Name(s)

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Project Number

S1207

Project Title

Target Acquired: A Comparison of the Effectiveness of Search Patterns Executed by Autonomous Robotic Vehicles

Abstract

Objectives/Goals

My objective was to determine the most effective of four search patterns I developed for an autonomous robotic vehicle.

Methods/Materials

I assembled wheeled robots equipped with ultrasonic sensors for obstacle detection, infrared sensors for target detection, and infrared wheel encoders for determining distance traveled. I programmed a series of tasks to control the low-level sensor and movement functions of the robots. The data from the repeating sensor tasks was then stored in a class where it could be accessed by the high-level obstacle-avoidance and searching behavior functions of the robot. I compared the amount of time the robot took to locate an infrared target with different search patterns. The first was a raster search pattern where a robot searches in incrementing lines of travel parallel to the walls of the room. A second random search pattern was utilized where a robot travels in a straight line until encountering an obstacle, at which point it pivots a random number of degrees away from the obstacle and begins another straight line movement. In the third pattern, a robot completes a movement of random length, pivots a random angle, and then begins another random movement. A fourth pattern was like the third, but used movement values determined by a Levy distribution. This results in a long movement followed by a series of short movements in the area. The fourth pattern mimics the search patterns of predatory animals where they choose a location and then check the vicinity for signs of prey.

Results

The raster search pattern yielded a faster mean search time and lower standard deviation than the other searches. The Levy search had the slowest mean search time and the greatest deviation, although it had the fastest mean search time for the target positions that were farthest from the searcher#s starting position.

Conclusions/Discussion

The data suggests a relationship between fast search times and deviation from the mean. The searches that were able to find targets the fastest were also the ones that could potentially take a very long time to find a target as a result of redundancy caused by their shorter movements. Refining the rules governing the search patterns by increasing the maximum movement lengths would dramatically improve the effectiveness of the random search patterns. However, random search patterns will have greater potential for deviation than a raster search.

Summary Statement

My project is a comparison of the effectiveness of several search patterns executed by autonomous robotic vehicles.