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Application of Vision Based Target Tracking and Motion Planning Algorithm in Dynamic Environment

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Abstract
Real time information about the environment is an important factor on availability of path planning [1]. The variance of applications and tracking performances keep increasing by involving deep learning algorithms and improving computer power [2]. In this paper, we present application of vision-based detection and tracking of multiple robots and dynamic obstacles for autonomous robot motion planning to the multiple point of destinations. Visual tracking provides key information for estimating the trajectory of detected objects which is an essential for motion planning [3].
In our work, a dynamic and unstructured environment is simulated in two-dimensional space. The randomly created obstacles are classified as ground-stationary, moving and aloft-stationary by learning based object detector YOLOv5. While the mobile robots cannot go through the ground-stationary obstacles, they can move under the aloft-stationary obstacles where visual data (measurement) is interrupted. After detection and classification of the objects (obstacles and mobile robots), they are tracked and identified by a learning based multiple object tracker so that their trajectories are estimated. Accurate object motion prediction is required for motion planning especially when the measurement coming from the object detector is not available. By sharing the estimated states and point of destinations among mobile robots, they are autonomously guided to the most cost-effective point of destination. During the real time motion planning, the optimal point of destination for each mobile robot is reassigned according to the dynamic environment. A cost function is defined that aims to enable mobile robots to reach the point of destinations without colliding with each other and the obstacles. Reasonable limits have been determined for the actions of the mobile robots by considering the physical constraints. Simulations in a dynamic environment demonstrate the success of the vision-based target tracking and motion planning algorithm in getting the mobile robots to the destination points by avoiding obstacles.

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