SICK LiDAR

- 2D

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Version : 1

Version Control

Ver no.	Summary	Created by	Reviewed by	Date
1.	Starter Guide for Sick 2D Lidar	G Nithish Chandra Reddy		

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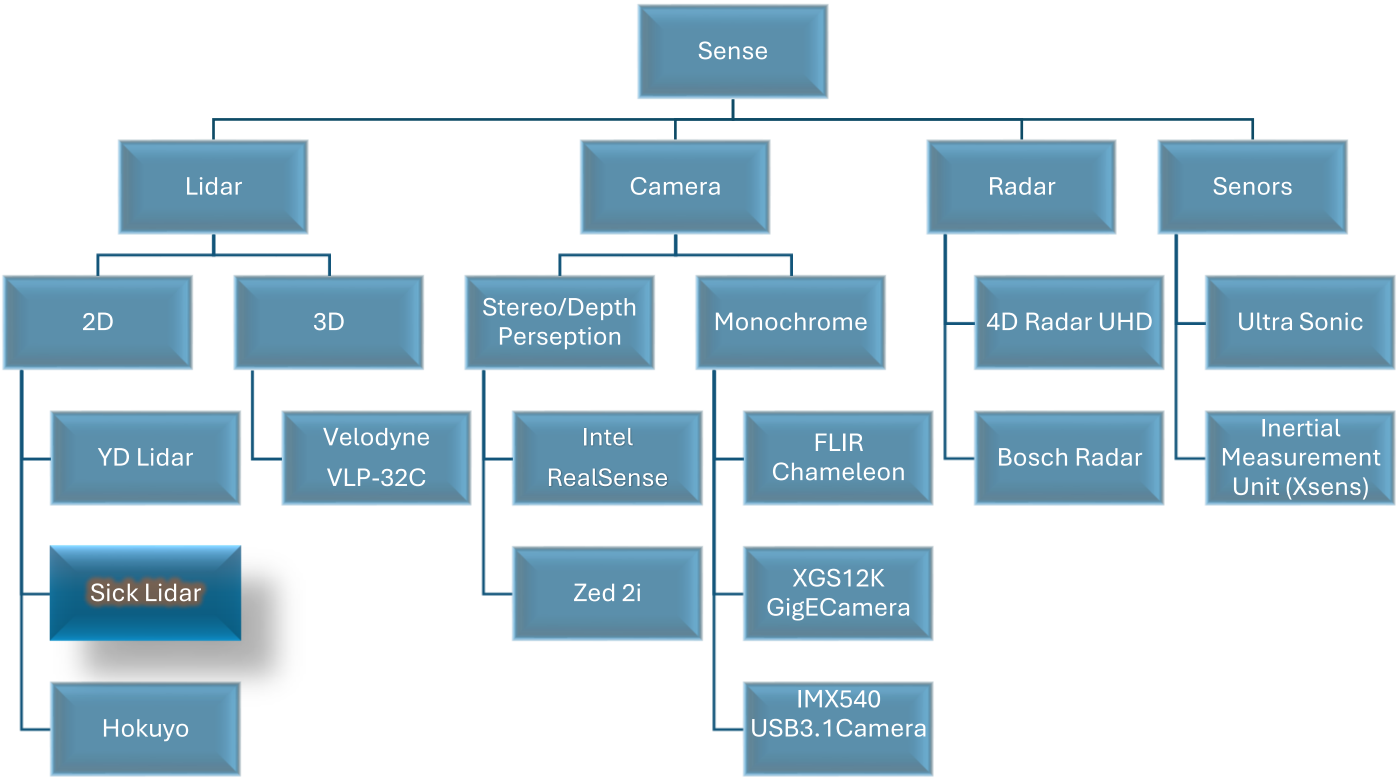
Sense Overview



I. Overview of 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 a 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 modelling, 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. 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)**

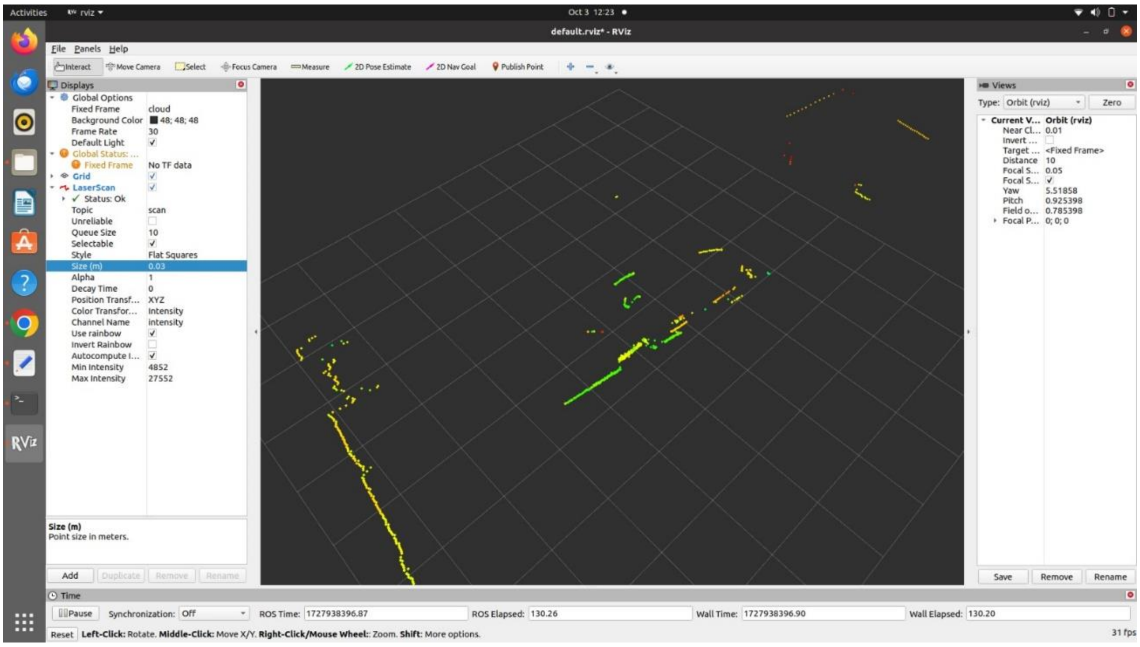
Before moving to the Hardware interface let's do an intresting activity: execute the .bag file and visualize the data in RViz, from the following link:

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 : You will be observing similar 2d 'point clouds' in XY-Plane in Rviz.



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

III. SICK 2D LiDAR

The subset of LiDAR sensors that operate in two dimensions all use a single plane of lasers to capture X and Y dimensions. This measurement data enables accurate navigation and detection of objects, both indoors and outdoors, regardless of the ambient light. For a wide range of applications, particularly in the industrial setting, this form of laser scanner provides an economical ranging solution.

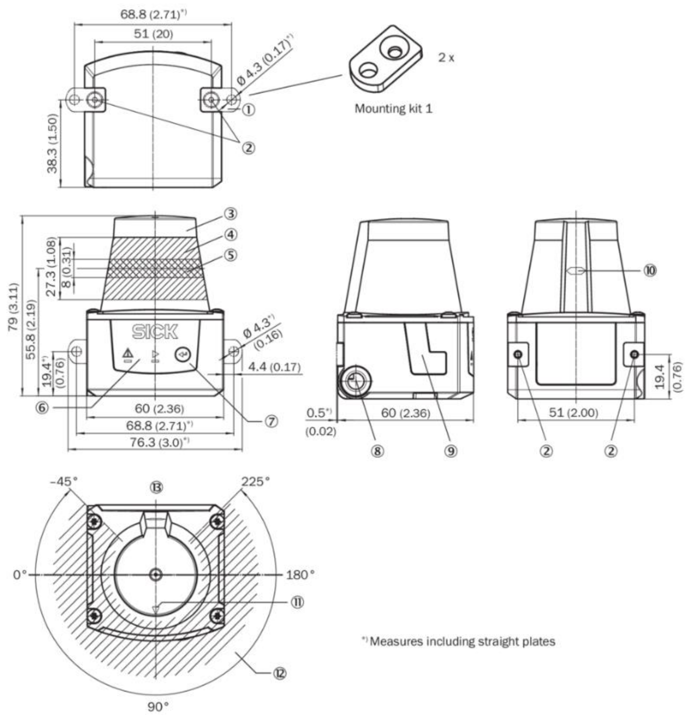
SICK 2D LiDAR sensors cover a wide range of indoor and outdoor applications, even in harsh weather conditions. In ports, they prevent collisions with cranes and containers. In logistics, they are used on mobile robots for palletizing and depalletizing processes, for collision avoidance by detecting hanging objects in factories, or obstacles and people in the travel path of autonomous delivery robots. On roads they are used to monitor speed and height violations, while in airports they efficiently monitor boarding gates and security door systems. In countless buildings they detect unauthorized access, open swing doors and activate escalators when a person approaches.

o Applications

- Robot Navigation and Obstacle Avoidance
- Smart Transportation
- Environmental Scanning and 3D reconstruction
- Robot ROS teaching and research.

o Key Features of SICK 2D LiDAR

- **Measurement Range**: Typically, these sensors have a range of several meters, often up to 10-30 meters, depending on the specific model and application.
- **Scanning Angle**: 2D LiDAR sensors provide a 2D planar scan, usually covering a wide angular range (e.g., 270° or 360°).
- **Resolution**: They offer high angular resolution, allowing for precise object detection and mapping. The resolution can vary, but it is generally around 0.25° to 1°.
- **Scan Frequency**: SICK LiDAR sensors can operate at high scanning frequencies, often up to 50 Hz or higher, enabling real-time data acquisition.

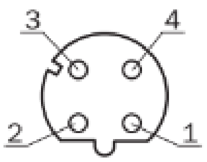


Specifications

Supply voltage	9v – 28v DC
Working range	0.05m -25m
Scanning range	8m (At 10% remission factor)
Aperture angle	270° (Horizontal)
Power consumption	Typ. 4 W
Output current	≤ 100 mA
Scanning frequency	15 Hz
Systematic error	± 60 mm [2]
Statistical error	< 20 mm [2]

Connection Type

Ethernet

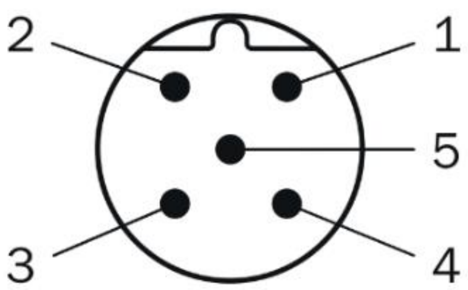


M12 female connector, 4-pin, D-coded

① TX+
② RX+
③ TX-
④ RX-

Pin Assignments

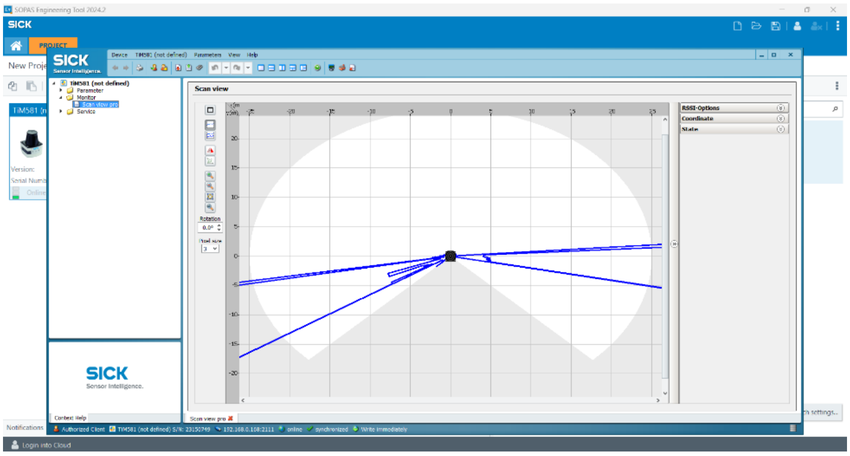
Power

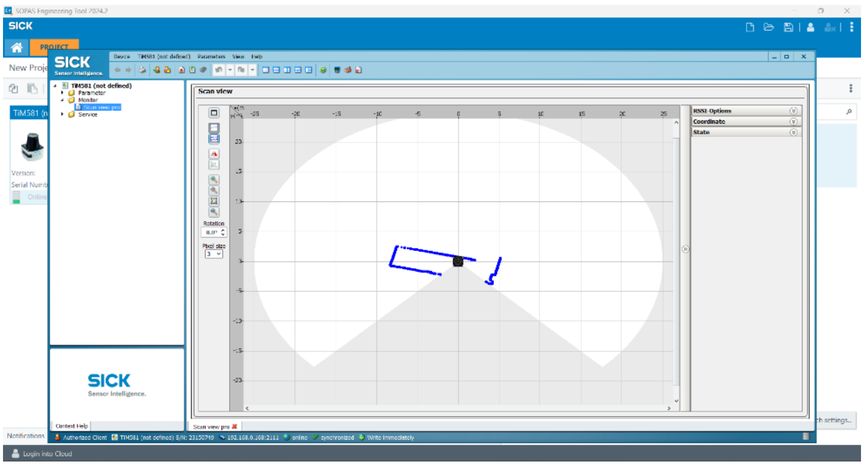


Pin	Signal
1	Vin (Brown)
2	SYNC/ device ready
3	GND (Blue)
4	NC
5	NC

IV. Interfacing 2D SICK LiDAR with SDK (in Windows)

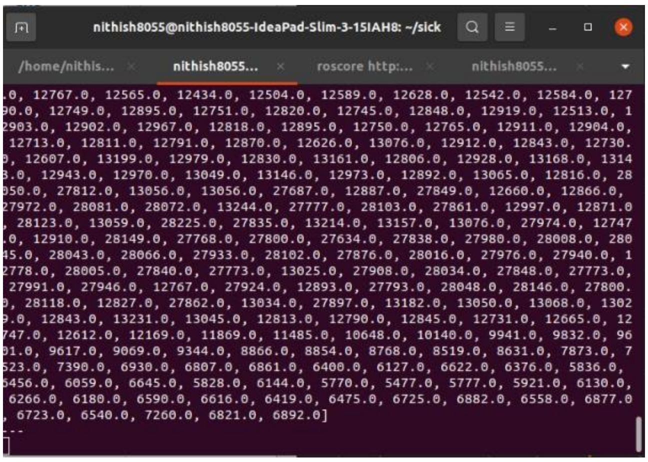
- Connect the SICK 2D LiDAR to the PC and provide the necessary power supply.
- Open the network settings on your PC, select the Ethernet connection associated with the LiDAR, and change the IP address to 192.168.0.2. This places your PC in the same subnet as the LiDAR, which uses the IP 192.168.0.1.
- Download and install SOPAS Engineering Tool from the official SICK website.
- Launch the SOPAS software. You will see the available connections on the right-hand side.
- Drag the detected device to the project window.
- If you see a "**Install Device Drivers**" warning, click on it.
- Select "**SICK.com**" or "**Disk**," then click Next.
- Choose "**From SICK Driver Repository**" and click Next.
- The software will automatically select the driver version for your device. If it doesn't, manually select the correct version. For the TiM581, use version: V5.0-30.03.23.
- Click Next to install the drivers, then click Finish once the installation is complete.
- Go online in the SOPAS software.
- Click on the three dots and select "**Open Device Window**."
- In the device window, expand "**Monitor**" on the left side and click on "**Scan View Pro**" to visualize something like this:





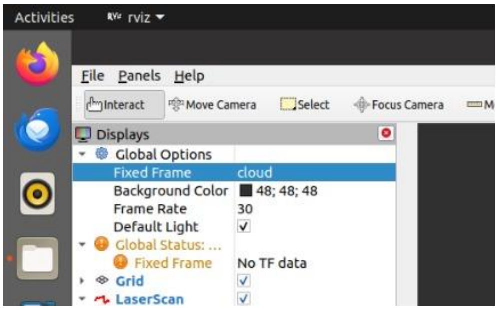
V. Interfacing 2D SICK LiDAR with ROS (in Ubuntu)

- Create a ROS workspace and inside it, create a src folder.
- Open the src directory in a terminal and clone the SICK LIDAR driver repository using:
  $ git clone https://github.com/SICKAG/sick_scan.git
- Build the driver packages by running the following command in the workspace root:
  $ catkin_make
- Source the workspace to make the packages available:
  $ source ./devel/setup.bash
- Before proceeding, ensure the IP address of the Ethernet port is set to the 0-series IP range as done in Chapter IV.
- Launch the SICK driver to visualize data by running:
  $ roslaunch <launch-file> hostname:=<ip-address>
- Replace <launch-file> with the correct launch file name and <ip-address> with the SICK LiDAR's IP address. For example:
  $ roslaunch sick_scan sick_tim_5xx.launch hostname:=192.168.0.168
- Now with no errors you should be able to launch the drivers using launch file but if you encounter "SOPAS mode" errors, try adjusting the IP address or launch file according to your SICK LiDAR configuration.
- **Visualize Data:**
- Open a new terminal and run the following command to see the topics being published:
  $ rostopic list
  You should see a topic named /scan.
- To view the values in this topic, use:
  $ rostopic echo /scan
- Output:

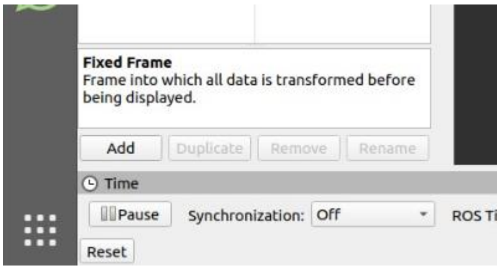


- Open another terminal and start RViz with the following command:
  $ rviz

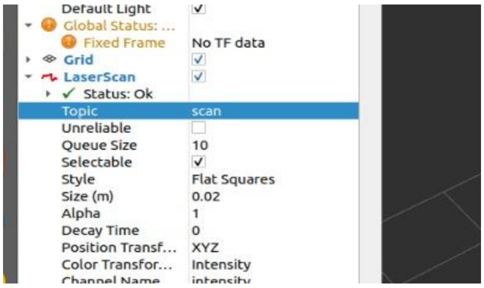
- In Rviz, Set the fixed frame to ‘cloud’



- **Now add topic** : LaserScan



- **Name the Topic**: scan



- You should now see a visualization similar to this: