Lab 4 Report - Localization

**Data**

|  |  |  |  |
| --- | --- | --- | --- |
| Test # | Measured Theta | Expected | Error |
| 1 | 88 | 90 | 2 |
| 2 | 89 | 90 | 1 |
| 3 | 90 | 90 | 0 |
| 4 | 89 | 90 | 1 |
| 5 | 90 | 90 | 0 |
| 6 | 89 | 90 | 1 |
| 7 | 85 | 90 | 5 |
| 8 | 85 | 90 | 5 |
| 9 | 88 | 90 | 2 |
| 10 | 89 | 90 | 1 |

|  |  |
| --- | --- |
| Mean | Standard Dev |
| 1.8 | 1.72 |

**Observation and Conclusions**

1. We found that light sensor localization performed better then ultrasonic localization during our tests. We believe that the light sensor localization was more accurate to the idea of the readings being less ambiguous and more binary. It is simply a yes/no if you’ve seen a line yet when compared to the ultrasonic sensor which is searching for an edge. By obtaining more consistent readings light sensor localization proved itself more accurate. However one advantage of ultrasonic localization that the light sensor method can’t achieve is the initial placement of the robot. Using the ultrasonic sensor the robot can be placed at any angle in a random position (allowing that the robot has space to turn) and will still be able to find its position. Light localization makes the assumption that the robot is at a position to hit 4 lines of the grid, the first of these lines being in the negative x-axis.
2. As mentioned the light sensor is more accurate due to the fact the values it is searching for are binary. When compared to the ultrasonic sensor which is looking for a characteristic of the data read a simple yes/no question would prove more accurate.
3. When the robot is perpendicular to a wall the reading that the ultrasonic sensor will receive will be its minimum for that wall. This is because there is no component of the distance measured that reflects the axis parallel to the wall being at 90. If we were to know the direction we are rotating and recognize the moment when the readings were decreasing we could use the minimum to capture the distance the robot is from the wall. However the idea of using a minima could pose issues if the readings are not consistent. If there is a single outlier that returns a small distance it could cause the minima to be an incorrect value

**Error Calculation**

**Further Improvement**

1. By taking the derivative to the readings we would be able to determine the trend that the readings are following. If we were to compare the newest reading to this derivative we can determine if this value is valid or not. This would be better than a clipping filter as it would also control the case where the reading is an outlier but is still within the expected values. (e.g. if you’re against a wall you won’t expect a reading of 50cm but this is not an abnormal value which we would want to clip)
2. A possible replacement of the ultrasonic sensor could be the implementation of a laser tape measure to calculate distance instead. The laser would firstly be able to pulse and record distance faster than the ultrasonic as the speed of light is much faster than the speed of sound. This would be helpful as the ultrasonic sensor is the main bottleneck in the program. Being able to read sensor values more often would allow localization to be more precise as it would detect edges earlier.
3. Another localization method that we could’ve used to determine the position and orientation of the robot could be the use of the minima value of the ultrasonic sensor. We can determine we are facing a wall by setting a threshold value. If we record the angle at which the minima value is found we can see that was 90 degrees with the wall. We can do this for both walls and relate our expected angle with the odometer angle to find orientation of the robot.