Paper ID: 28793
poster

66th International Astronautical Congress 2015

SPACE SYSTEMS SYMPOSIUM (D1)
Interactive Presentations (IP)

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INDIRECT ADAPTIVE FUZZY H-INFINITE CONTROL OF THE FREE-FLOATING SPACE ROBOT SYSTEM WITH FLEXIBLE JOINTS

Abstract

With the development of the space technology, the influences of the space robot system's flexibility (including flexible joint and flexible manipulator) should not be ignored. In the practical application of space, space robot joint has flexible characteristic, thus discusses the modeling and control of dynamic problems of body position controlled and attitude uncontrolled of the free floating space robot with flexible joints. The dynamical equation of the free-floating space robot with flexible joints is successively derived by combining with the system linear momentum and angle momentum conservation, Lagrange equation, the assume mode method used to describe the linear spring model of the flexible joint. With the joint flexibility compensating concept, the singular perturbation method is extended to control the space robot with general flexible joints successfully. The system is decomposed into a slow subsystem and a fast subsystem. For purposes of realizing the accurate positioning and the elastic vibration active suppression of the free-floating space robot system with flexible joints, indirect adaptive fuzzy H-infinite control algorithm based on a joint flexibility compensation controller is proposed. For the slow subsystem, the design of indirect adaptive fuzzy H-infinite control algorithm. This algorithm is composed of two parts: the first is the fuzzy logic system, use it to approximate the trajectory tracking of the system, and achieve the desired trajectory asymptotically; second is a robust H-infinite control, overcome the fuzzy approximation error and eliminate the influence of the external disturbance to the output tracking error, and ensure the stability of the system. For the fast subsystemthe design of a joint flexibility compensation controller. Based on Lyapunov stability theory proved that this algorithm can ensure the control system is asymptotically stable. The control algorithm proposed in this paper is verified by the system numerical simulation experiments. The simulation results based on a planar two-joint free-floating space robot with flexible joints proved the validity and feasibility of the proposed control algorithm.