Hokuyo UST-20LX

By : N Sai Pranay Kumar

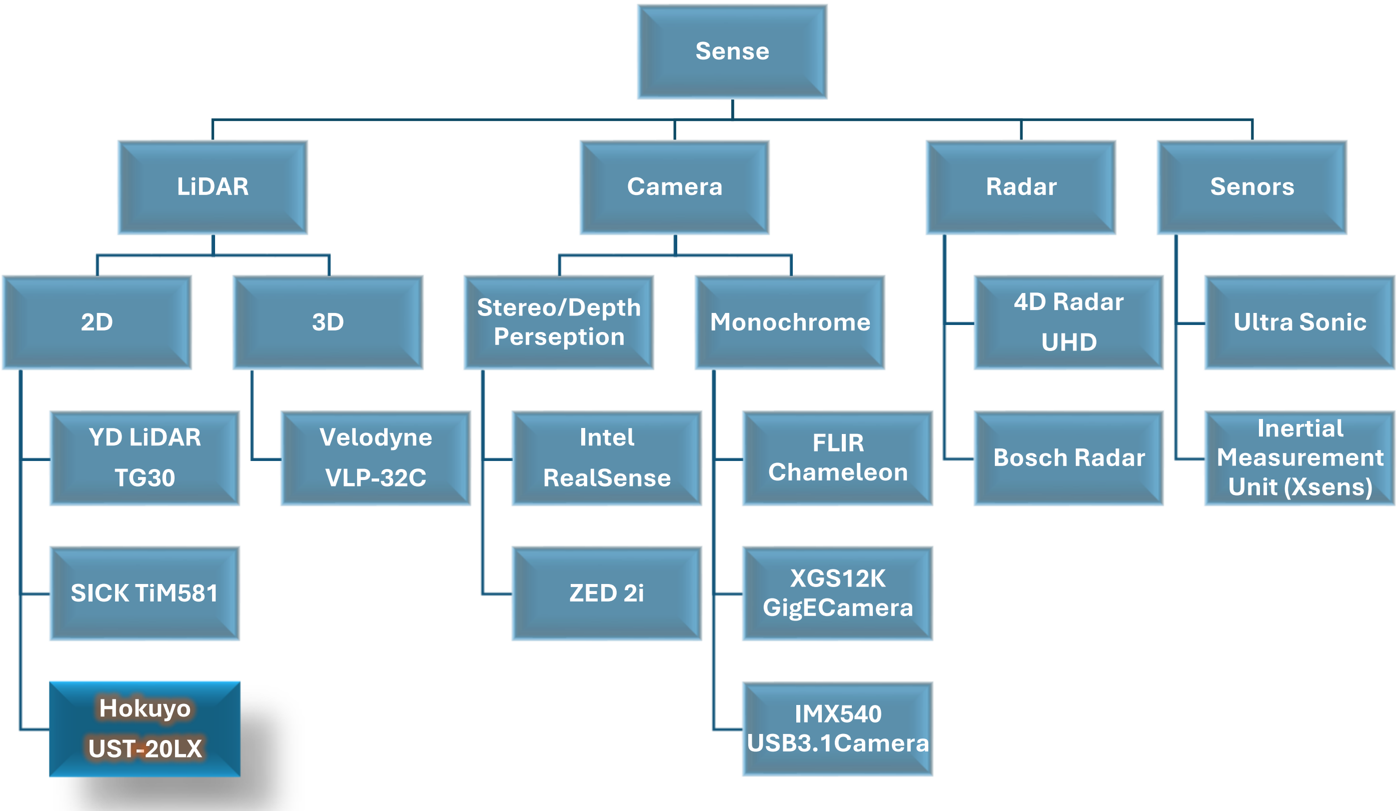
Version : 1

Version Control

Version	Summary	Created by	Reviewed by	Date
1	Starter Guide for Hokuyo UST-20LX	N Sai Pranay Kumar	G Nithish Chandra Reddy	

Contents

Sense Segment



I. Introduction to LiDAR

LiDAR (Light Detection and Ranging) is a remote sensing technology that uses laser light to measure distances. By emitting laser pulses and measuring the time it takes for the light to return after hitting an object, LiDAR can create precise, high-resolution 3D maps of the environment.

History of LiDAR

LiDAR technology has its roots in the 1960s, developed shortly after the invention of the laser. Initially, it was used for meteorological purposes, such as measuring atmospheric particles. Over the decades, advances in technology and computing power have significantly expanded LiDAR's applications, making it a crucial tool in geology, forestry, and, more recently, autonomous vehicles and robotics.

Types of LiDARs

2D LiDAR:

This type of LiDAR scans in a single plane, creating a two-dimensional map of the surroundings. It's commonly used in applications where a flat representation is sufficient, such as in industrial automation settings or simple obstacle detection systems.

3D LiDAR:

By rotating or using multiple beams, 3D LiDAR captures data in multiple planes, resulting in a three-dimensional map of the environment. This type of LiDAR is essential for more complex applications requiring a comprehensive spatial understanding, such as autonomous driving, advanced robotics, and detailed topographical mapping.

Applications of LiDAR

1. **Autonomous Vehicles:** LiDAR is critical in self-driving cars, providing detailed 3D maps that help the vehicle navigate and avoid obstacles.
2. **Geospatial Mapping:** Used for creating high-resolution topographic maps, LiDAR helps in urban planning, flood modeling, and forestry management.
3. **Archaeology:** LiDAR can penetrate forest canopies to reveal hidden structures and landscapes, aiding in archaeological discoveries.
4. **Environmental Monitoring:** It helps in tracking changes in vegetation, coastline erosion, and other environmental changes over time.
5. **Agriculture:** Precision farming uses LiDAR for crop assessment, field mapping, and soil analysis.
6. **Infrastructure Inspection:** LiDAR is used to inspect power lines, bridges, and other infrastructure for maintenance and safety assessments.

LiDAR's ability to produce accurate and high-resolution data quickly makes it invaluable across various industries, driving innovation and efficiency in multiple fields.

II. Hokuyo UST-20LX Introduction

Product Overview :

The Hokuyo UST-20LX scanning laser rangefinder is a small, accurate, high-speed device for obstacle detection and localization of autonomous robots and automated material handling systems. This model uses an Ethernet interface for communication and can obtain measurement data in a wide field of view up to a distance of 20 meters with a millimeter resolution. Due to its low power consumption, this scanner can be used on battery-operated platforms.

Specifications :

- Range : 0.06m to 20m
- Scan Angle : 270°
- Scan Speed : 25ms (motor speed, 2400 RPM)
- Accuracy : ±40mm
- Angular Resolution : 0.25°
- Operating Voltage : DC 12 V - 24 V

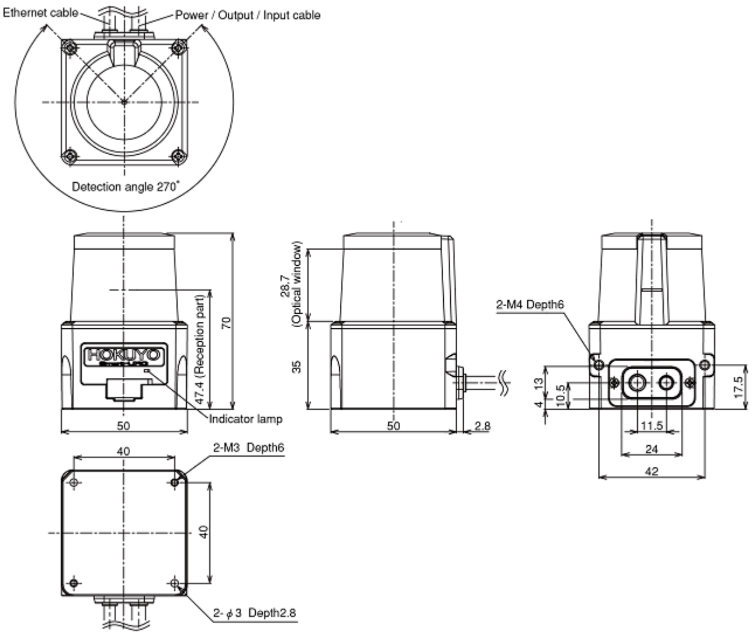


Figure 1 Hokuyo LiDAR External Dimensions

Official Website : https://www.hokuyo-aut.jp/search/single.php?serial=167

III. Prerequisites

Linux Version : Ubuntu 20.04 and before versions

Ubuntu Installation : https://robocademy.com/2020/05/17/best-4-ways-to-install-ubuntu-for-ros/

YouTube Link : https://youtu.be/mXyN1aJYefc?si=XJbUZmC5jgrDRQQF (Dual Boot)

ROS : Noetic and before versions

ROS Installation : https://wiki.ros.org/noetic/Installation/Ubuntu (noetic version)

Complete ROS tutorials to get familiar with ROS.

https://robodev.blog/series/ros101 (ROS Basics)

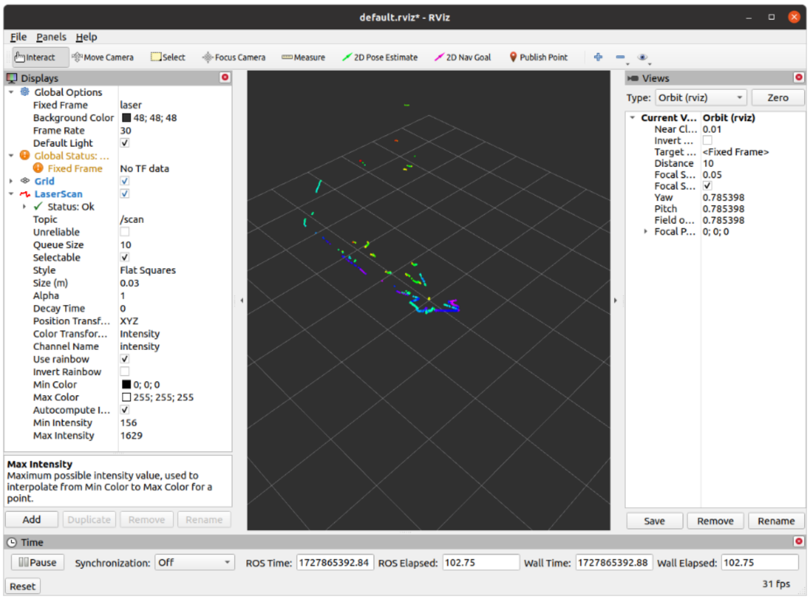
Before moving to the Hardware interface execute the .bag file and visualize the data… from the following link

Activity :

Dataset : https://drive.google.com/drive/folders/1mP5sizC77ARcK9fO5BmCwU82d5yzVs6Y?usp=sharing

- Instead of recording a .bag file. First, visualize the data with the bag file by following the steps.

Sample Output :



Note

- To uninstall Ubuntu (Dual Boot) - https://youtu.be/mQyxtWrUNlE?si=3eXOnEqIGjViTH0D
- If you face a Grub Screen Issue - https://youtu.be/ih2NjlhLLic?si=TEpkIDzkKJVkWzZB

IV. Hokuyo UST-20LX Interface

The device has two Cables: an I/O Cable for the Power source and an Ethernet Cable.

I/O Cable :

Color	Signal
Red	COM I/P+
Gray	COM O/P-
Light Blue	IP Reset Input
Orange	Synchronous Output
Brown	+Vin
Blue	-Vin

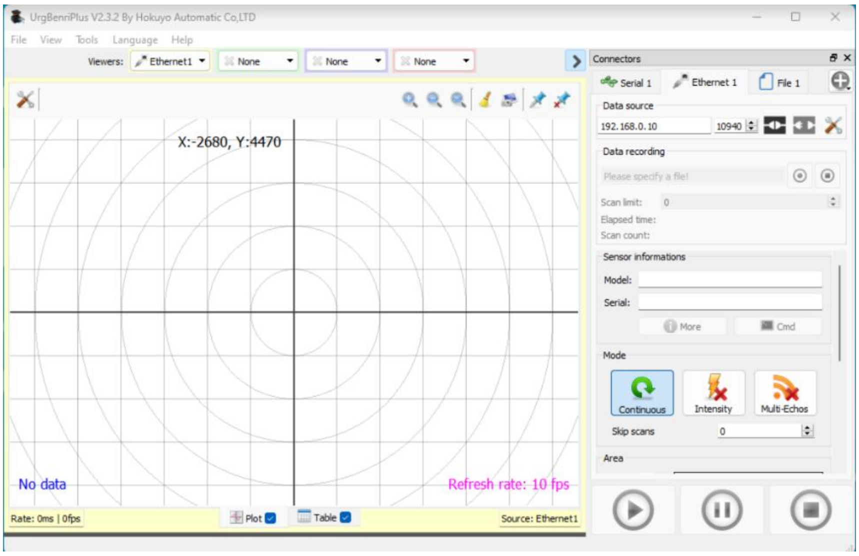
Figure 2 Hokuyo UST20LX SetUp

V. Visualization using SDK

Download the Tool Kit from https://sourceforge.net/projects/urgbenri/

Download and Install the application.

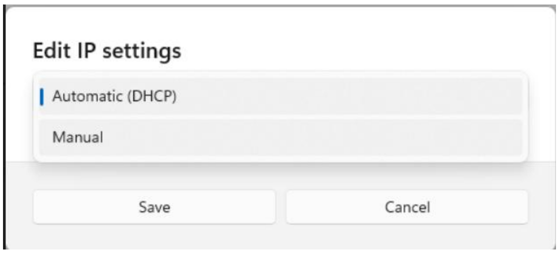
Open the Application you will get the screen as shown below…

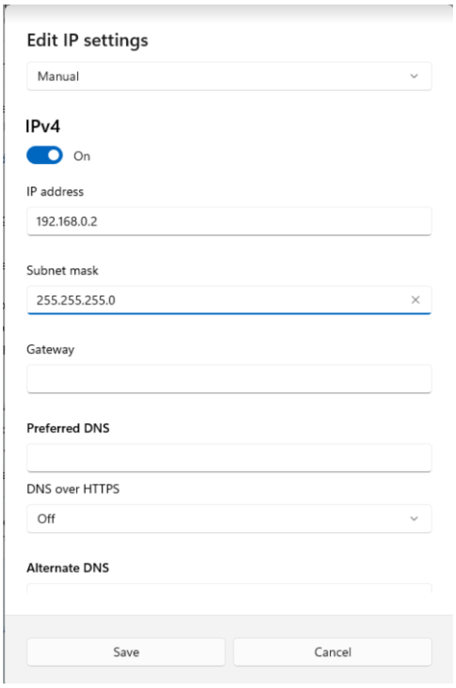


Connect your Hokuyo UST20LX to the System.

Open Settings in your system to configure the LiDAR. Select the respective ethernet Connection and change it to Manual.

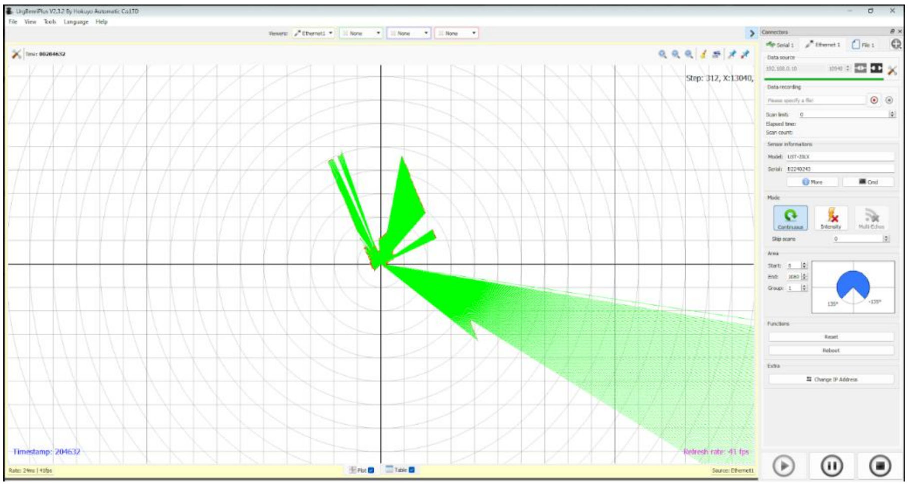
The IP Address of LiDAR is 192.168.0.10. So, change the System IP Address to the same 0 series (192.168.0.XX) as shown and save it…



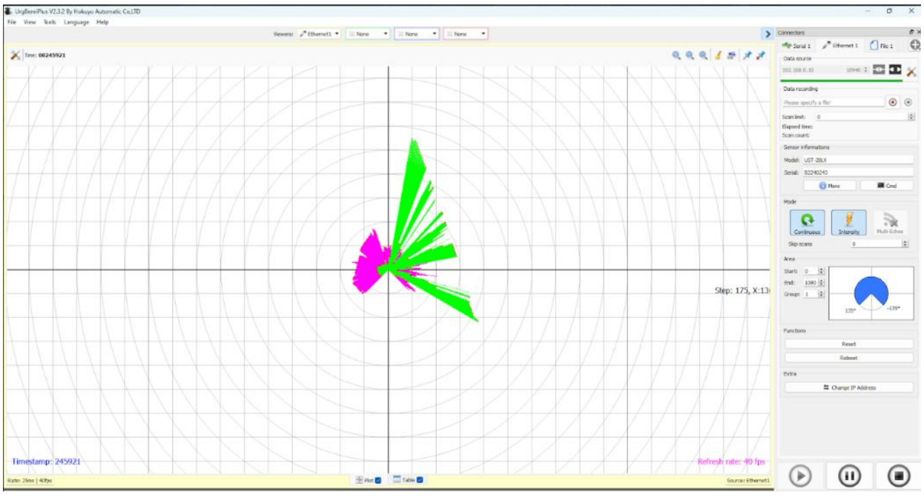


Now open the SDK set the IP Address and Port Number of the LiDAR as Shown and Click on Connect device…

As soon as the device is connected you can visualize the LiDAR data as shown…



We can also visualize Intensity Data for it



VI. Integrating with ROS

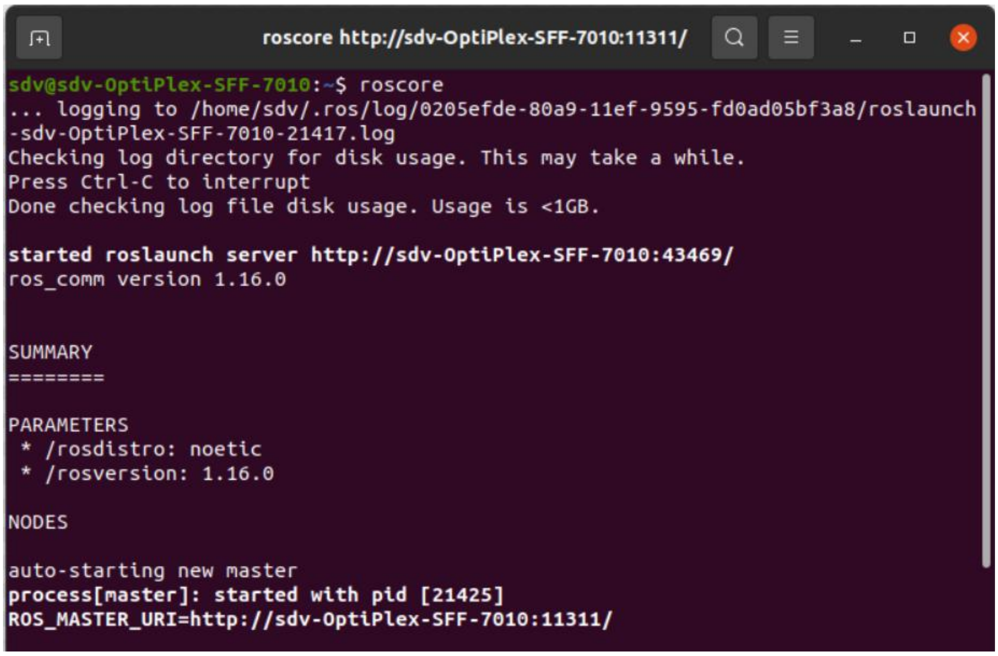
The Installation Procedure has been done in Ubuntu 20.04 and its respective ROS Version (Noetic).

Open the ROS Terminal and execute the following commands…

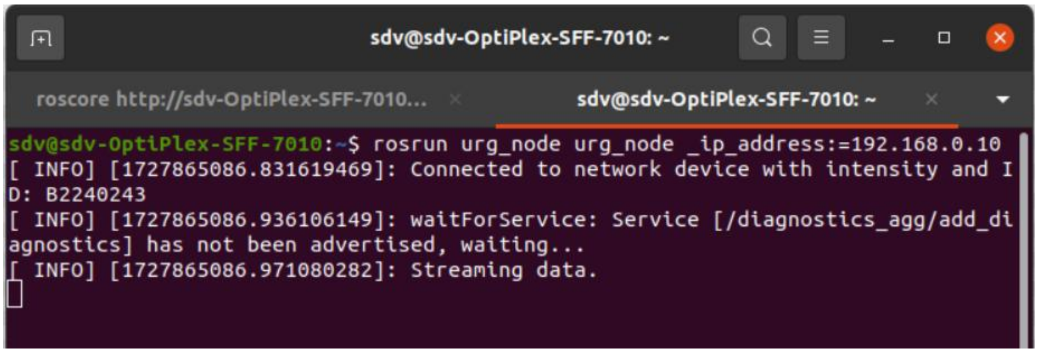
$ sudo apt-get install ros-noetic-urg-node

Connect your Hokuyo LiDAR to the System.

In One terminal run *'roscore'*



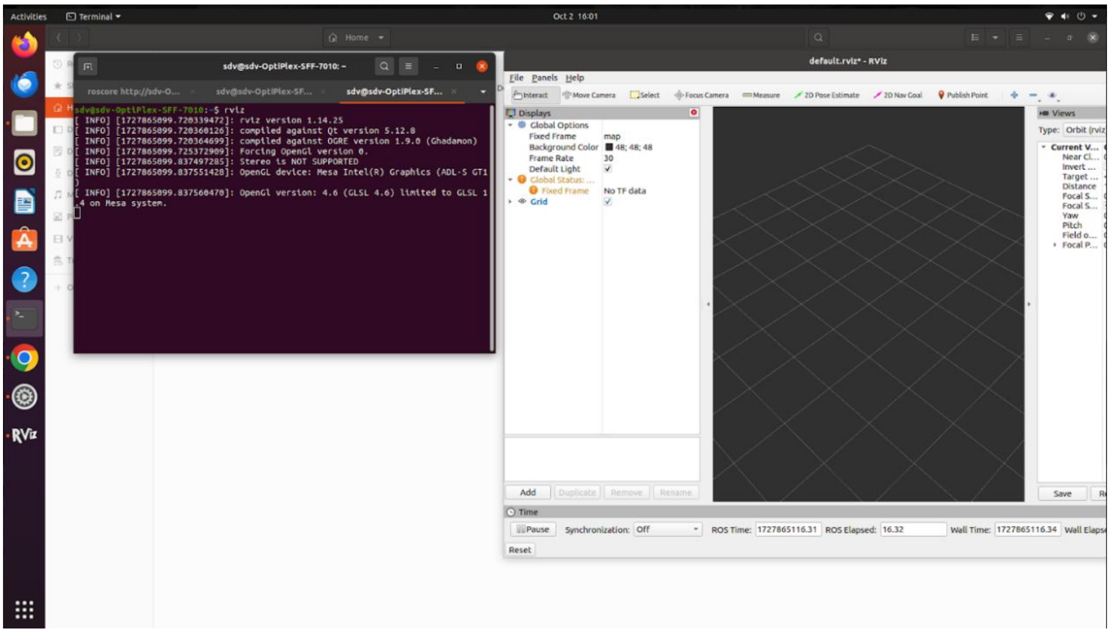
In another terminal execute the following command as shown…



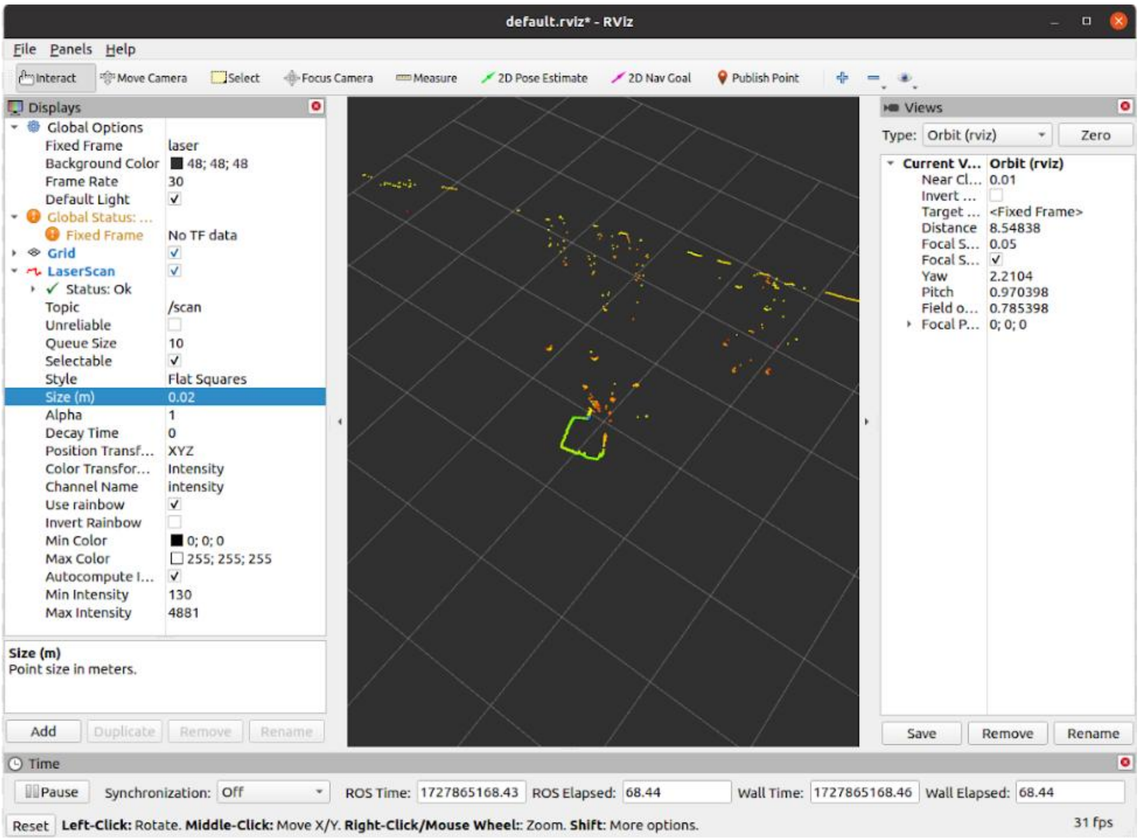
To check where data is coming or not use the following command

$ rostopic echo /scan

Now open rviz in another terminal.



Change fixed frame to *'laser'* now add the *'LaserScan'* topic from Add button in bottom. You can visualize the LiDAR data as shown

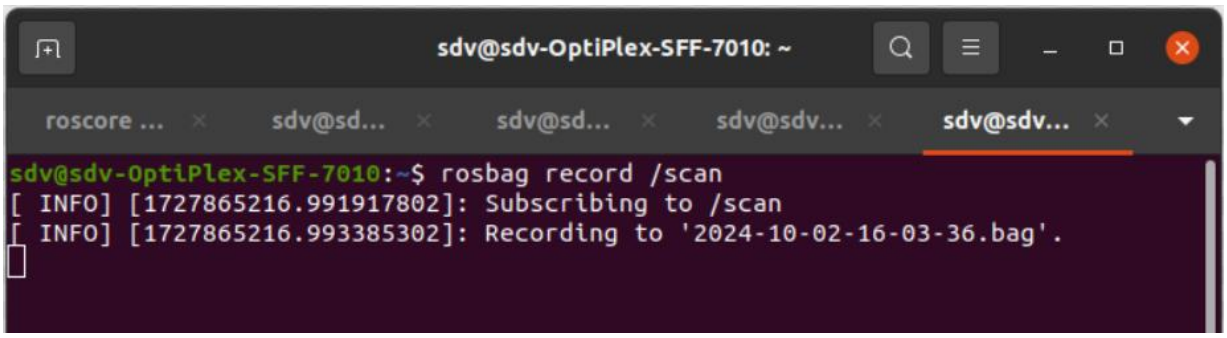


- ### Recording the data into a .bag file :

To record the data firstly you have to connect the LiDAR to your system and launch it in the terminal…

$ rosrun urg_node urg_node _ip_address:=192.168.0.10

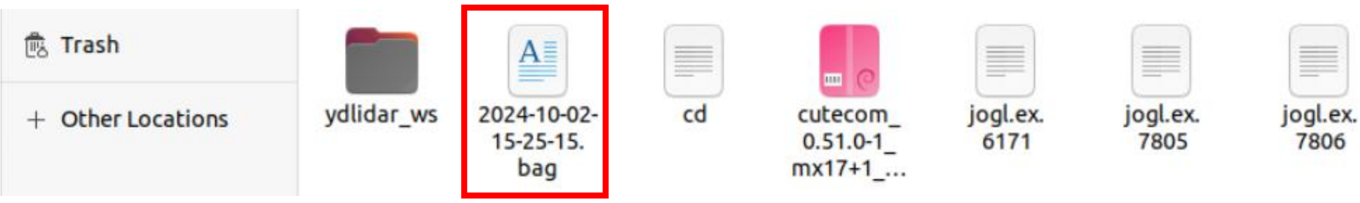
open another terminal and use the following command to record the data



/scan is used because it is the topic that Hokuyo publishes.

To stop the recording use Ctrl+C in the terminal.

This stores the .bag file in your workspace as shown



- ### Visualizing .bag file :

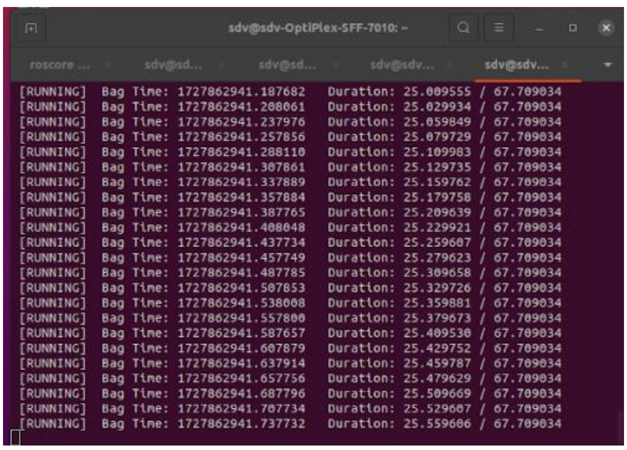
Disconnect the Hokuyo LiDAR if you are connected to the system.

To play the .bag file that you recorded. Open the terminal and run *roscore*.

Open one more terminal, use the following command

$ rosbag play 'Path_to_your_bag_file'

This will play the bag file as shown



To visualize it open RViz using another terminal.

Set the global frame as *laser* and add the topic */scan.*

Now you can visualize the recorded data as shown below…