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An Exponential Field Path Planning Method for Mobile Robots Integrated with Visual Perception

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Abstract : Global vision, whether provided by overhead fixed cameras, on-board aerial vehicle cameras, or satellite images can always provide detailed information on the environment around mobile robots. In this paper, an intelligent vision-based method of path planning and obstacle avoidance for mobile robots is presented. The method integrates visual perception with a new proposed field-based path-planning method to overcome common path-planning problems such as local minima, unreachable destination and unnecessary lengthy paths around obstacles. The method proposes an exponential angle deviation field around each obstacle that affects the orientation of a close robot. As the robot directs toward, the goal point obstacles are classified into right and left groups, and a deviation angle is exponentially added or subtracted to the orientation of the robot. Exponential field parameters are chosen based on Lyapunov stability criterion to guarantee robot convergence to the destination. The proposed method uses obstacles' shape and location, extracted from global vision system, through a collision prediction mechanism to decide whether to activate or deactivate obstacles field. In addition, a search mechanism is developed in case of robot or goal point is trapped among obstacles to find suitable exit or entrance. The proposed algorithm is validated both in simulation and through experiments. The algorithm shows effectiveness in obstacles' avoidance and destination convergence, overcoming common path planning problems found in classical methods.

Keywords : path planning, collision avoidance, convergence, computer vision, mobile robots
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