f27b942f0
10, unit_size=65536, unit_count=700, allocator=DefaultMemAllocator
[INFO] [1691394410.756865946] [ivu_pub]:  9686 stage_client_read.h:168 filename: ', play_round: 0
[INFO] [1691394410.756870113] [ivu_pub]:  9686 lidar_client.cpp:57 falcon uses live lidar at 172.168.1.10 port=8010 udp_port=0
[INFO] [1691394410.756874482] [ivu_pub]:  9686 api_common.cpp:385 add lidar 1 (total=1 total_active=1)
[INFO] [1691394410.756878601] [ivu_pub]:  9686 config.cpp:56 config LidarClient_Communication(1) set get_conn_timeout_sec to 5.0
[INFO] [1691394410.756882723] [ivu_pub]:  9686 config.cpp:56 config LidarClient_StageClientRead(1) set misorder_fix_enable to 1
[INFO] [1691394410.756886715] [ivu_pub]:  9686 net_manager.cpp:110 Requesting /command/?set_reflectance_mode=2 from 172.168.1.10:8010
[INFO] [1691394410.757778770] [ivu_pub]:  9686 net_manager.cpp:110 Requesting /command/?set_return_mode=1 from 172.168.1.10:8010
[INFO] [1691394410.758405100] [ivu_pub]:  9686 driver_lidar.cc:220 Use name_value_pairs
[INFO] [1691394410.758422239] [ivu_pub]:  9686 driver_lidar.cc:56 ## first call for ros2 driver ##
```

**[Parameter description]**

coordinate_mode: The reference coordinates of the displayed point cloud, ranging from 0 to 4. A default value of 0 means that the X-axis is pointing up, the Y-axis is pointing right, and the Z-axis is pointing forward.

- A value of 1 means that the X-axis is pointing right, the Y-axis is pointing forward, and the Z-axis is pointing up.
- A value of 2 means that the X-axis is pointing right, the Y-axis is pointing up, and the Z-axis is pointing forward.
- A value of 3 means that the X-axis is pointing forward, the Y-axis is pointing reverse right, and the Z-axis is pointing up.
- A value of 4 means that the X-axis is pointing forward, the Y-axis is pointing up, and the Z-axis is pointing right.

### 5.2.6 Configure the reflectance mode and the return mode

Note

Before viewing the point cloud data, please confirm that the point cloud data can be obtained correctly. About how to obtain the point cloud data, see *5.2.2 Obtain point cloud data*.

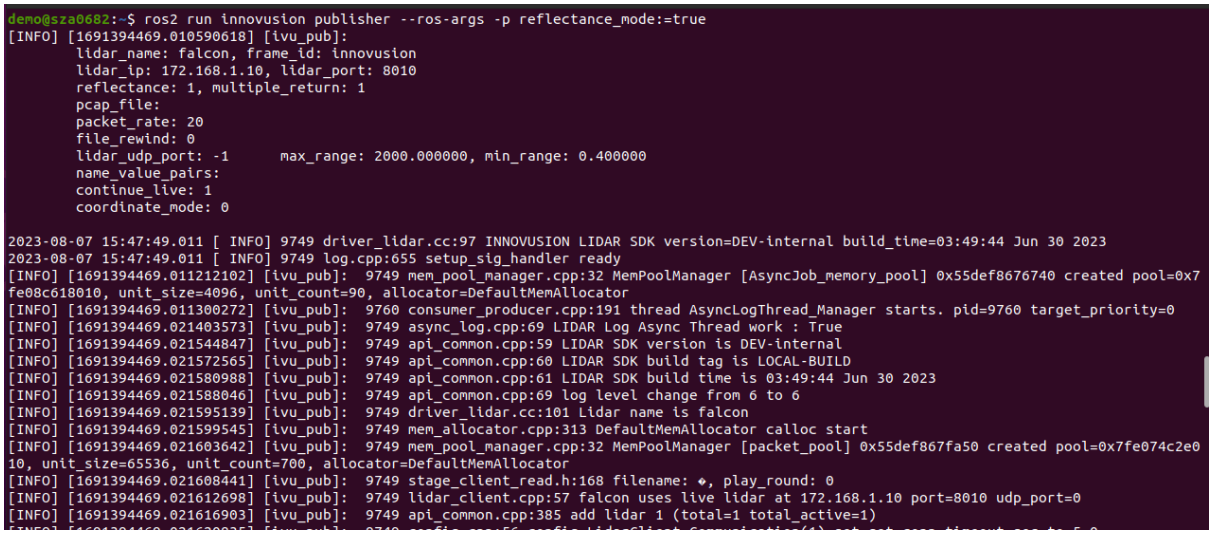
1. Configure the reflectance mode.

```
ros2 run innovusion publisher --ros-args -p reflectance_mode:=<reflectance_mode>
```

**[Parameter description]**

reflectance_mode: reflectance mode of the LiDAR. The value of reflectance mode can be either false or true.

- A value of false means that the reflectance mode of the LiDAR is selected as intensity. The return value in intensity mode is the echo read directly by LiDAR. The intensity varies with the influence of the factors including object distance, object reflectivity, beam angle, etc.
- A value of true means that the reflectance mode of the LiDAR is selected as reflectivity. The return value in reflectivity mode is the calculated result based on the intensity and rectified with the object distance, beam angle and other parameters.




### 5.2.7 Configure the return mode

Note

Before viewing the point cloud data, please confirm that the point cloud data can be obtained correctly.

About how to obtain the point cloud data, see *5.2.2 Obtain point cloud data*.

1. Configure the return mode.

```
ros2 run innovusion publisher --ros-args -p multiple_return:=<return_mode>
```

**[Parameter description]**

multiple_return: the echo received when a laser is emitted once.

- A default value of 1 means the single return mode.
- A value of 2 means the strongest + 2 strongest return mode.
- A value of 3 means the strongest & furthest return mode.

```
demo@sza0682:~$ ros2 run innovusion publisher --ros-args -p multiple_return:=1
[INFO] [1691394547.578989701] [ivu_pub]:
       lidar_name: falcon, frame_id: innovusion
       lidar_ip: 172.168.1.10, lidar_port: 8010
       reflectance: 1, multiple_return: 1
       pcap_file:
       packet_rate: 20
       file_rewind: 0
       lidar_udp_port: -1      max_range: 2000.000000, min_range: 0.400000
       name_value_pairs:
       continue_live: 1
       coordinate_mode: 0

2023-08-07 15:49:07.579 [ INFO] 9807 driver_lidar.cc:97 INNOVUSION LIDAR SDK version=DEV-internal build_time=03:49:44 Jun 30 2023
2023-08-07 15:49:07.579 [ INFO] 9807 log.cpp:655 setup_sig_handler ready
[INFO] [1691394547.579665574] [ivu_pub]:  9807 mem_pool_manager.cpp:32 MemPoolManager [AsyncJob_memory_pool] 0x55da4d8a26e0 created pool=0x7f1
2cc7bf010, unit_size=4096, unit_count=90, allocator=DefaultMemAllocator
[INFO] [1691394547.579732572] [ivu_pub]:  9818 consumer_producer.cpp:191 thread AsyncLogThread_Manager starts. pid=9818 target_priority=0
[INFO] [1691394547.589870476] [ivu_pub]:  9807 async_log.cpp:69 LIDAR Log Async Thread work : True
[INFO] [1691394547.589903658] [ivu_pub]:  9807 api_common.cpp:59 LIDAR SDK version is DEV-internal
[INFO] [1691394547.589923398] [ivu_pub]:  9807 api_common.cpp:60 LIDAR SDK build tag is LOCAL-BUILD
[INFO] [1691394547.589930577] [ivu_pub]:  9807 api_common.cpp:61 LIDAR SDK build time is 03:49:44 Jun 30 2023
[INFO] [1691394547.589942911] [ivu_pub]:  9807 api_common.cpp:69 log level change from 6 to 6
[INFO] [1691394547.589953230] [ivu_pub]:  9807 driver_lidar.cc:101 Lidar name is falcon
[INFO] [1691394547.589962091] [ivu_pub]:  9807 mem_allocator.cpp:313 DefaultMemAllocator calloc start
[INFO] [1691394547.589969089] [ivu_pub]:  9807 mem_pool_manager.cpp:32 MemPoolManager [packet_pool] 0x55da4d8ab9f0 created pool=0x7f12a942f010
, unit_size=65536, unit_count=700, allocator=DefaultMemAllocator
[INFO] [1691394547.589977254] [ivu_pub]:  9807 stage_client_read.h:168 filename: , play_round: 0
[INFO] [1691394547.589984739] [ivu_pub]:  9807 lidar_client.cpp:57 falcon uses live lidar at 172.168.1.10 port=8010 udp_port=0
[INFO] [1691394547.589991958] [ivu_pub]:  9807 api_common.cpp:385 add lidar 1 (total=1 total_active=1)
[INFO] [1691394547.590007492] [ivu_pub]:  9807 config.cpp:56 config LidarClient_Communication(1) set get_conn_timeout_sec to 5.0
[INFO] [1691394547.590013931] [ivu_pub]:  9807 config.cpp:56 config LidarClient_StageClientRead(1) set misorder_fix_enable to 1
```

### 5.2.8 Change the distance limitation for the displayed point cloud

Note

Before viewing the point cloud data, please confirm that the point cloud data can be obtained correctly.

About how to obtain the point cloud data, see *5.2.2 Obtain point cloud data*.

1. Change the distance limitation for the displayed point cloud.

```
ros2 run innovusion publisher --ros-args -p max_range:=<max_distance> -p min_range:=<min_distance>
```

**[Parameter description]**

- max_range: The maximum distance of the displayed point cloud in meters, up to 2000.0.
- min_range: The minimum distance of the displayed point cloud in meters, down to 0.4.

Note

Please notice that the max_range should be greater than the min_range.

```
demo@sza0682:~$ ros2 run innovusion publisher --ros-args -p max_range:=1800.0 -p min_range:=1.0
[INFO] [1691394722.053783138] [ivu_pub]:
        lidar_name: falcon, frame_id: innovusion
        lidar_ip: 172.168.1.10, lidar_port: 8010
        reflectance: 1, multiple_return: 1
        pcap_file:
        packet_rate: 20
        file_rewind: 0
        lidar_udp_port: -1      max_range: 1800.000000, min_range: 1.000000
        name_value_pairs:
        continue_live: 1
        coordinate_mode: 0

2023-08-07 15:52:02.054 [ INFO] 9889 driver_lidar.cc:97 INNOVUSION LIDAR SDK version=DEV-internal build_time=03:49:44 Jun 30 2023
2023-08-07 15:52:02.054 [ INFO] 9889 log.cpp:655 setup_sig_handler ready
[INFO] [1691394722.054316021] [ivu_pub]:  9889 mem_pool_manager.cpp:32 MemPoolManager [AsyncJob_memory_pool] 0x564b86df7a30 created pool=0x7
f84bcc31010, unit_size=4096, unit_count=90, allocator=DefaultMemAllocator
[INFO] [1691394722.054393215] [ivu_pub]:  9900 consumer_producer.cpp:191 thread AsyncLogThread_Manager starts. pid=9900 target_priority=0
[INFO] [1691394722.064486544] [ivu_pub]:  9889 async_log.cpp:69 LIDAR Log Async Thread work : True
[INFO] [1691394722.064582825] [ivu_pub]:  9889 api_common.cpp:59 LIDAR SDK version is DEV-internal
[INFO] [1691394722.064603403] [ivu_pub]:  9889 api_common.cpp:60 LIDAR SDK build tag is LOCAL-BUILD
[INFO] [1691394722.064608874] [ivu_pub]:  9889 api_common.cpp:61 LIDAR SDK build time is 03:49:44 Jun 30 2023
[INFO] [1691394722.064613651] [ivu_pub]:  9889 api_common.cpp:69 log level change from 6 to 6
[INFO] [1691394722.064620777] [ivu_pub]:  9889 driver_lidar.cc:101 Lidar name is falcon
[INFO] [1691394722.064624559] [ivu_pub]:  9889 mem_allocator.cpp:313 DefaultMemAllocator calloc start
[INFO] [1691394722.064628041] [ivu_pub]:  9889 mem_pool_manager.cpp:32 MemPoolManager [packet_pool] 0x564b86e00d40 created pool=0x7f849d42f0
10, unit_size=65536, unit_count=700, allocator=DefaultMemAllocator
[INFO] [1691394722.064632237] [ivu_pub]:  9889 stage_client_read.h:168 filename: , play_round: 0
[INFO] [1691394722.064636103] [ivu_pub]:  9889 lidar_client.cpp:57 falcon uses live lidar at 172.168.1.10 port=8010 udp_port=0
```

### 5.2.9 Shut down the LiDAR

Disconnect the power supply to shut down the LiDAR.

## 5.3 Operate on ILA

The ILA only supports the log and LiDAR version view features.

### 5.3.1 Start the LiDAR

1. Connect the power supply to start the LiDAR.
2. The LiDAR completes initialization and generates data after powering on for 11 to 18 seconds.

Note

The LiDAR does not have a power switch. It will become operational when power is applied.

### 5.3.2 Login

1. Connect the computer to LiDAR and ensure the Ethernet connection.
2. Change the computer IP address to the same subnet with the LiDAR.
3. Open the web browser. Enter the LiDAR IP address and port number in the address bar `<IP Address>: <PORT>` to access the ILA.

Note

The default LiDAR IP address is 172.168.1.10. By default, the ILA port number is 8675. The default ILA login address is 172.168.1.10:8675.

It is recommended to check the access to the LiDAR IP address by using the ping command. The return value is shown in the figure below.

It is recommended to use the Google Chrome browser to log in to the ILA.

```
demo@demo-OMEN-by-HP-Laptop-16-b0xxx:~$ ping 172.168.1.10
PING 172.168.1.10 (172.168.1.10) 56(84) bytes of data.
64 bytes from 172.168.1.10: icmp_seq=70 ttl=64 time=0.448 ms
64 bytes from 172.168.1.10: icmp_seq=71 ttl=64 time=0.222 ms
64 bytes from 172.168.1.10: icmp_seq=72 ttl=64 time=0.200 ms
64 bytes from 172.168.1.10: icmp_seq=73 ttl=64 time=0.208 ms
64 bytes from 172.168.1.10: icmp_seq=74 ttl=64 time=0.200 ms
64 bytes from 172.168.1.10: icmp_seq=75 ttl=64 time=0.219 ms
64 bytes from 172.168.1.10: icmp_seq=76 ttl=64 time=0.255 ms
64 bytes from 172.168.1.10: icmp_seq=77 ttl=64 time=0.212 ms
64 bytes from 172.168.1.10: icmp_seq=78 ttl=64 time=0.206 ms
64 bytes from 172.168.1.10: icmp_seq=79 ttl=64 time=0.170 ms
64 bytes from 172.168.1.10: icmp_seq=80 ttl=64 time=0.207 ms
64 bytes from 172.168.1.10: icmp_seq=81 ttl=64 time=0.207 ms
64 bytes from 172.168.1.10: icmp_seq=82 ttl=64 time=0.145 ms
64 bytes from 172.168.1.10: icmp_seq=83 ttl=64 time=0.168 ms
64 bytes from 172.168.1.10: icmp_seq=84 ttl=64 time=0.316 ms
64 bytes from 172.168.1.10: icmp_seq=85 ttl=64 time=0.192 ms
64 bytes from 172.168.1.10: icmp_seq=86 ttl=64 time=0.309 ms
64 bytes from 172.168.1.10: icmp_seq=87 ttl=64 time=0.295 ms
^C
--- 172.168.1.10 ping statistics ---
87 packets transmitted, 18 received, 79% packet loss, time 88040ms
rtt min/avg/max/mdev = 0.145/0.232/0.448/0.069 ms
demo@demo-OMEN-by-HP-Laptop-16-b0xxx:~$
```

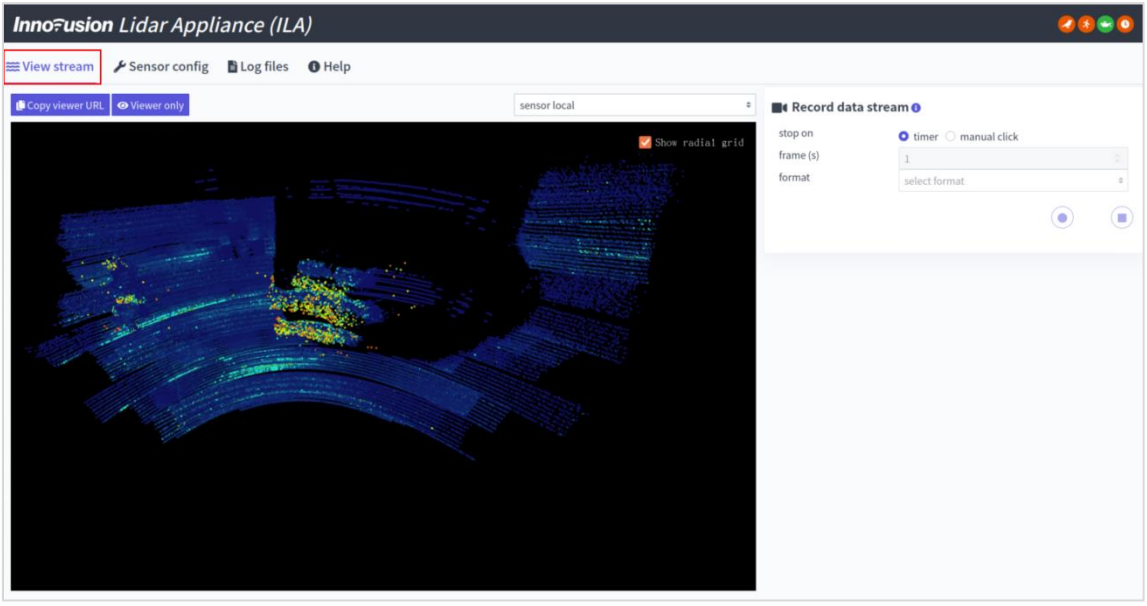
### 5.3.3 View the point cloud status of the LiDAR

Note

Before viewing the point cloud status, please ensure the computer can access to the Internet. While the latest ILA has a built-in WebGL viewer, a more feature-rich viewer is available with an Internet connection.

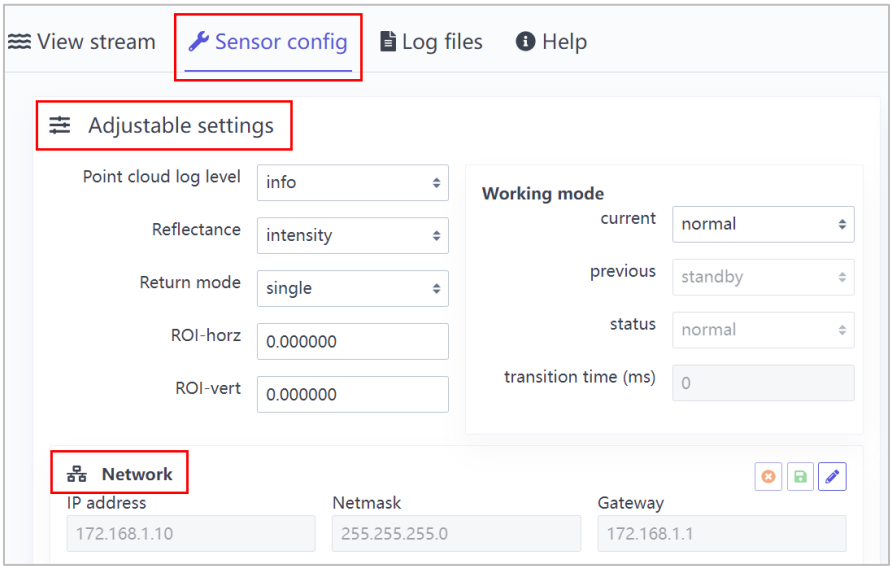
1. Directly view the status of the LiDAR point cloud in real-time on the **View Stream**.
2. (Optional) Change the viewing angle and distance in which the point cloud data is displayed using the keyboard shortcuts and mouse.

   Click **Viewer Only** to see the more detailed point cloud in a new tab.



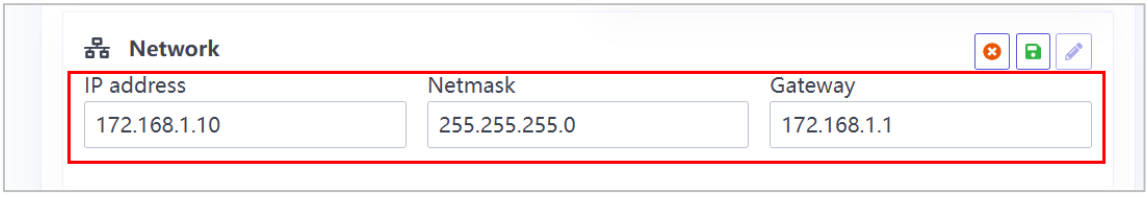
### 5.3.4 Change the LiDAR IP address

1. Go to **Sensor Config** > **Adjustable settings**.

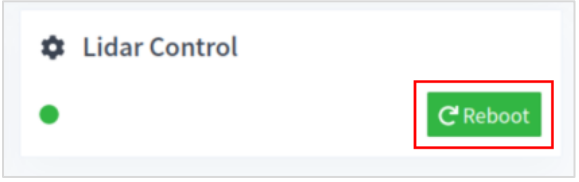



2. Click  to change the IP address, netmask address, and gateway address of the LiDAR according to user needs.

3. Click  to save the changes.




4. Click **Reboot** to reboot the LiDAR.



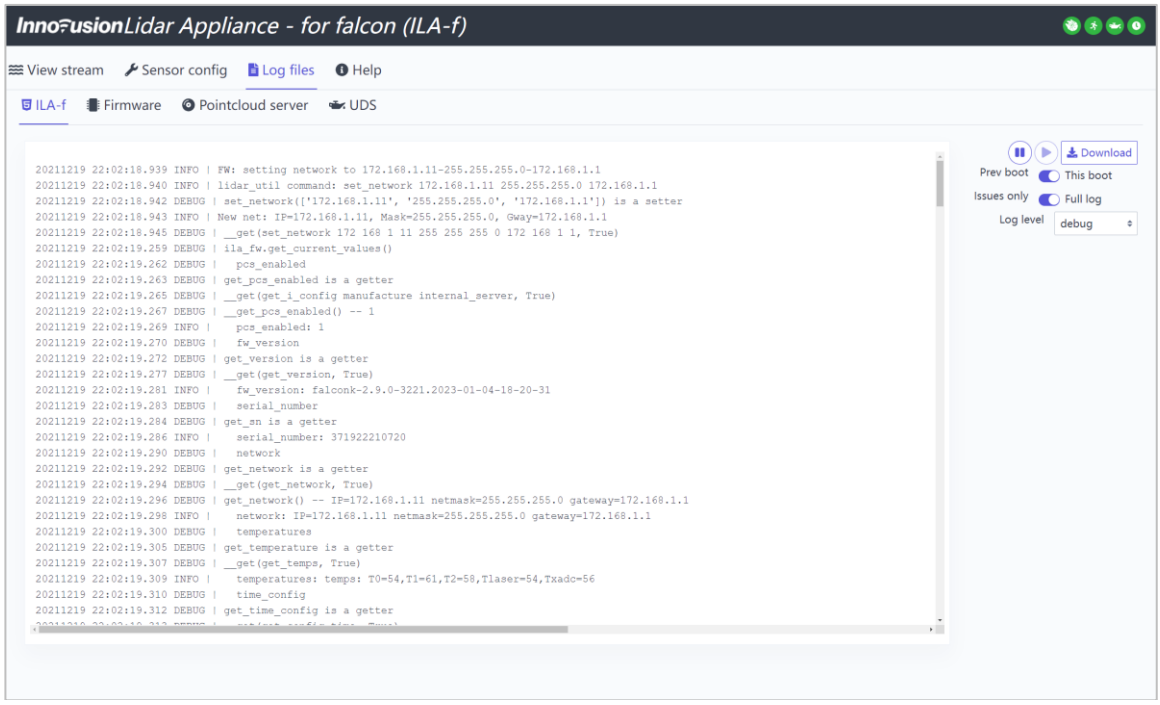

5. The IP address will be reset after rebooting. Be sure to use the new IP address when logging into the ILA.

### 5.3.5 View/download logs

You can view and download logs related to different components to confirm operations and alarm information.

1. Go to **Log File**.
2. Select the log type. There are four types of logs: **ILA-f (related to the webpage)**, **Firmware**,

**Pointcloud server,** and **UDS**.




3. (Optional) Set the filtering criteria of the logs.

   - Time range: Select **Prev boot** or **This boot** to choose whether to display the last 100 log messages generated before this boot or those generated after this boot.
   - Type of log: Select **Issues only** or **Full log** to choose whether to display only the problem or all logs.
   - Log level: Click **Log level** and select the log level to be displayed. The log level is described in the following table.

4. View logs on the left panel. Click **Download** to download the corresponding logs.

### 5.3.6 Check the LiDAR information

Check the serial number, firmware version, SDK version and other information in **Sensor Config** > **Robin values**.

### 5.3.7 Shut down the LiDAR

Disconnect the power supply to shut down the LiDAR.

# Appendix A. Upgrade the LiDAR Firmware

Note

If necessary, please contact Seyond staff to obtain the upgrade package in img format. The upgrade package includes firmware and software upgrades.

1. Connect a computer to LiDAR.
2. Obtain the upgrade package in img format and copy it to a local directory on the computer.
3. Change the computer IP address to the same subnet with the LiDAR and confirm a good Ethernet connection between them.
4. Open the Chrome browser and enter the LiDAR IP address to access LiDAR.

Note

- The default LiDAR IP address is 172.168.1.10.
- It is recommended to check the access to the LiDAR IP address via the ping command. Ensure that the computer is connected to the LiDAR network. The return value is shown in the figure below.

```
demo@demo-OMEN-by-HP-Laptop-16-b0xxx:~$ ping 172.168.1.10
PING 172.168.1.10 (172.168.1.10) 56(84) bytes of data.
64 bytes from 172.168.1.10: icmp_seq=70 ttl=64 time=0.448 ms
64 bytes from 172.168.1.10: icmp_seq=71 ttl=64 time=0.222 ms
64 bytes from 172.168.1.10: icmp_seq=72 ttl=64 time=0.200 ms
64 bytes from 172.168.1.10: icmp_seq=73 ttl=64 time=0.208 ms
64 bytes from 172.168.1.10: icmp_seq=74 ttl=64 time=0.200 ms
64 bytes from 172.168.1.10: icmp_seq=75 ttl=64 time=0.219 ms
64 bytes from 172.168.1.10: icmp_seq=76 ttl=64 time=0.255 ms
64 bytes from 172.168.1.10: icmp_seq=77 ttl=64 time=0.212 ms
64 bytes from 172.168.1.10: icmp_seq=78 ttl=64 time=0.206 ms
64 bytes from 172.168.1.10: icmp_seq=79 ttl=64 time=0.170 ms
64 bytes from 172.168.1.10: icmp_seq=80 ttl=64 time=0.207 ms
64 bytes from 172.168.1.10: icmp_seq=81 ttl=64 time=0.207 ms
64 bytes from 172.168.1.10: icmp_seq=82 ttl=64 time=0.145 ms
64 bytes from 172.168.1.10: icmp_seq=83 ttl=64 time=0.168 ms
64 bytes from 172.168.1.10: icmp_seq=84 ttl=64 time=0.316 ms
64 bytes from 172.168.1.10: icmp_seq=85 ttl=64 time=0.192 ms
64 bytes from 172.168.1.10: icmp_seq=86 ttl=64 time=0.309 ms
64 bytes from 172.168.1.10: icmp_seq=87 ttl=64 time=0.295 ms
^C
--- 172.168.1.10 ping statistics ---
87 packets transmitted, 18 received, 79% packet loss, time 88040ms
rtt min/avg/max/mdev = 0.145/0.232/0.448/0.069 ms
demo@demo-OMEN-by-HP-Laptop-16-b0xxx:~$
```

5. Click **Recovery/Update File**.


6. Click **Choose File**.
7. Select the required upgrade package in the **Open** window.

8. Click **Start Recovery/Update** to start the upgrade.
9. Power off and restart the system after the upgrade.
10. (Optional) View the version information on the **System info**.

# Appendix B. Abbreviations and terms

*Table 5 Abbreviations*

| Abbreviations | Full name |
|---|---|
| AC | Alternating Current |
| DC | Direct Current |
| ETH | Ethernet |
| FAQ | Frequently Asked Questions |
| FOV | Field of View |
| GEN | Generation |
| GND | Ground |
| GPS | Global Positioning System |
| H × W × D | Height × Width × Depth |
| IP | Internet Protocol |
| LiDAR | Light Detection and Ranging |
| MAC | Media Access Control |
| MEC | Multi-Access Edge Computing |
| NTP | Network Time Protocol |
| PD | Points of Detection |
| PPS | Pulse Per Second |
| PTP | Precision Time Protocol |
| PWR | Power |
| ROI | Region of Interest |
| ROS | Robot Operating System |
| SDK | Software Development Kit |
| SN | Serial Number |
| SW | Software |
| TCP | Transmission Control Protocol |
| TOF | Time of Flight |
| UDP | User Datagram Protocol |

*Table 6 Technical Terms*

| Terms | Definition |
|---|---|
| Class 1 laser product | Within the corresponding wavelength and emission duration, the exposure of personnel to laser radiation is not allowed to exceed Class 1 laser products that can reach the emission limit. |
| NTP | Network Time Protocol (NTP) is a protocol used to synchronize computer time. It is widely used to synchronize computers to Internet time servers, such as radio or satellite receivers or telephone modem services. |

| | |
|---|---|
| PTP | Precision Time Protocol (PTP) is a high-precision time synchronization protocol. It is used for high-precision time synchronization between devices but can also be used for frequency synchronization between devices. |
| Installer | Installers refer to those who have received professional training and have appropriate experience in the relevant field, fully understand the application of protective devices on the machine, and can assess its working safety state. |
| Commissioning personnel | Commissioning personnel have received professional training and have appropriate experience in the relevant field, fully understand the application of protective devices on the machine, and can assess its working safety state. |
| Time of flight (TOF) | The time-of-flight (TOF) calculates distance measurement by determining the elapsed time interval between transmitting and receiving signals. For the formula, see the **Principles of operation** section. |
| Laser product | Combination of any products or components used to construct or prepare for use to construct a laser or a laser system. An electronic component sold as a component to another manufacturer is not a laser product. |
| Laser | An electromagnetic radiation device that mainly generates or amplifies the wavelength in the range of 180nm ~ 1mm through a controlled laser emission process. |
| Laser equipment | A combination of laser products or laser products containing lasers. |
| Server | A computer that can directly issue operation and control commands. The server sends commands first to the slave computer, and then the slave computer controls the device according to this command. The slave computer reads the device status data from time to time, converts it into a digital signal, and feeds it back to the server. |
| Configuration personnel | The configuration personnel should have expertise and experience in the relevant field and have sufficient experience to evaluate whether the machine is in a safe operation status after using protective equipment. |
| Eye safety | Although the product design meets the Class 1 eye safety standard, to protect your safety to the greatest extent, do not use amplification equipment (such as a microscope and magnifying glass) to look at the laser light in transmission directly. |
| Service personnel | Qualified service personnel refer to those who have received professional training and have appropriate experience in the relevant field, fully understand the application of protective devices on machines, and have received the guidance of the machine operation supervisor. |
| Automotive Ethernet | Automotive Ethernet is a form of Ethernet network with a physical layer adapted to automotive use cases. |

# Appendix C. Revision history

*Revision history*

| Version number | Revised content | Revision time |
|---|---|---|
| V1.2.0 | **Update**<br>Add the ROS2 operations | 2023/11/01 |
| V1.0.1 | **Update**<br>Specifications （# Section 1.5）<br>Dimensions（# Section 2.1） | 2023/09/03 |
| V1.0 | The first draft | 2023/07/28 |