Research question: What is the best traversal algorithm for the University Rover Challenge (URC)?

Background

- **Autonomous Traversal**
  Autonomous traversal refers to the robot task of navigating in an environment to reach a certain goal location. It has been a huge topic of interest for research with applications in the robotics as well as the autonomous vehicle industry.

- **URC Autonomous Navigation Mission**
  Challenges the designed rover to autonomously travel to a location with given GPS coordinates but is complicated by unchartered obstacles along the way.

Current Navigation Algorithms

- **Simultaneous Localization and Mapping (SLAM)**
  Map-building using range sensors while the robot is moving around and exploring an unknown environment.

- **Global Map: Graph Search, Sampling Methods**
  Predefined map of the environment, which includes all the static obstacles. An optimized path could be pre-generated using different methods and guide the traversal.

- **Velocity-based methods**
  Algorithms that search the velocity space of the robot based on its current position and find an optimal path.

- **Potential Fields**
  Algorithms that models the space using physical space where the target exerts an attractive force on the robot and obstacles exert negative forces.

- **Reactive Methods**
  Algorithms that detect critical obstacles and guides the robot around them towards a waypoint to the goal.

Algorithm

- **Algorithm Overview**
  A simple design of a reactive algorithm that uses an encounter-conquer strategy.

![Algorithm Flowchart](image)

- **Shortcomings of the Algorithm**
  A specially designed map, with obstacles covering the robot from three sides, would cause the algorithm to fail in simulation. Only reaches a local optimum constrained by the iterative nature.

- **Comparison to other Algorithms**
  Computationally fast for each decision point. Does not require extensive use of memory. Does not require a global map – fits the constraints of the URC. Avoids obstacles is usual configurations.

Results

- **Theoretical results**
  The algorithm provides satisfies the major expectation of being both computationally and financially cheap while being effective for ‘usual’ obstacles.

- **Testing on Mars Rover**
  Yes to be tested on the actual rover to determine the full efficacy of the algorithm.

Future work

- **Integration of the other aspects of the Rover**
  Integrate sensors and GPS module for obstacle detection. Include physical constraints of the Rover, e.g., size, steering angle etc.

- **Further improvement on algorithm**
  Diminish special cases where the algorithm will fail.

- **Implementation on Rover and the URC**
  Test performance during the competition challenge.

- **Potential of integrating AI and neural networks**
  Follow current trends to improve the algorithm.

References

1. Koubha, A., ROS for Beginners II: Localization, Navigation and SLAM, UDEMY course