MTE544 Lab 1

Group 29

Friday 3:00 PM

Kevin Xue (20814292)

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Station Number: 161

Robot Number: 6

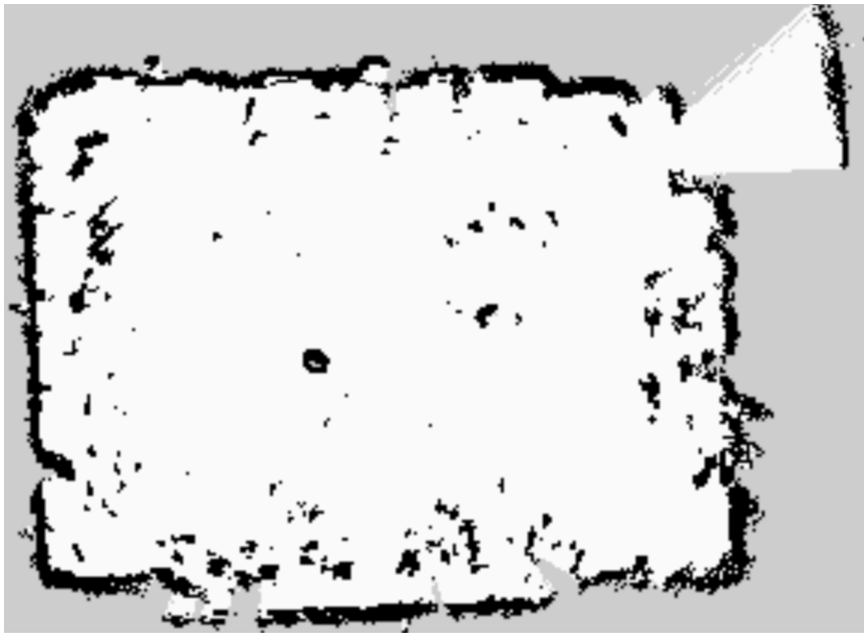

Figure 1: Map of the room

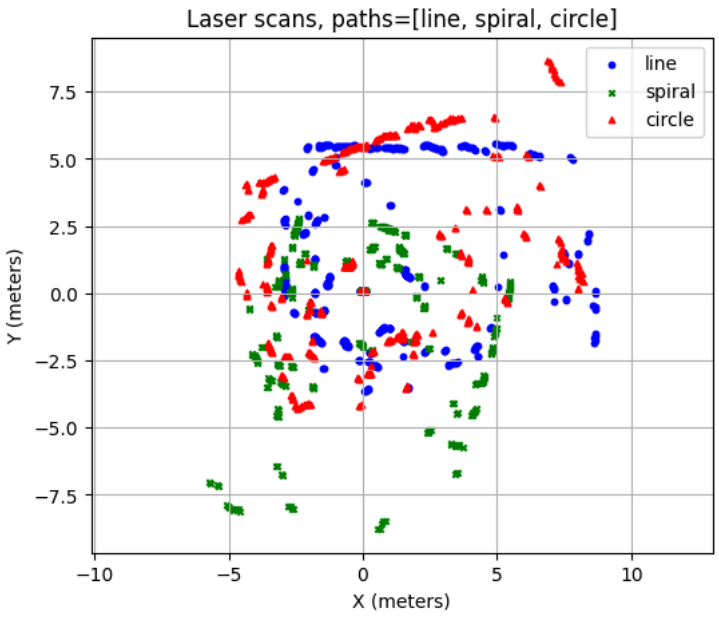

Figure 2: LiDAR data (t_0, cleaned) for various paths (line, spiral, circle)

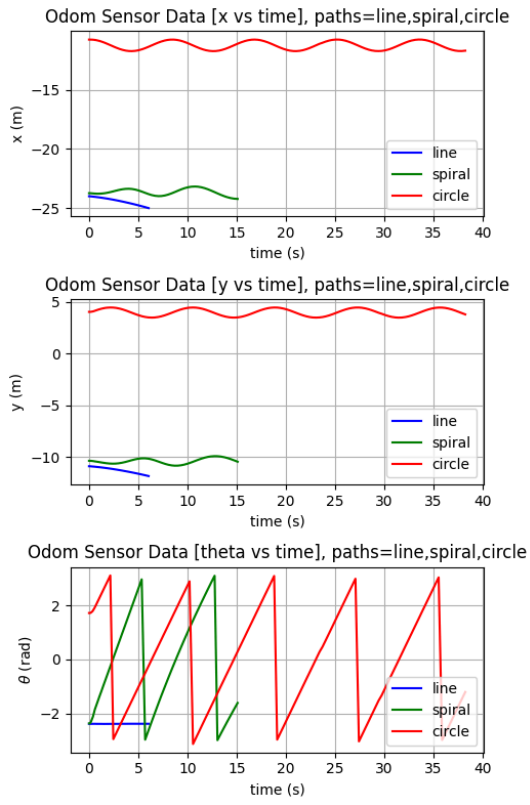

Figure 3: Odometry Data with Respect to Time

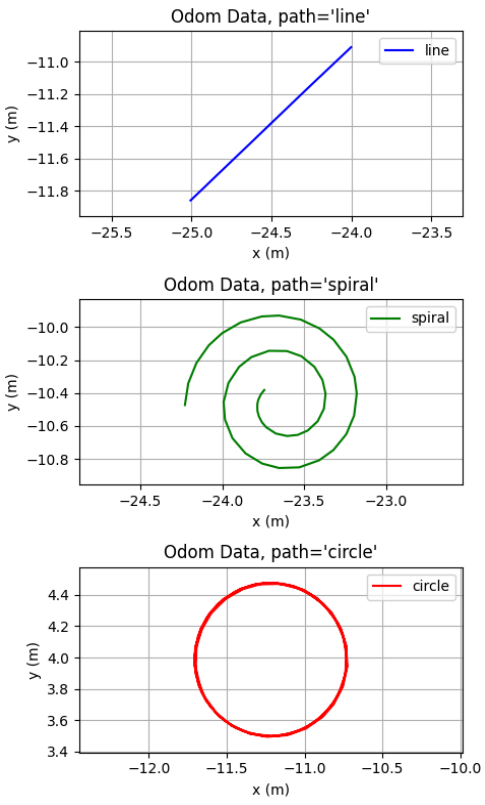

Figure 4: Path Plotting with Odometry Data

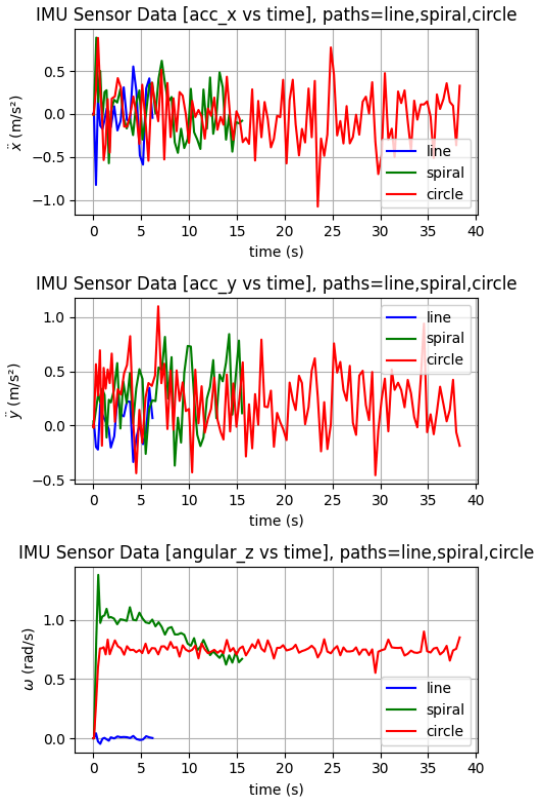

Figure 5: IMU Data

Map of the room

The map acquired during Part 8 of Lab 1 can be seen in Figure 1. Based on analysis of the map the solid black barrier surrounding the map is the wall, whereas the smaller isolated black parts are obstacles that the LiDAR detected. Also it appears the door was open while the robot was mapping the top right corner of the room.

Laser Scans

The laser scan at the start of each trajectory (t_0) can be seen in **Figure 2**. Based on the angle increment, each LiDAR measurement contained 360 different values. Not all values were plotted due to the measurements being out of range. From the plot, it is evident that the laser scan at a single timestamp does not capture the level of detail of the room compared to the map acquired via the SLAM package for a longer period of time (**Figure 1**).

Circle

Based on the trajectory plot (**Figure 4**), we can see that the robot's path is in the shape of a circle. This is confirmed in **Figure 3** as the x & y positions are following sinusoidal paths with respect to time. Furthermore in **Figure 5**, the circle has a relatively constant angular velocity after the initial spike, which implies a circular shape.

Spiral

Based on the trajectory plot (**Figure 4**), we can see that the robot's path is in the shape of a spiral. This is also confirmed in **Figure 3** as the x & y positons follow a sinusoidal shape with an increasing amplitude over time. Angular velocity is also non-zero during the path which implies a circular shape. The angular velocity is decreasing over time after the initial spike, as shown in **Figure 5**, and is also somewhat evident from the decreasing slope of the angular position vs time plot in **Figure 3**. This implies that the radius of the circle is increasing faster than the linear velocity, this relationship can be seen in equation (1).

$$\omega = v/r \tag{1}$$

Line

Based on the trajectory plot in (**Figure 4**), we can see that the robot's path is in the shape of a line.
We can see the line is increasing over time because in **Figure 3** the x & y positions are increasing in a non-linear manner with respect to time, implying that the robot is accelerating. It is also known that the line is straight because the angular velocity in **Figure 5** is constant at zero.

Further Data Analysis

Looking at the amount of noise in the odometry data (**Figure 3**) versus the IMU data (**Figure 5**), it is evident that the IMU data has much more high frequency noise than the odometry data (especially the linear acceleration values). Additionally, the sawtooth shape of the angular position (yaw angle) vs time from the odometry data suggests that there is an implicit range of the function used to calculate the yaw angle, which appears to be from [-2π, 2π].