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ROBUST TRACKING CONTROL OF DUAL-ARM FLEXIBLE JOINT SPACE ROBOT BASED ON BACKSTEPPING TECHNOLOGY

Abstract

Space robots will play a significant role in the future missions such as the construction, repairment and maintenance of satellites and space stations. Wherefore, it has received extensive attention. Different from the terrestrial robot, the space robots work in microgravity environment. Therefore, there exsits high dynamic coupling between the base and arms. In other words, the motion of arms will disturb the position and attitude of base, especially for the dual-arm space robots. Furthermore, as the development of science technology, future space robots will become lighter and more flexible. And the structure flexibility has to be considered in the controller design process if high performance is required. However, due to the highly nonlinear equations of space robots motion, most controllers aim at the control problems of rigid space robots or single-arm flexible joint space robots. In this paper, the dynamic control for coordinated motion between the base's attitude and the arm's joints of free-floating dual-arm flexible joint space robot with uncertain parameters is considered. The system can be viewed as a cascade control system, which consist of rigid subsystem and actuator dynamics system. According to the principle of backstepping control, firstly, the integral backstepping sliding model control for rigid subsystem is designed to generated virtual control variable. Secondly, an adaptive RBF sliding model control scheme is designed to control the actuator dynamics system to track this virtual control variable. Stability proof of the overall closed-loop system is given via the Lyapunov method. Two key advantages of this scheme are as follows: (i) the proposed control approach can solve the control problems of space robot with unknown parameter; (ii) the control scheme can avoid the measurement of joint acceleration and the complex derivative calculation. Simulation results confirm the effectiveness of the proposed control scheme.This paper work is supported by the National Natural Science Foundation of China (Grant No. 11372073)