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TERMINAL SLIDING MODE CONTROL AND VIBRATION SUPPRESSION OF FLEXIBLE JOINT MANIPULATOR OF THE SPACE STATION WITH ELASTIC FOUNDATION

Abstract

In recent years, with the continuous development of space technology, human activity has been further extended to explore space. Human completed from atmosphere to outer space, gradually expand to Mars from the moon. Space technology expanded from satellite launching to establish space station that human engaged to complete scientific and technological research. It is obvious that space will become the new place where human can survival and working in. But due to the big difference in temperature, small gravity, high vacuum, strong radiation environment, making the human in space under the threat of increased greatly. Using of the flexible joint manipulator of the space station to assist or replace human to finish a large number of work in space has become the world's consistent goal. Space robot is dominated by the space robot substrate and carry on the base of t he mechanical arm, can assist or replace human to finish special task assignment. For example : recycling and release the satellite, repairing the station, refuel for aircraft. Therefore, the research of the joint control system of flexible joint manipulator of the space station has great significance for human space exploration activities. The trajectory tracking control and the vibration suppression of flexible joint manipulator of the space station with elastic base are discussed in this paper. The Lagrangian method and the momentum conservation are adopted in building the dynamic equations. The system can be viewed as a cascade control system, which consist of rigid subsystem of elastic base and actuator dynamics system of flexible joint. For the rigid subsystem of elastic base, in order to damp out vibration of elastic base, conception of virtual force is used to design hybrid desired trajectory which integrate both flexible mode and rigid motion, through transforming the original control scheme and a robust adaptive sliding mode control based on virtual force conception is proposed. Since using the concept of virtual control force, so rigid trajectory track is guaranteed just by inputting one control, and at the same time, active suppression on flexible vibration of elastic base is made, it's more suitable in practical using for flexible joint manipulator of the space station space system. At the same time, in the presence of unknown parameters, using cascade control method can effectively suppress the vibration of the flexible joint. Theoretical analysis and simulation results verify the feasibility of the proposed control schemes.