UNIVERSITY OF COLORADO AT BOULDER

COEN 5830 - ROBO 5000

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Final Project

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1 Problems Attempted

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2 Perception

2.1 Lidar Occupancy Grid

Lidar Occupancy Grid - 2 points

For the lidar occupancy grid problem we elected to use the **Brensenham Line Algorithm** to rasterize the rays throughout the environment. We chose this method after Dr. Leo highlighted the benefits of the line algorithm for rasterizing rays. One particularly amazing feature of the algorithm is the use of only integer arithmetic in the calculation of occupancies. Using only integer calculations in the occupancies reduces computationally complexity and therefore increases speed. Now since Brensenham's line algorithm is the heart of our work, we will describe the steps in our implemention that lead up to and after the Brensenham portion of our code.

2.1.1 Lidar Occupancy Algorithm High-level Steps

In this section we will highlight the main steps in our algorithm for this part of the project. We will try to stick to plain old english when describing these steps and save coding details for the oral exam portion of this project.

Algorithm 1 Lidar Occupancy Grid Algorithm

```
Read in lidar, heading, and position data then store in internal data structures
Create Grid based off passed in lidar CSV data
Start animation loop
while True do
    Convert incoming lidar readings and robot position data to grid coordinates
    Mark current position of robot on grid
    Rasterize lidar readings using Brensenham's line algorthim and update grid
    Rescale grid x,y axis to real world x,y axis
    display animation, i.e. show state of lidar scan to user
end while
```

The above algorithm highlights the main steps in the occupancy grid algorithm. As previously stated, code details will be highlighted upon request at the oral examination.

2.2 IMU Sensor Fusion

IMU Sensor Fusion - 1 points

2.3 Canny Edge Detection - 1 + 1 Bonus Point

Canny Edge Detection - 1 Point + 1 Bonus Point

3 Path Planning

3.1 RRT - 3 points

4 Dynamics and Control

4.1 Part A - 2 Points