

# **StarROS**

## **User Manual**

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Surestar Technology Corporation

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# StarROS User Guide

## 1 Prelude

StarROS is the software designed for Surestar navigation LiDAR to make data analysis and display point cloud. Users shall have a basic understanding of Linux system and ROS (Robot Operating System). This user manual provides introduction of features, scopes of use, procedures of installation and operation, parameters set-up and how to use RVIZ in ROS to display point cloud.

## 2 Brief Introduction

StarROS receives and analyzes LiDAR data, publish and displays real-time point clouds through RVIZ display. At present, autonomous driving generally chooses the ROS system for development (or the systems based on ROS). Through StarROS, point cloud can be released in real time and reliable for other programs to subscribe to fulfill environment perception, positioning and obstacle avoidance in automatic driving.

Features:

- RVIZ can display stable point cloud data in real time
- The published point cloud data can be reliably used by developers and the format is fit for users's needs;
- The ROS system is open source and has many algorithms to facilitate users' further development;
- Point cloud with outputting a specific data structure is convenient for users to develop perception functions for robots, autonomous driving and SLAM.

## 3 Software Installation Requirements:

- Operating System: 16.04 (ros kinetic)
- RAM:  $\geq 4\text{GB}$
- The default PC IP address is 192.168.0.xxx, with a subnet mask of 255.255.255.0.(Same as the IP address of the sensor)

## 4 Code Compilation & Operation

### 4.1 ROS Driver Source Code Compilation

Click to open the terminal and create ROS working directory: `mkdir -p ~ / ros_ws / src`

Initialize ROS workspace: `cd ~ / ros_ws / src→catkin_init_workspace`

Unzip StarROS\_vX.X.X.zip to get a folder named StarROS\_vX.X.X. Copy the StarROS in this folder to the directory of `~ / ros_ws / src` directory  
Install dependent libpcap library: `sudo apt-get install libpcap-dev`  
Compile: `cd ~ / ros_ws catkin_make`

## Start the Sensor

Enter the `ros_ws` directory and set workspace:

```
cd ~ / ros_ws
```

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

Run StarROS:

```
roslaunch rfans_driver node_manager.launch
```

## 4.2 RVIZ Display Point Cloud

Start RVIZ

Open a new terminal(interface): `rviz`

Load the RVIZ configuration file: Click the Open Config button (Ctrl + O) in the File option of the RVIZ menu bar to load `StarROS_Rviz_cfg.rviz` under `ros_ws / src / StarROS`

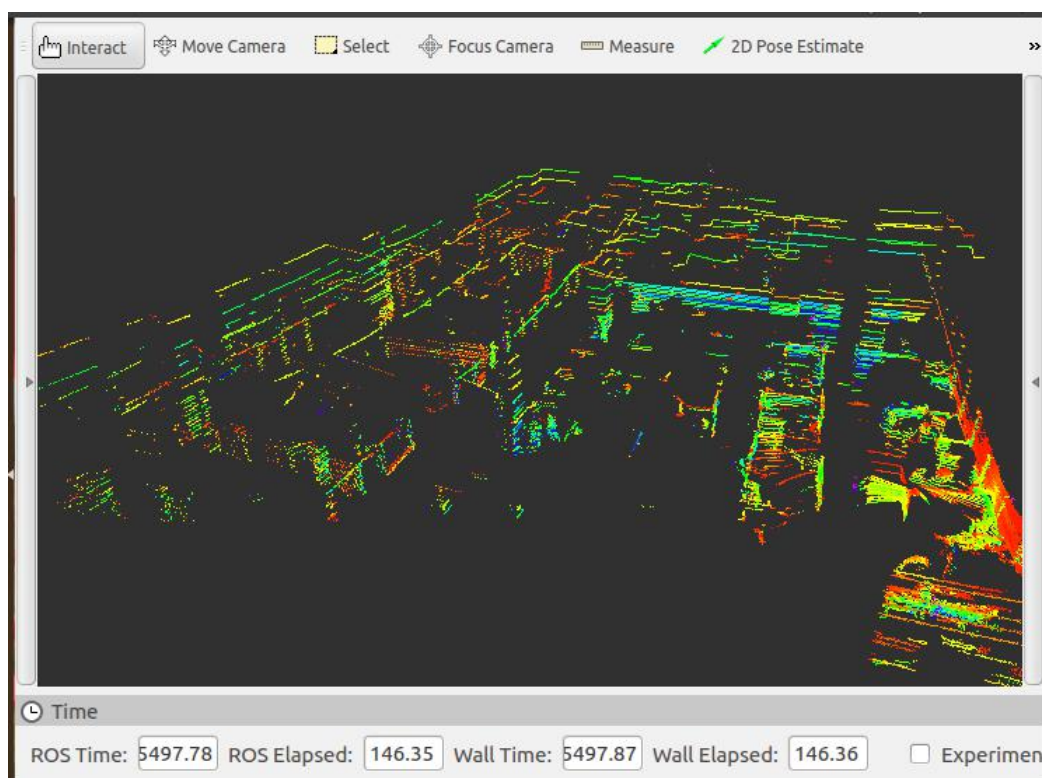


Figure 1 Point Cloud Display

## 5 Functions

## 5.1 Dynamic Parameter Configuration

All parameters are dynamically configured through ROS Dynamic Reconfigure. The parameters are as following,

- Min\_range - Minimum distance value of point cloud output
- Max\_range - Maximum distance value of point cloud output
- Min\_angle - Minimum angle value of point cloud output
- Max\_angle - Maximum angle value of point cloud output
- Use laserSelection - Enable laser channel selection function
- Enable laser use after the channel selection function: select the corresponding laser channel number (R-Fans-32 sensor parameter value is 0-31, R-Fans-16 sensor parameter value is 0-15)

Steps:

After running node\_manager.launch, open a new terminal and execute `roslaunch rqt_reconfigure rqt_reconfigure`, select the node in the left function box, and enter the dynamic configuration parameter interface.

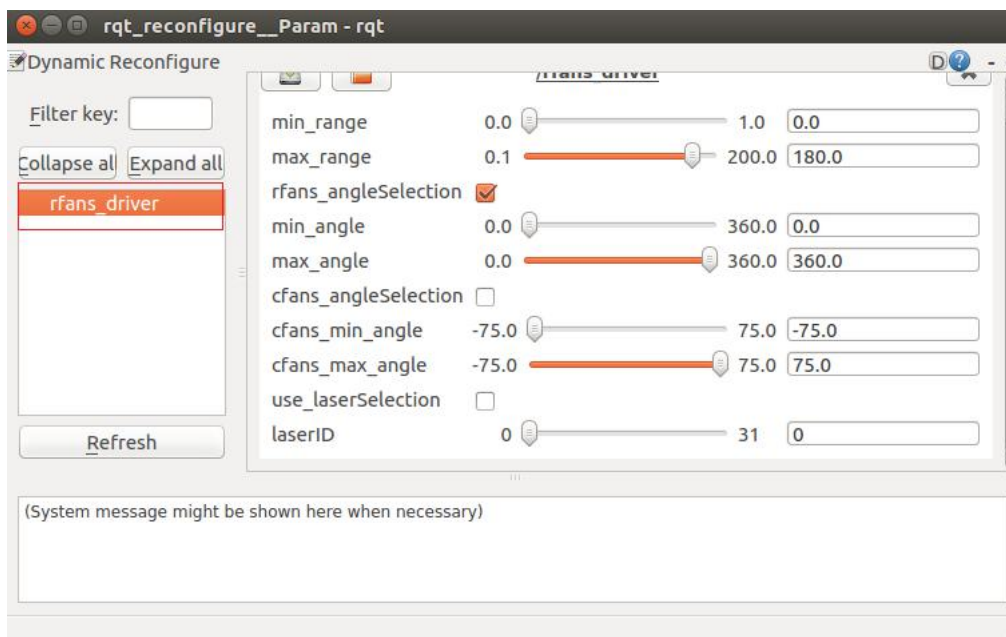


Figure 2 Dynamic Reconfigure Interface

## 5.2 Time Synchronization

GPS time is used to time the sensor, and the point cloud timestamp is synchronized with the sensor. Time synchronization function requires R-Fans to receive GPRMC data and PPS signals through the serial port.

Steps:

Enter the ros\_ws directory and set workspace:

```
cd ~ / ros_ws
```

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

Open the launch file: `roslaunch rfans_driver node_manager.launch`

Change the value of use\_gps parameter to "true" (default value is "false")

```
7 <param name="subscribe_name" value="rfans_packets" />
8 <param name="use_gps" value="true"/>
9 <param name="angle_duration" value="360" />
```

Figure3 use\_gps parameter setup

Exit the compiler to run the launch file

## 5.3 Data Storage and Playback

### 5.3.1 Pcap Interception and Preservation

Install wireshark: `sudo apt-get install wireshark`

Start wireshark: `sudo wireshark`

Wireshark configuration:

Steps to follow:

1<sup>st</sup> step:

Select eth0 in the first step: (Make sure R-Fans is connected to the computer and the sensor and PC are on the same network IP address)

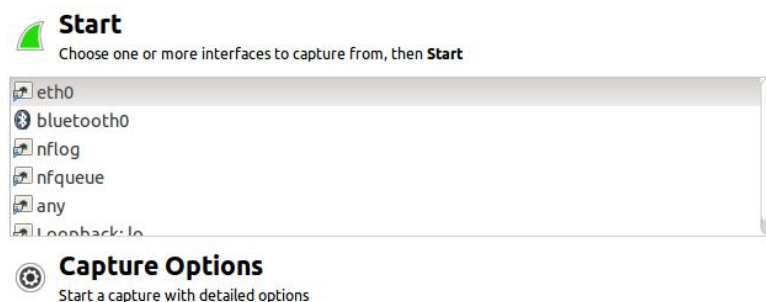


Figure 4 eth0 demonstration

2<sup>nd</sup> Step:

Filter the udp data of a specific port number.



Figure 5 Designated port

3<sup>rd</sup> Step:

Click "start a new live capture" in the upper left corner to start recording data, it takes 2-3 minutes.



Figure 6 "Start a new live capture" icon

#### 4<sup>th</sup> Step:

Click the "stop the running live capture" in the upper left corner (which is on the right side of the "start a new live capture") to stop data recording. Click File - > save as and name the file, such as "181016", select second item in File type.

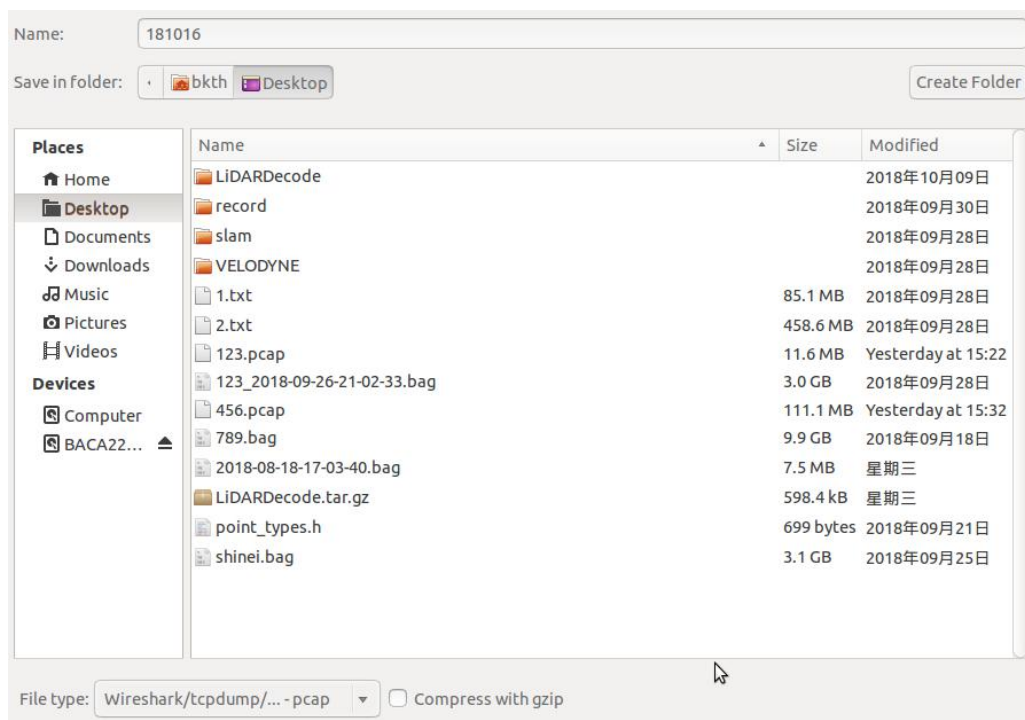


Figure 7 Save pcap file

Click "save" button, save this pcap file on the desktop as 181016.pcap.

#### 5.3.2 Isf File Broadcast

Enter ros\_ws catalogue and set workspace:

```
cd ~/ros_ws
```

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

Open launch file:

```
roslaunch rfans_driver node_manager.launch
```

Change the parameter value of readfile\_path to the absolute path of isf file.

Change the parameter value of model to corresponding sensor. (Types: R-Fans-32 or R-Fans-16, set according to the specific model)

```
<param name="readfile_path" value="" />
<!-- <param name="readfile_path" value="/home/bkth/qt_ws/src/StarROS/usr/date/Cfan32/data-20200102-142559-29.000.isf"/>-->
```

Figure 8 Model parameter

Start "launch" file :

```
roslaunch rfans_driver node_manager.launch
```

Launch RVIZ:

Create a terminal: rviz

Note:

- When reconnecting the sensor, set the value of the readfile\_path to "null" so the real-time point cloud can be displayed.
- Operation of playback of isf files is the same as that of isf file playback.
- Isf file can read directly without sensor connection. It is same as offline playback.

## 5.4 Display of Point Clouds of Multiple Sensors

### 5.4.1 Modify the IP address and port of sensor

Take two sensors as an example ( StarROS supports display of multiple sensors). To avoid the conflicts of different IP of each sensor, please use CtrlView to modify the IP address and Data port of one of the sensors (For example, change IP address to 192.168.0.4 and Data Port to 2016) .

Change the value of "device\_IP" of ns2 in "multi\_lidar.launch" to "192.168.0.4" and the device port's value to "2016".

### 5.4.2 Browse Point Cloud

```
cd ~/ros_ws
```

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

```
roslaunch rfans_driver multi_lidar.launch
```

Note: Name of topic at this time is "/ns1/rfans\_driver/rfans\_points" and "/ns2/rfans\_driver/rfans\_points".

Launch RVIZ:

Create a terminal and input RVIZ

Click "Add" button at the left bottom of RVIZ, select "By topic" and load "/ns1/rfans\_driver/rfans\_points" and "/ns2/rfans\_driver/rfans\_points" respectively.



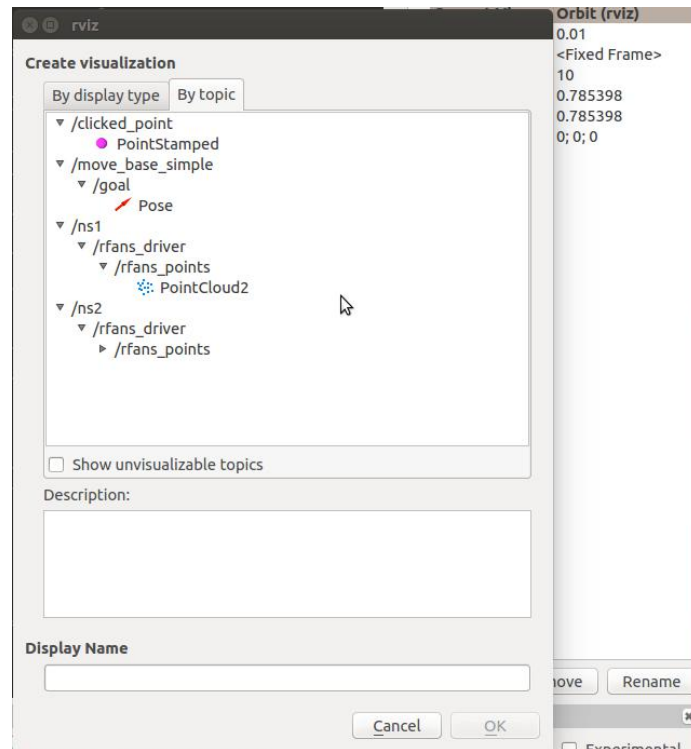


Figure 9 Load topic

## 5.5 Control Interface of Sensor

Through the interface, users can modify the rotate speed and echo mode of sensor in real time. Rotate speed and single-dual-echo mode will come back to that of the default setting when the sensor is power off.

Create a new terminal to initialize the workspace in the `ros_ws` directory after starts the sensor.

```
cd ~/ros_ws
```

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

Start RVIZ:

Load RVIZ configuration file:

Click Open Config button (Ctrl+O) in the File options in the RVIZ menu bar and load the `StarROS_Rviz_cfg.rviz` in the `ros_ws/src/StarROS`.

Loading control interface in RVIZ:

Click Add New Panel button in the Panels options in the RVIZ menu bar, please refer to the Figure 10.

Select the option of TeleopPanel, please refer to the Figure 11.

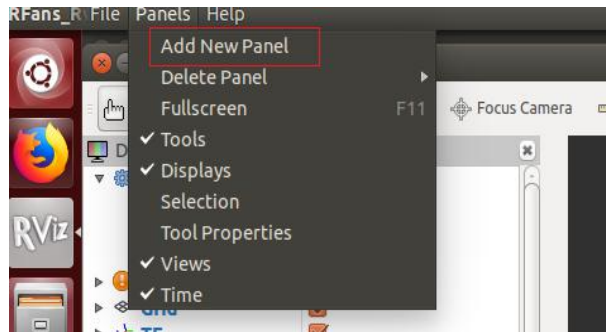


Figure10 Add New Panel

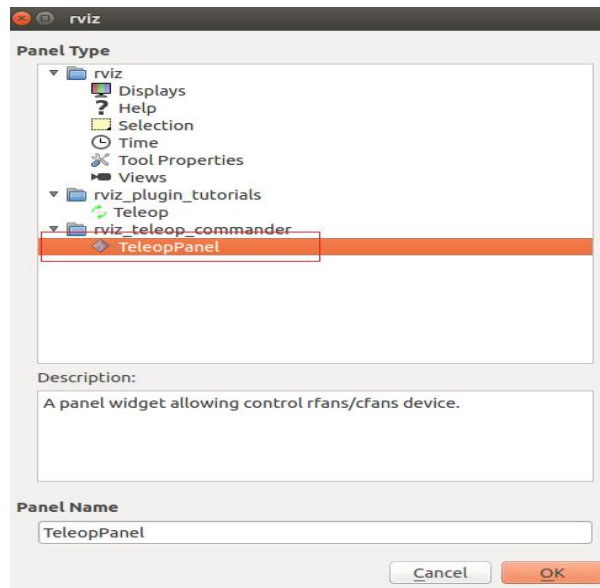


Figure 11 Select control panel of sensor

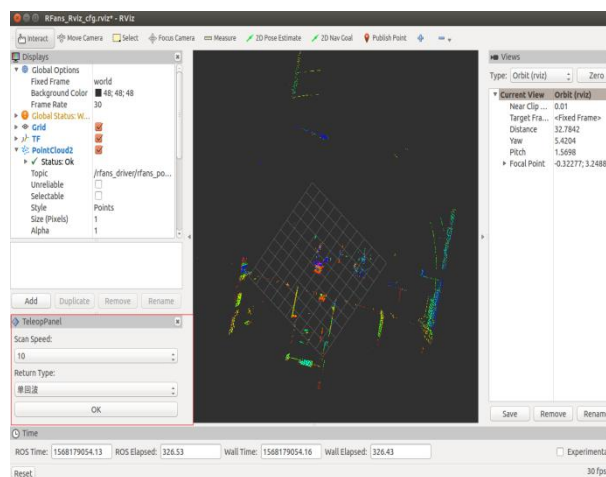


Figure12 Control interface of sensor

## 6 Parameter Configuration and Illustration

```

<?xml version="1.0"?>
<launch>
<arg name="read_fast" default="false" />
<arg name="read_once" default="false" />
<arg name="repeat_delay" default="0.0" />
<param name="model" value="R-Fans-32" /> <!-- R-Fans-32 R-Fans-16 C-Fans-128 C-Fans-32 -->
<node pkg="rfans_driver" type="driver_node" name="rfans_driver" output="screen">
  <param name="advertise_name" value="rfans_packets" />
  <param name="control_name" value="rfans_control" />
  <param name="device_ip" value="192.168.0.3" />
  <param name="device_port" value="2014" />
  <param name="rps" value="10"/>
  <param name="readfile_path" value=""/>
  <!-- <param name="readfile_path" value="/home/bkth/qt_ws/src/StarROS/uxr/date/Cfan32/data-20200102-142559-29.000.isf"/>-->
  <param name="cfg_path" value=""/>
  <!-- <param name="cfg_path" value="/home/bkth/qt_ws/src/StarROS/uxr/date/Cfan32/revise.ini"/>-->
  <param name="save_xyz" value="false"/>
  <param name="OutExport_path" value=""/>
  <!-- <param name="OutExport_path" value="/home/bkth/qt_ws/src/StarROS/uxr/date"/>-->
  <param name="use_double_echo" value="false"/> <!-- Whether to use use_double_echo -->
  <param name="use_gps" value="false"/>
  <param name="read_fast" value="$(arg read_fast)" />
  <param name="read_once" value="$(arg read_once)" />
  <param name="repeat_delay" value="$(arg repeat_delay)" />
  <param name="cut_angle_range" value="360.0"/>
</node>
</launch>

```

Figure 13 Parameters in node\_manager.launch

The parameters in the node are defined as follows:

Table 1 Parameter definition in the node

Parameter name	Explanation
Read_fast	For playing back files. Set to "true" to accelerate the playback mode, and set to "false" to play back the file in normal speed.
Read_once	For playing back files. Indicate whether the file is played only once. Default value is "false", function as loop playback.
Repeat_delay	For playback of a file. Play a file after a delay and then play it again.
Model	For playback of pcap/isf files, the sensor defaults as "R-Fans-32". If the sensor is R-Fan-16, set the value of the model to "F-Fans-16"; If the sensor is R-Fan-32, the value of the model is set to "R-Fans-32"; If the sensor is C-Fans-128, the value of the model is set to "C-Fans-128".
Advertise_name	The name of topic publishing of R-Fans_driver. The default value is "R-Fans_packets".
Control_name	The name of service publishing of R-Fans_driver. The default value is "R-Fans_control".
Device_ip	IP address of the sensor and its default address is 192.168.0.3.
Device_port	Point clouds port of Lidar sensor and its default one is 2014.
Rps	It means the rotate speed/second of LiDAR motor. R-Fans' rotate speed can be set to 0/5/10/20; C-fans' rotate speed can be set to 0/20/40/80
Readfile_path	File path of play back of pcap or isf. If it is "null", it indicates a real-time connection to the sensor.
Cfg_path	The file path of revise.ini when using C-Fans or its data.
Save_xyz	Default value is "False". If it is "true", it means to save the xyz file.
OutExport_path	Path of xyz file storage
Use_double_ech	Whether to use the dual echo mode.

0	
Use_gps	Whether the timestamp of the published point cloud uses GPS time or not. The system time will be used if the value is "False".

## 7 Attention

- When starting multiple sensors, ensure to modify the IP address and Port of the sensor and parameter information in "multi\_lidar.launch" to avoid conflicts.
- Make sure to load the "revise.ini" file when using the C-Fans sensor or its data.

## 8 Our contact

Company Name: SureStar Technology Corporation  
 Address: 1-502, 5 Yongfeng Rd, 100094  
 Tel: 010-58711158  
 Fax: 010-58711158, 58717175, 58717176, 58717178  
 E-mail: bkth@isurestar.com  
 Website: www.isurestar.com