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COORDINATED PATH PLANNING STRATEGY FOR DUAL-ARM SPACE ROBOT USING B SPLINE

Abstract

In light of the space robots currently planned by worldwide space agencies, an increase in number and the capacity of robot applied in space missions will be a foregone conclusion in the coming future. The complex space missions call for the application of multi-arm robotic system to execute dexterous manipulator in space. Nevertheless, how to design an appropriate coordination strategy for multi-arm space robot is a huge challenge when multi-objective, such as safety, reliability and accuracy are required. Moreover, in the space robotic programs, space missions executed under free-floating mode are of great interests to the researchers. However, space robots exhibits special properties due to the dynamic coupling effect between the space manipulators and the spacecraft (base). Accordingly, particular path planning techniques have to be developed to cope with the dynamic coupling effect and coordination of multi-arm space manipulators.

In this paper, a coordinated path planning strategy by fully exploiting the dynamic coupling effect between the kinematically redundant dual-arm robot and spacecraft base is presented to cope with different objectives. The reason for choosing kinematically redundant manipulator is the existence of infinite solutions which can be employed to fulfil additional constraints, such as regulating base attitude, or collision avoidance, and so on. B spline curve for its simplicity and normalization is chosen to delineate the end-effector's path in task-space. The path constraints of the end-effectors are satisfied through determination of the path execution time. On that basis, motion coordination of the dual-arm space robot is implemented in the framework of the task-priority based redundancy resolution. Simulation results are presented for coordinated path planning of two kinematically redundant manipulators mounted on a free-floating spacecraft and demonstrate the effectiveness of the proposed method.