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An Efficient Robot Navigation Model in a Multi-Target Domain amidst Static and Dynamic Obstacles

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Abstract : This paper presents an efficient robot navigation model in a multi-target domain amidst static and dynamic workspace obstacles. The problem is that of developing an optimal algorithm to minimize the total travel time of a robot as it visits all target points within its task domain amidst unknown workspace obstacles and finally return to its initial position. In solving this problem, a classical algorithm was first developed to compute the optimal number of paths to be travelled by the robot amidst the network of paths. The principle of shortest distance between robot and targets was used to compute the target point visitation order amidst workspace obstacles. Algorithm premised on the standard polar coordinate system was developed to determine the length of obstacles encountered by the robot hence giving room for a geometrical estimation of the total surface area occupied by the obstacle especially when classified as a relevant obstacle i.e. obstacle that lies in between a robot and its potential visitation point. A stochastic model was developed and used to estimate the likelihood of a dynamic obstacle bumping into the robot's navigation path and finally, the navigation/obstacle avoidance algorithm was hinged on the hybrid virtual force field (HVFF) method. Significant modelling constraints herein include the choice of navigation path to selected target points, the possible presence of static obstacles along a desired navigation path and the likelihood of encountering a dynamic obstacle along the robot's path and the chances of it remaining at this position as a static obstacle hence resulting in a case of re-routing after routing. The proposed algorithm demonstrated a high potential for optimal solution in terms of efficiency and effectiveness.

Keywords : multi-target, mobile robot, optimal path, static obstacles, dynamic obstacles
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