THE REWARDS OF SENSORY-BASED PATH PLANNING

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ABSTRACT

In a previous project, we had constructed a robotics system that relied on GPS, which led to a significant degree of inaccuracy. To address these issues, we have enhanced our system by utilizing computer vision and a scanning laser. Our path-planning program provides waypoints where robots can take panoramas and the collection of images provides for complete visual coverage of the area.

A limitation that we have is that we can capture a limited number of images given our ability to manufacture robots and the time we have. Our program compensates for this by performing a cost-and-benefit analysis, taking into account factors such as terrain, obstacles, and other objects of interest. Our research will advance autonomy and boost efficiency through cost containment and will further the field of artificial intelligence.

OBJECTIVES

To develop a robotic path planning behavior that determines optimal waypoints for panoramas through a cost-and-benefit analysis

To explore methods to optimize usage of computer resources

METHODS

We developed the GUI using Java Swing and JFSL and the program using Java.

The program simulates terrain and obstacles through population, terrain, and factors in traversal and opportunity costs of wasted visual coverage.

The program rewards the robot for providing visual coverage of the area and effectively any object of interest.

TESTING

We programmed a Robot Simulator that artificially sends positions to the program and automatically adjusts positions according to the published waypoint, which is useful for debugging purposes and helps ensure program compatibility with the robot. As our lab was upgrading software libraries, we chose not to deploy the code on the robots.

RESULTS

Scanner piloted between a 3.6 GHz Intel Xeon 16 GB RAM computer with an Intel Core i5-6500 processor and the Ubuntu 14.04 operating system.

Optimized line search mechanism, using some concepts of the greedy algorithm, which is designed to obtain the best result available at a time, has asymptotic time complexity of O(n), increasing as an area of coverage grows, whereas the area of the map.

Complete coverage of a map is not guaranteed, especially in large maps.

FUTURE WORK

Improve computational efficiency by implementing a more sophisticated line search algorithm that employs some type of wave search and evaluates the map in a holistic manner which can deliver a best overall result.

Incorporate obstacles in planning the path of traversal from the original position to the desired resource.

Revise the area parameter and represent the area as a graph with multiple edges and vertices that is not predetermined for flexibility.

CONCLUSION

Taking into account factors such as terrain and obstacles, we can perform a cost-and-benefit analysis and create a program that determines locations where robots can take a panorama that they cannot afford to waste visual coverage. Our tests prove that in most cases, especially in large areas, the optimal solution is determined by the map and will always provide complete coverage.

In addition, different implementations of search algorithms may impact the performance and efficiency of the program. Indeed, we believe that through further research, this program can be further improved to become more competent and be able to use a variety of computer simulations.

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