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A NOVEL FAST MOTION PLANNING ALGORITHM FOR SPACE REDUNDANT ROBOT

Abstract

The fast motion planning of space redundant robot in operating tasks (target capture, mechanical maintenance, etc.) is a key problem. Factors such as the relative motion of obstacles, the huge cost of collision, and the high degree of freedom all urgently require the faster motion planning capability of space redundant robot. Therefore, a novel motion planning algorithm is proposed, named DYNAMIC-PROBABILITY-STABLE-SPARSE-RRT(DP-SST), which can not only realize fast and safe motion planning, but also optimize the trajectory of the robot at the same time. In the proposed algorithm, by introducing the dynamic change law of target bias probability based on collision feedback, the planning efficiency of STABLE-SPARSE-RRT (SST) algorithm can be improved, and the conflict between planning efficiency and trajectory optimization in SST can also be solved. In the process of motion planning, if the obstacles are densely distributed in the range extended by the path map in the current state, the sampling points are driven by the dynamic target bias probability to accelerate the global expansion of the path map. On the contrary, the dynamic target bias probability drives the path map to expand to the target point. In addition, in order to further improve the speed of motion planning, the dynamic collision detection of manipulator-obstacle is simplified to the intersection test of discrete time line segment and discrete orientation polytope(k-DOP) to complete fast collision detection. The collision detection algorithm not only meets the detection efficiency and accuracy of dynamic obstacle collision detection requirements, but also provides sufficient operating space for the manipulator combined with the characteristics of k-DOP. Finally, the simulation of the space redundant robot with free floating base is completed for the operation task in the dynamic obstacle environment, and the results show that the proposed algorithm can be better applied to the environment where obstacles are unevenly distributed in the operation task, and can not only achieve fast motion planning, but also optimize the trajectory of the robot.