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DYNAMIC MODELING AND FINITE-TIME CONTROL STUDY FOR FREE-FLOATING SPACE ROBOTS WITH ELASTIC BASE,ELASTIC JOINTS AND FLEXIBLE LINKS

Abstract

In recent years, with the development of space technology and the further development of human space exploration, space robot technology has become the key technology of in-orbit service in the future. Considering elasticity and free-floating base are two main issues that cause vibrations and instability of space robots, the dynamic modeling and control of free-floating space robots with elastic base, elastic joints and flexible links is of great significance. For the active vibration and motion control of space robot with multiple elastic elements, a finite-time controller based radial basis neural network is proposed. First of all, the dynamic models of the space robot system with multiple elastic elements is derived by multi-body theory. After that, various singular perturbation control algorithms are leveraged to the system is decomposed into a slow subsystem which represents the rigid motion and a fast subsystem which represents the flexible links, elastic joints and elastic base vibration. For the slow subsystem, a finite-time controller based on radial basis neural network is designed to realize the rigid desired trajectory tracking. For the fast subsystem, the linear quadratic optimal control method is adopted to suppress the vibrations of flexible links, elastic joints and elastic base simultaneously. The proposed control method can realize active vibration suppression, and has good robustness and anti-interference performance. Numerical simulation verified the effectiveness of the proposed control scheme.