Assignment 2

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24th of October 2023

Figure 1: Leo Rover
Source: https://www.mybotshop.de/bilder/Prod_Beschreibung_Bilder/LeoRover_Top.JPG

Contents

1 Introduction

The purpose of this assignment is for the students to get a better understanding on how coordinated frames function, how to set up a system and how this can be useful. Using the LeoRover the students are to set up frames for two of the mounted sensors with the base_link frame as reference, the RPLIDAR and the Intel Realsense slam camera. To achieve this gaining knowledge on how the TF package for ROS is set up and how to use it is critical.

2 Intel Realsense t265

The Intel RealSense T265 tracking camera that are used on the leo rover is feeding into a Visual Inertial Simultaneous Localization and Mapping algorithms (VI-SLAM) made by intel. This system integrates sensory data to generate a real-time 6 degrees of freedom (DOF) of the camera's position and velocity in relation to its environment at a 200 Hz rate.

2.1 Sensors

The camera is equipped with two global shutter fisheye world cameras, each capturing imagery at a resolution of 848 x 800 pixels and a 30 Hz sampling rate. These cameras have a 173° diagonal field of view. In addition to the visual sensors, the device has an Inertial Measurement Unit (IMU) for the detection of acceleration in 3 dimensions and rotations in 3 dimensions. The gyroscope has a range: $\pm 2000°/s$ and a sampling Rate of 200 Hz. The accelerometer has a range of $\pm 4g$ and a sampling rate of 62.5 Hz.

2.2 Power and data transfere

Connectivity and power management are using a USB 3.1 Gen 1 Micro B interface. All operational power and data are sourced directly through this USB connection.

2.3 Coordinate system

In the ROS coordinate system X is Forward, Y is Left and Z is Up. This system is based on the image labeled figure 2. When visualizing this system, the X-axis (green) points forward, the Y-axis (red) points to the left, and the Z-axis (blue) points upward.
In the camera optical coordinate system X is Right Y is Down and Z is Forward. This system corresponds to the image labeled figure 2. Here, the X-axis (red) points to the right, the Y-axis (green) points downward, and the Z-axis (blue) points forward.

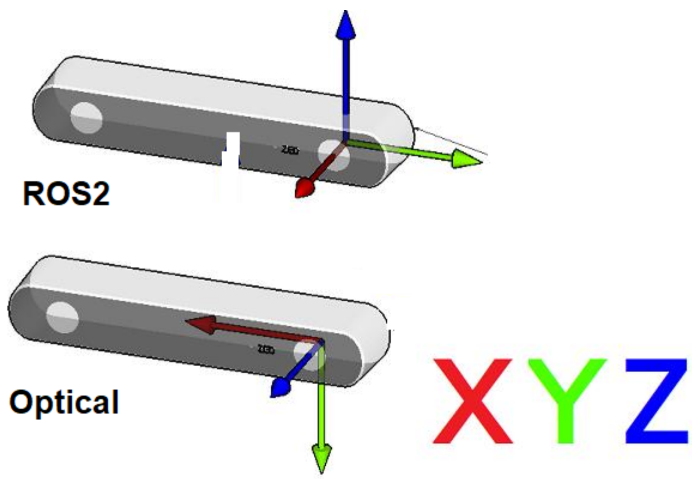

Figure 2: Camera orientation

3 RPLIDAR A1M8

The RPLIDAR A1, developed by Slamtec, is a 360-degree 2D laser scanner (LIDAR) specifically designed SLAM applications.
The RPLIDAR A1 consistently captures a full 360-degree environment. This LIDAR is capable of capturing up to 8000 samples of laser ranging data per second. The modulated laser can effectively prevent ambient light and sunlight during ranging scanning process. The device can detect objects from 0.15m to 12m away. RPLIDAR A1's scanning frequency reached 5.5 hz when sampling 360 points each round. And it can be configured from 1 to 10 hz.

3.1 Coordinate system

Figure 3 shows the orinetatio of the axis on the lidar

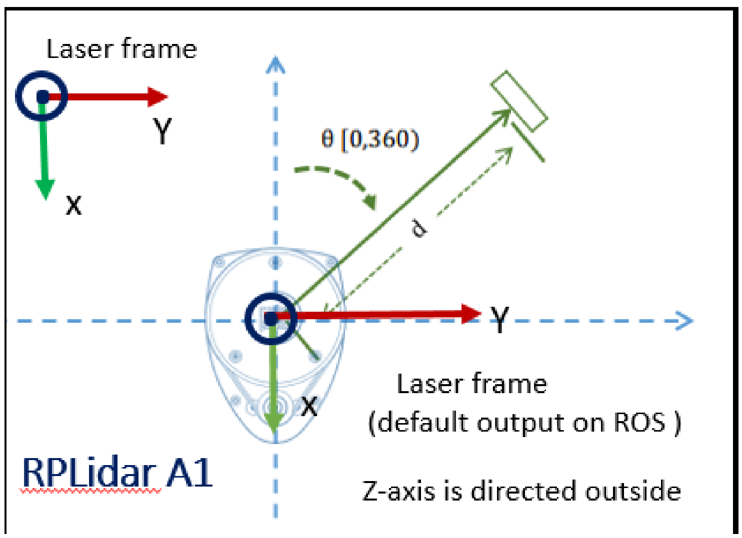

Figure 3: Camera orientation

4 TF package

Robotic systems often contain several components and keeping track of accurate transformations and spatial information is essential. To make this easier the TF package has been developed, which is short for "Transform Libary". The package help the user set up a framework for managing coordinated frames and setting up transformations between them. This ensures accurat and helpful data from various sensors and components within the system.

4.1 Transforms

The core of this package is the transformation between frames. This gives an understanding for how different components are located in location to each other or compared to a reference component. Transforms take into consideration several arguments like position compared to the x, y and z axis as well as rotations in yaw, pitch and roll.

4.2 Static transform publisher

In this assignment transforms are created using the "static_transform_publisher" function provided by the tf package installed on the rover. This function takes into consideration 6 arguments for location and orientation for the frame that is published (x, y, z, yaw, pitch, roll), one argument for what frame it references to (frame_id) and the name of the published frame (the child_frame_id). The x, y and z values are formatted in meters while the yaw, pich, roll values are formatted in radians.

4.3 Integrating tf in a launch file

One part of the given task was to have a launch file that can set up several transformations with launching just one file. This was achieved with implementing the "`static_transform_publisher`" function into a launch file as showed in figure 4.

```
tf_adjust.launch ×
launch_files > tf_adjust.launch
<launch>

    <node pkg="tf" type="static_transform_publisher" name="camera_odom_link" args="0.12 0.04 0.025 0 0 0 base_link camera_odom_link 100"/>

    <node pkg="tf" type="static_transform_publisher" name="rplidar_link" args="0.07 0.005 0.115 3.14159265 0 0 base_link rplidar_link 100"/>
</launch>

```

Figure 4: tf_adjust.launch

4.4 Results of transformations

In figures 5, 6 and 7 are screenshots with measurements between the base_link frame and the two frames that is added by the launch file seen in figure 2.

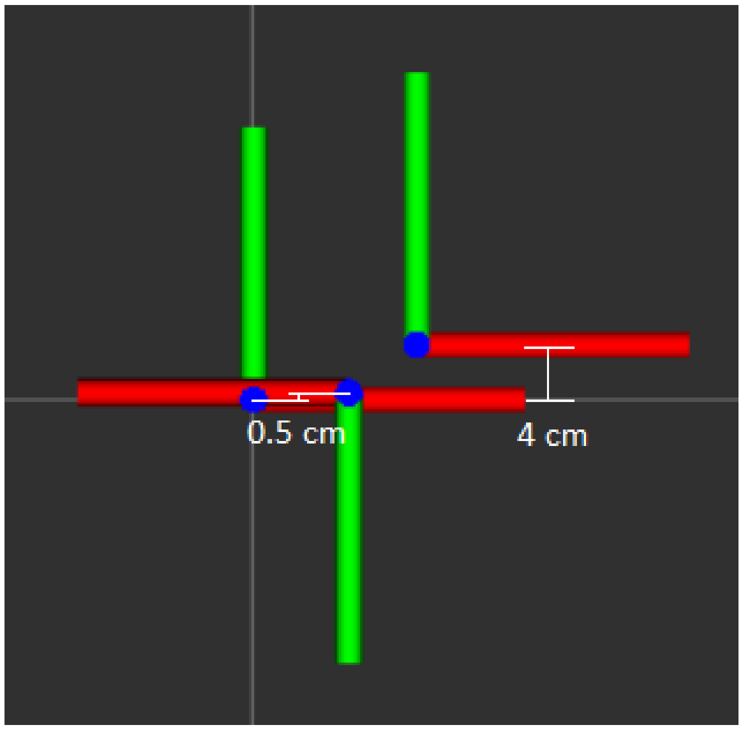

Figure 5: Top view

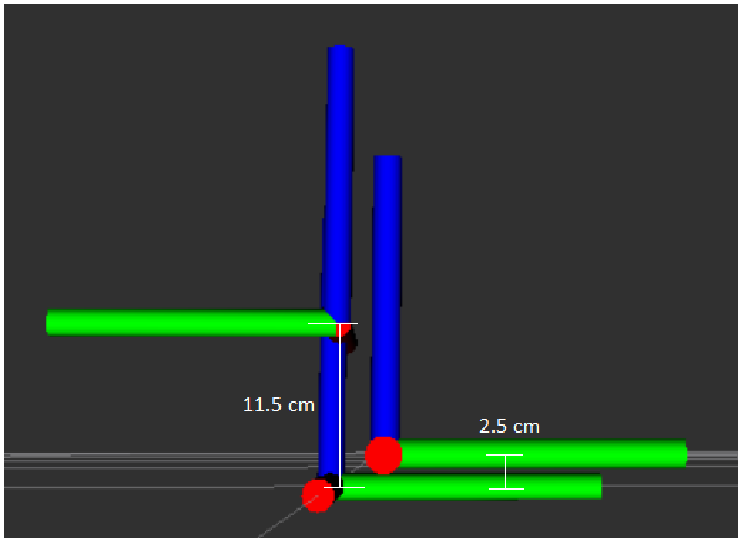

Figure 6: Front view

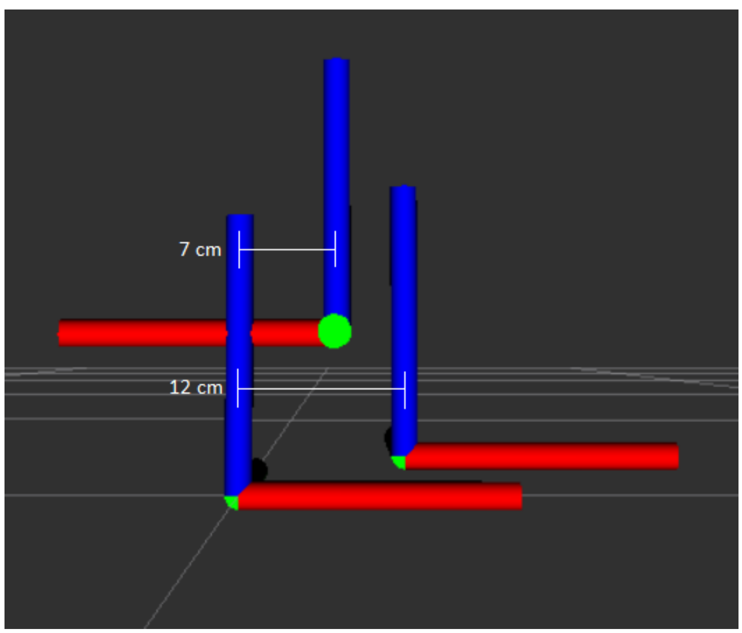

Figure 7: Side view

5 Conclusion

This assignment highlights the significance of spatial transformations in robotics, emphasizing the TF package's role in managing coordinate frames. We also highlighted the capabilities of the Intel RealSense T265 tracking camera, with its real-time positioning and VI-SLAM integration. Lastly, the RPLIDAR A1M8 was introduced as a proficient 2D laser scanner, offering comprehensive environmental scans. This assignment has given insight into the importance of understanding spatial transformations in robotics.

References

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[5] RPLIDAR A1, SLAMTEC, Shanghai Slamtec.Co.,Ltd, 2016-07-04 rev.1.0, https://www.generationrobots.com/media/rplidar-a1m8-360-degree-laser-scanner-development-kit-datasheet-1.pdf.

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