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TIME DELAY ESTIMATION CONTROL OF FLEXIBLE-JOINT DUAL-ARM SPACE ROBOT

Abstract

As the development of astronautics technology, more and more spacecraft are sent into space, and the astronautics operation missions for fault spacecraft capturing and recycling are becoming heavier. To ensure the smooth implementation of various space missions, space robots will undertake an important role undoubtedly. Because of the preciousness of space fuel, space robots are usually operated in the base's position-uncontrolled mode which can consume less energy. In order to increase the system bearing capacity, etc., dual-arm space robots are inevitably utilized in future space explorations. Besides, the appearance of flexible space robots also attracts much attention by human beings. In this paper, the elastic deformation of joint was described by the linear torsion spring, in terms of the principle of linear and angular momentum and the Lagrange method, the dynamic model of flexible-joint dual-arm space robot was derived. According to the principle of time delay estimation control, firstly, the rigid motion tracking control scheme based on time delay estimation fuzzy wavelet neural network control is proposed. Secondly, an adaptive neural network sliding mode 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. We achieve unknown dynamics of space robot system online by using time delay estimation and compensate control process. 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.