Livox Viewer

User Manual v1.0

2020.01

LIVOX LIDAR

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Using this Manual

Legend

⊘ Warning   ⚠ Important   💡 Hints and Tips   📖 Explanation

Term Definition

Direct Connection: Connect a Livox device to a computer using an Ethernet cable.

Extrinsics: Extrinsics explain how to convert the data from the local coordinate system to the world coordinate system by changing the six variables of roll, pitch, yaw, x, y, and z. Refer to the Extrinsics Calibration section for more information.

Manual Version

This user manual was created based on Livox Viewer v0.X.X. The user manual will be updated regularly. Visit the Livox official website to download the latest user manual.

Contents

Introduction

Livox Viewer

Livox Viewer is a computer software designed for Livox LiDAR sensors and Livox Hub. Users can check real-time point cloud data of all the Livox LiDAR sensors connected to a computer, and can easily view, record, and save the cloud data for offline or further use.

Supported Systems

Livox Viewer supports WINDOWS® 7/8/10 (64 bit) and UBUNTU®16.04 (64 bit).

System Requirements

No special configuration is required to use Livox Viewer. However, the point cloud data display requires a computer with compatible graphics capabilities. It is recommended to use a computer with a discrete graphics card if the point cloud data of multiple Livox LiDAR sensors need to be displayed. A better computer GPU will result in a considerably improved graphics performance.

Pre-Start Checklist

Connecting Livox LiDAR Sensor to the Computer

Make sure the Livox device is connected to a power source of 12 V. Livox Mid Series: connect Livox Mid series LiDAR sensors to a router using an Ethernet cable, and then connect the router to the computer. Other Livox products: connect the Livox device to the computer using an Ethernet cable.

⚠ • The connection methods listed above only apply to Livox devices with default IP address settings.
- Routers and switchboards are different. The Livox device may not work properly if it is connected to a switchboard.
- Make sure the Livox device is connected to a LAN port instead of a WAN port. The Livox device may not work properly if it is connected to an incorrect port.

Turning off Firewalls

There is a risk that a Livox device will be blocked by Windows firewall due to the ethernet connection. It is recommended to turn off Windows firewall to avoid the Livox device being undetected.

Configuring the IP Address of the Computer

Set the IP address mode of the computer to dynamic IP address if the computer is connected to a router. For Windows users, the computer can acquire the IP address automatically. If the computer is connected to a Livox device through a direct connection, set the IP address mode of the computer to static IP address with an IP address of 192.168.1.2, subnet mask of 255.255.0, and default gateway of 192.168.1.1.

Checking the Graphics Driver of the Computer

Make sure a compatible graphics driver has been installed on the computer before using Livox Viewer. Livox Viewer may not be able to launch or may crash during startup if the graphics driver is not correctly installed. Additionally, make sure the computer supports advanced vector extensions (AVX) 2, otherwise, Livox Viewer may not work properly (for Intel users, 5th generation CPU or later is recommended).
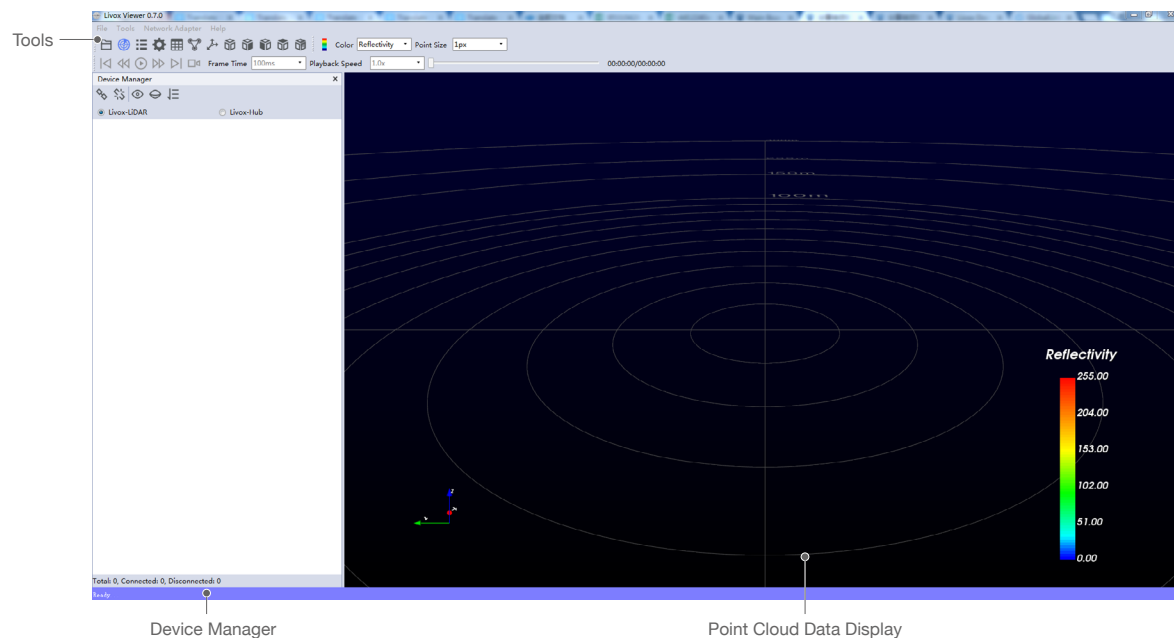
Usage

Downloading the Livox Viewer

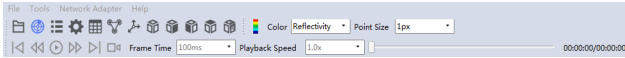Visit http://www.livoxtech.com and download the latest Livox Viewer.
• For Windows users: unzip the Livox Viewer file and click "Livox Viewer" .exe file to run the application in the unzipped folder.
• For Ubuntu users: unzip the Livox Viewer file , open the console and go to the root directory, and run the command "./livox_viewer.sh" to use the application.

Interface Introduction

Launch Livox Viewer to enter the main page. The main page of Livox Viewer can be separated into three main parts: control panel, device manager, and point cloud data display.

Control Panel

The control panel has multiple functions as described below:

⊟ : Click to open a saved point cloud data file in .lvx format.:

◉ : Display or hide the device manager.

☰ : Display or hide detailed information displayed on the device manager.

⚙ : Check and set the properties of the selected Livox device.

⊞ : Display or hide the spreadsheet to select the point cloud.

⌄ : Display or hide the extrinsic parameter tool.

⤴ : Click to display or hide the grid.

⬡ : Recenter the point cloud data display.

⬡ ⬡ ⬡ ⬡ : Click to choose the angle of view. Choose from right view, front view, top view, and back view. The angle of view can be manually adjusted using the mouse and keyboard.

a. Zoom in or out using the mouse wheel.

b. Hold the right mouse button and move the mouse to zoom in and out of the point cloud data.

c. Hold the left mouse button and move the mouse to adjust the angle of view.

d. Press "Ctrl" on the keyboard, hold the left mouse button, and move the mouse to rotate the point cloud data.

e. Press "Shift" on the keyboard, hold the left mouse button, and move the mouse to move the grid.

▌ : Display or hide the color bar. The color bar works as a reference of the point cloud data. You can set to display the color bar according to the color depth or the reflectivity.

Color: reflectivity ▾ : Click to select the coloring method for the point cloud data. Users can select a solid color or set based on LiDAR ID, reflectivity, depth, or height. Note that by default the point cloud data will be colored based on reflectivity.

Point Size 1px ▾ : Click to set the point size. Choose from 1 px, 2 px, 3 px, 4 px, and 5 px.

Frame Time 100ms ▾ : Click to set the frame time. Choose from 50, 100, 200, 500, 1000, and 3000 ms. The longer the frame time is, the denser the point cloud data will be.

Playback Speed 4.0x ▾ : Click to set the frame speed. Choose from x0.5, x1.0, x2.0, and x4.0 (only available when running a recorded .lvx file).

⎯⎯⎯ 00:00:00/00:00:00 : Drag to adjust the time of the saved point cloud data file (only available when running a recorded .lvx file).

⧎ ⧏ ⊙ ⧐ ⧑ ⎙ : Viewer controls:

◁ : Click to rewind to the beginning (not available when checking real-time point cloud data).

◀◀ : Click to rewind by one frame (not available when checking real-time point cloud data).

⊙ : Click to play or pause.

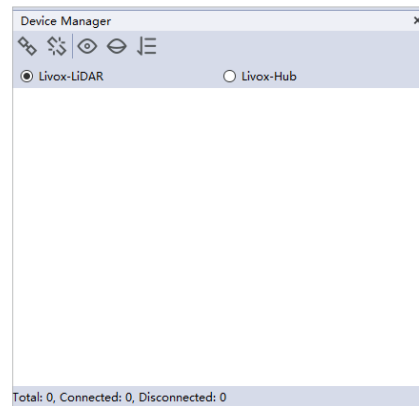▷▷ : Click to fast forward by one frame (not available when checking real-time point cloud data).

▷| : Click to fast forward to the end (not available when checking real-time point cloud data).

☐◁ : Click to record. When one or more Livox LiDAR sensors are connected, click to start recording the live data. Click again to stop recording.

⚠ : Click to display/hide information center (coming soon).

Device Manager

Click File -> Open -> Open Device Manager or click ⊕ to open the device manager. The device manager is shown as below:

Icons Description:

✎ : Connect all devices.

✁ : Disconnect all devices.

◉ : Display the point cloud data of all connected LiDAR sensors.

⊖ : Hide the point cloud data of all connected LiDAR sensors.

Note: the ◉ ⊖ icons can only display or hide the point cloud data displayed in Livox Viewer. They will not affect the states of LiDAR sensors.

○ Lidar ○ Hub : Select the type of device you would like to check. Note: Connecting Livox Hub and Livox LiDAR sensors simultaneously to Livox Viewer is not supported.

If Livox Viewer detects connected devices, the device information will be displayed in the device manager.
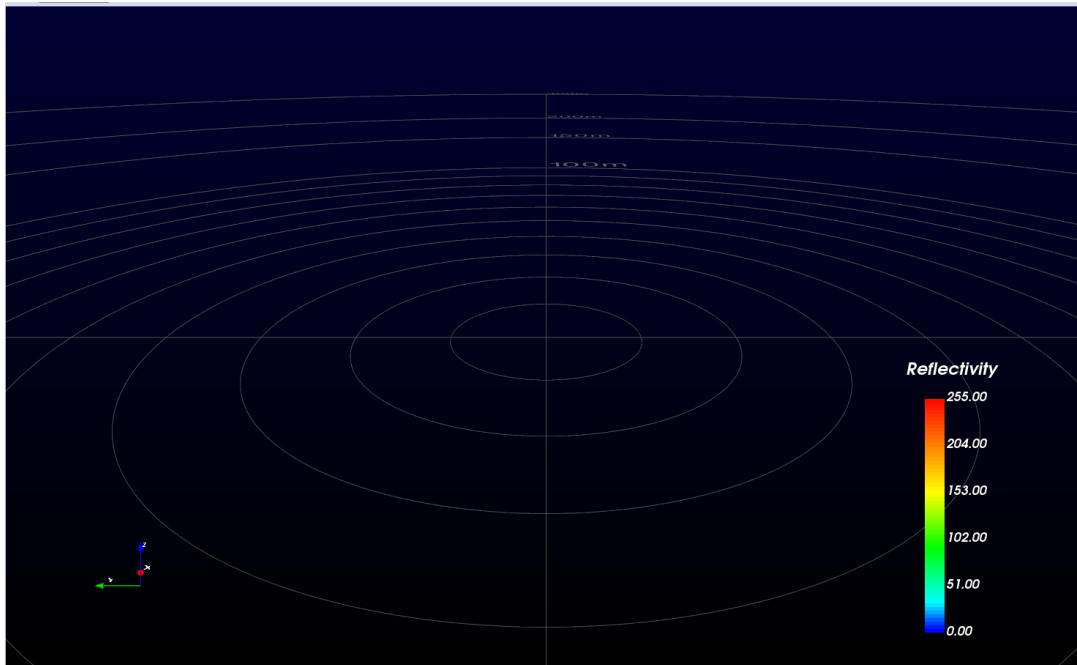
⊙ 1LVDFBC00401731	Mid-40	⬤ ⌄
⊙ 1LVDFBC00401732	Mid-40	⬤ ⌄
⊙ 1LVDFBC00401733	Mid-40	⬤ ⌄

⌄ : Check the working states. When in error state, users can check the status codes.

⊙ : Display or hide the point cloud data of the selected Livox device.

⬤ : Click to connect or disconnect the selected Livox device.

Point Cloud Data Display

After the Livox device is connected to Livox Viewer and begins to run, the point could data will be displayed. In the lower left corner are the reference coordinates. In the lower right corner is the reflectivity bar, which shows the reflectivity of the target object.
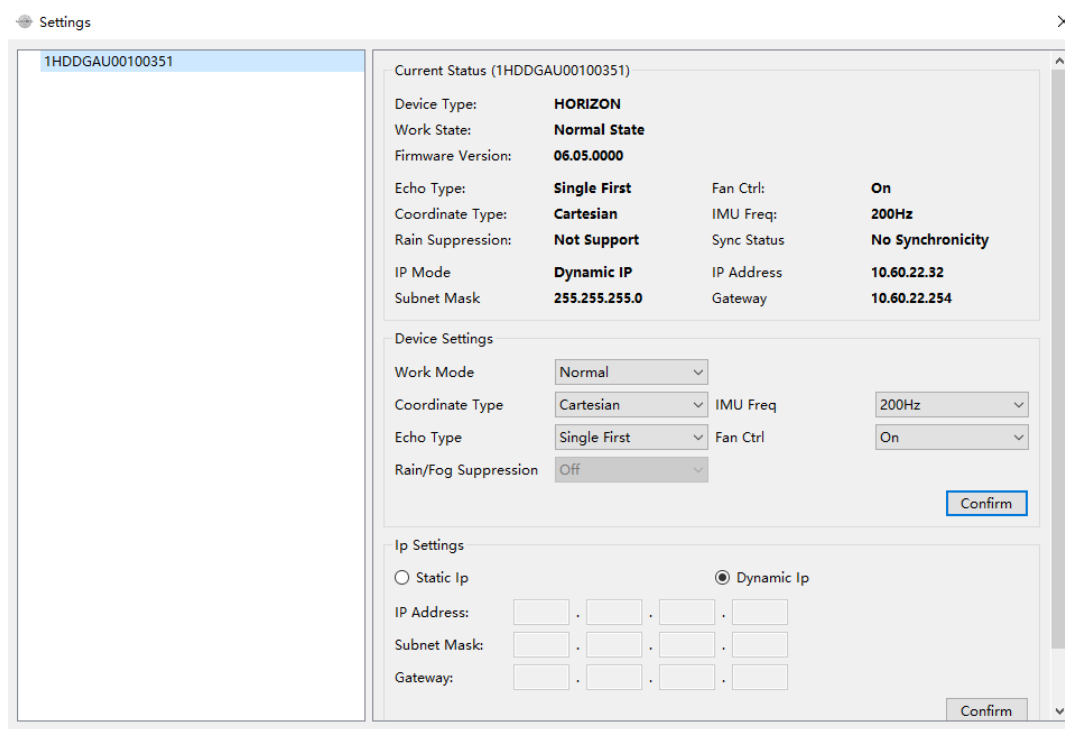
Common Functions

The common functions of Livox Viewer will be described in this section. 3.3.1 Checking Real-Time Point Cloud Data

1. Connect the Livox device and run Livox Viewer. Select a device by clicking it in the device manager. Click ⚲ or ⬯ to connect.
2. After connecting, click ⊙ to view the point cloud data of the selected device.
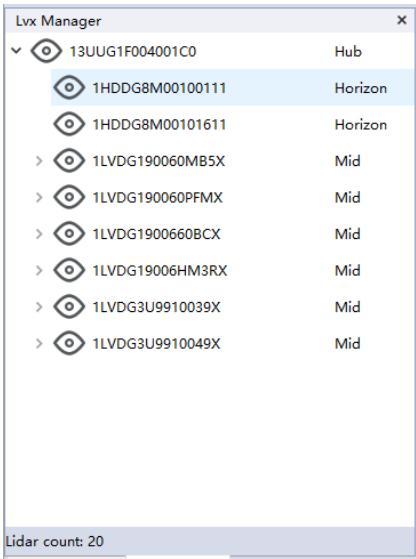3. Click ☐◁ to start or stop recording while displaying the point cloud data.

Configuring Parameters of the Device

After the Livox device is connected, click ✿ in the control panel to open the settings. The status of the selected device can be checked and the parameters can be set.

Displaying Saved Point Cloud Data

Click File -> Open -> Open file or click 🗁 to open the saved files in .lvx format. The Lvx Manager window will appear if the file is opened successfully.
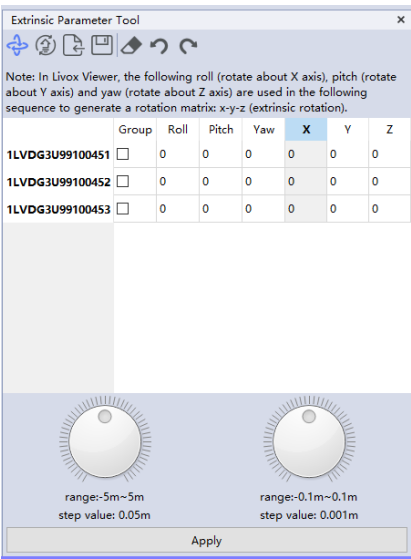

👁 : Click to hide or display the point cloud data of the selected device.

When viewing saved point cloud data, you can use the tools introduced in the Control Panel section to control the playback of the recording.

⚠ •While viewing saved point cloud data, you can choose to save any part of the recording as a new .lvx format file.

Extrinsics Calibration

Click 🌣 to open the extrinsic parameter tool:

Icons Description:

🌣 : Click to start or stop extrinsics calibration.

Note: Before starting extrinsics calibration, make sure that the Livox device is connected and has been running for a few seconds. Otherwise, the extrinsics calibration cannot be activated.

⟳ : Click to import external extrinsics from the connected device and refresh current point cloud data.

⮩ : Click to import external extrinsics from a file and refresh current point cloud data.

💾 : Click to save current extrinsics.

◆: Reset the input numbers to zero.

↺ : Undo last step.

↻ : Redo last step.

How to Calibrate Extrinsics

1. Connect a Livox device and allow it to run for a few seconds. Click ⛎ to enter the extrinsic parameter tool page.

2. Click ⚙ to start extrinsics calibration. If extrinsics calibration is activated, the point cloud data will be white and a table will appear with the broadcast codes and the extrinsics of the Livox devices currently running.

3. Select one or more coordinates in the same column, and the point cloud data of the selected device will be red. Note that coordinates from different columns cannot be adjusted at the same time. Type in a number or use the wheel icons below to adjust the selected coordinates. The real-time point cloud data will be updated immediately after the coordinates are adjusted.

    Note: The wheel icons below are used to adjust the coordinates roughly or accurately.

4. Click Apply to confirm the new coordinates. The new coordinates will be updated in Livox Viewer and on the Livox device.

    Note: The new coordinates will only be effective after you click Apply. If you do not click Apply, the extrinsics of the Livox device will revert to the original extrinsics as before after you leave the calibration mode.

5. Click ⚙ to disable the extrinsics calibration tool and to continue point cloud data sampling.

How to Calculate Extrinsics

Tait-Bryan extrinsic rotations in a sequence of x-y-z are used to describe the orientation of Livox's point cloud data. The point cloud data first rotates around the x-axis (roll), then around the y-axis (pitch), and finally around the z-axis (yaw).
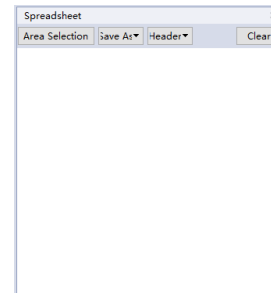
The matrix of rotation can be presented as below:

$$M = \underbrace{\begin{bmatrix} \cos\theta_z & -\sin\theta_z & 0 \\ \sin\theta_z & \cos\theta_z & 0 \\ 0 & 0 & 1 \end{bmatrix}}_{R_z(\theta_z)} \underbrace{\begin{bmatrix} \cos\theta_y & 0 & \sin\theta_y \\ 0 & 1 & 0 \\ -\sin\theta_y & 0 & \cos\theta_y \end{bmatrix}}_{R_y(\theta_y)} \underbrace{\begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta_x & -\sin\theta_x \\ 0 & \sin\theta_x & \cos\theta_x \end{bmatrix}}_{R_x(\theta_x)}$$
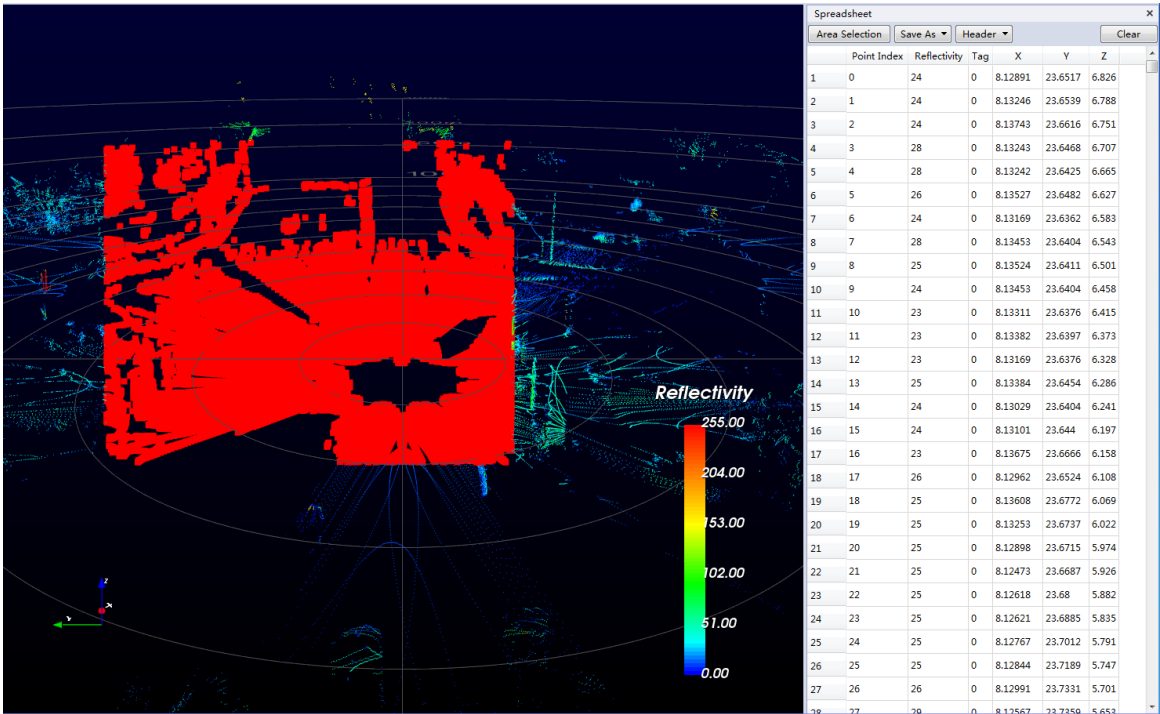
After the point cloud data is rotated by the above matrix, the translation can be performed on the x-y-z axis to complete the calculation of the extrinsic.

Selecting and Checking Point Cloud Data

Click ▦ on tools to open the spreadsheet:

Area Selection: Click Area Selection and move the mouse to the point cloud data display. Left click while using the cross cursor to select an area. The selected area will be red and detailed information about this area will be displayed in the spreadsheet.

Save As: Save the data of the selected area in .csv or .las format.

Header: Select which information to display.

Clear: Clear current selected area.

Firmware Update

Click Tools -> Firmware Upgrade to enter the firmware upgrade page, and then follow the steps below to update your Livox device:

1. Select Upgrade Mode:

    a. Upgrade LiDAR without Livox Hub: Update Livox LiDAR sensors not connected to a Livox Hub.

    b. Upgrade LiDAR through Livox Hub: Update Livox LiDAR sensors connected to a Livox Hub.

    c. Upgrade Livox Hub: Update Livox Hub.

2. Click "…" to select the firmware saved on your computer, or click "Download" to download the firmware from the Livox official website.

3. Select the Livox device you wish to update and click "Start Upgrade" to update the firmware of the selected Livox device.

4. Click Back to return to main page after the update is complete.

Additional Functions

Livox Viewer has other complementary functions listed below:

a. Save as: Point cloud data can be saved in .csv or .las format. Click File -> Save As to save the point cloud data.

b. Grid Property: Users can customize the grid on the point cloud data display. Click Tools -> Grid Property to set the properties of the grid.

c. File Converter: Users can convert a .lvx file into a .las or .csv file using Livox Viewer. Click Tool -> File Converter to convert a file.

d. Device Reset: Users are allowed to reset the IP address of a Livox device without connecting the device to the computer. Click Tools -> Reset Tool to reset the IP address. When resetting the IP address, click Search and wait a while. Devices that can be reset will be displayed in the column on the left. Select the Livox device whose IP address you wish to reset and click Reset. The selected device will appear in the right column.

⚠ • Before resetting the IP address, check the broadcast number of the selected device. Otherwise, other devices may be reset accidentally. Meanwhile, make sure that the Livox device and the computer running Livox Viewer are connected to the same subnetwork or the Livox device is connected to the computer directly. Otherwise, the IP address of the selected device cannot be reset.