Michigan Technological University

MEEM 4707: Autonomous system

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Lab - 4

By

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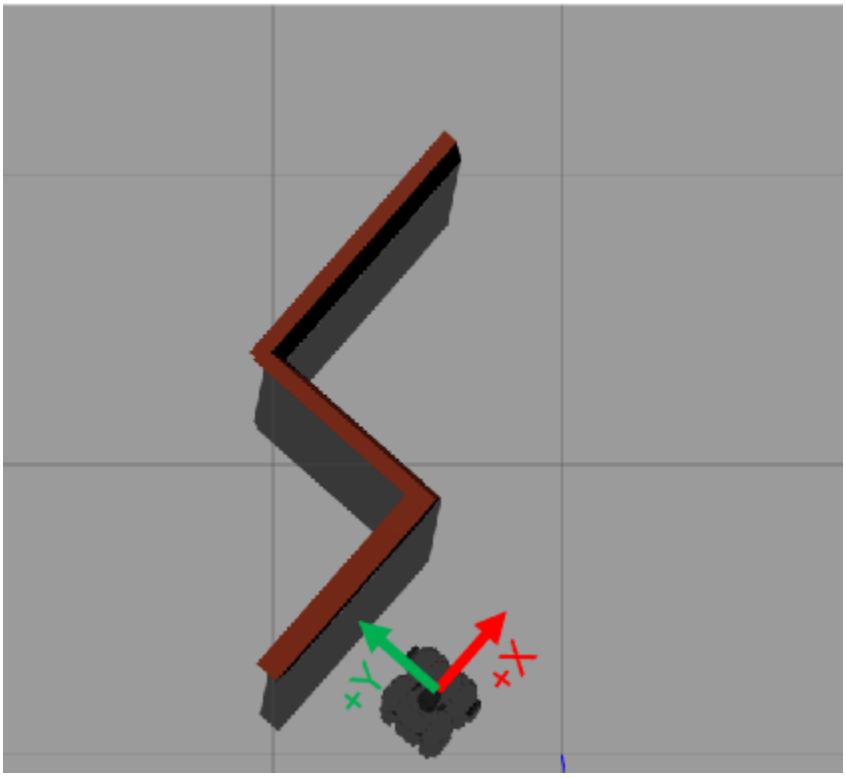
Problem 1. For the given gazebo environment, it is given that the TB3's x-axis is approximately parallel to the wall, and the wall is on the left (towards + y-axis). The LiDAR sensor senses 360 degrees counterclockwise, starting from 0 degrees at TB3's forward axis. A student used the scan array data received from the TB3's Lidar and reported that the minimum distance from that wall is approximately 0.4 m. Still, the student did not mention the index number of the point with the minimum distance.

1) Guess the index number of the point with the minimum distance and explain the reason briefly for the guessed value? You can also explain using a hand-drawn figure/sketch.



Assuming an angular resolution of 1 degree, there should be exactly 360 distances measured. If the robot is faced perpendicular to the wall (as shown above) and scans CCW from the X+ axis, then the closest measurement should be at 90 degrees, or index 89.

Problem 2. In this problem, you need to open the gazebo environment.

1) Initially, when the TB3 is located at (0,0), what is the minimum distance of the robot from the wall?

The minimum distance is initially 0.9189 m.

2) And what is the angle of the minimum distance point with respect to the x-axis of the robot?

The angle is initially 55 degrees CCW of the X+ axis.

Problem 3. Read the "wall_follow.py" code script and summarize your understanding. Provide the variable names and commands in the code that 1) stores the lidar scan data, 2) the minimum distance value in the scan array, and 3) the index of the minimum distance value in the scan array that we intend to use. Additionally, explain how you can utilize these variables to detect and navigate along the wall.

1) The Lidar data is initially defined in lines 29-34, where scn_arr represents one full sweep worth of measured distances, and res represents the resolution in terms of degrees/sample (ex: 180 samples -> res = 2)

```
28              rospy.Subscriber('/scan',LaserScan,rec.scan_callback)
29              if not scn_arr:
30                  scn_arr = list(np.zeros(360))   # GAZEBO L=360 / REAL L = 1153
31              else:
32                  scn_arr = recorder.scan_data
33              L = len(scn_arr)
34              res = float(360)/L
```

2) The minimum distance value is stored in the variable d on line 42. It is found by taking the minimum value of scn_arr, which holds distances from the last full sweep.
3) The angle at which the minimum distance is found is calculated from the index of d in scn_arr on lines 43-44. The angle itself is calculated by multiplying the index by res (angles/sample) to find it in degrees.

```
42              d = min(scn_arr)
43              ind = scn_arr.index(min(scn_arr))   # This is index of minimum distance value in scn_arr
44              ang = ind*res           # This is angle of minimum distance value in scn_arr
45              print(d, ang)
```