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A BACKSTEPPING SLIDING MODE FAULT-TOLERANT CONTROL FOR FREE FLOATING SPACE MANIPULATOR ON REACTION NULL-SPACE

Abstract

Trajectory tracking control of space robots is of great importance to space missions, which require on-orbit manipulations. An adaptive sliding mode fault-tolerant control method based on the reaction null space was proposed for a free-floating rigid space manipulator with three links. Firstly, the reaction null space motion planning was made, and the coupling inertia matrix of the link and the base was determined, and the reactionless desired trajectory was determined by the theory of the reaction null space. Then the sliding mode controller was designed according to the backstepping control strategy to convert the low-order sliding mode surface function into a high-order state, in which an adaptive term was added. This control algorithm takes account of merits of fast terminal sliding mode controller, nonsingular sliding mode controller and integral sliding mode controller, which can respond quickly and reduce the vibration of the system. Meanwhile, the adaptive term assures this controller to respond and stabilize at higher speed, and to be fault-tolerant. Finally, the effectiveness and fault-tolerance of the control method was proved by the simulation.