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ROBUST CONTROL AND DOUBLE FLEXIBLE VIBRATION ACTIVE SUPPRESSION OF SPACE ROBOT WITH FLEXIBLE-LINK AND FLEXIBLE-JOINT THAT USED IN SPACE STATION

Abstract

With the development of the space technology, the influences of the space robot system's flexibility (including flexible manipulator and flexible joint) should not be ignored. Based on the above backgrounds, the dynamics modeling and motion, vibration active control of free-floating space robot system with flexible manipulator and flexible joints are developed in this paper.

The flexibility of space robot system is mainly embodied in links of space robot and their connected hinge joints. For the reason of complexity of space robot system structure, researchers usually pay less attention on the system which both has flexible joint and link. So it's discussed in this paper for dynamics simulations, algorithm design of motion control, and active suppression problem of joint and link double flexible vibration for space robot system with flexible-joint and flexible-link under the situation of parameter uncertain. With the conservation relationship of linear and angular momentum, a system dynamics model is established by Lagrange equations, linear torsion spring and hypothesis modal method. To solve the problem that the application of traditional singular perturbation approach is limited by joint flexibility, a joint flexibility compensation controller is introduced, which can properly enhance the equivalent stiffness of joints. Then, based on singular perturbation theory, the whole system is resolved into flexible arm subsystem and motor moment power subsystem on the basis of joint flexible compensation controller and singular perturbation technology. An robust control scheme is proposed for flexible arm subsystem, since tracking virtual desired trajectory, so rigid trajectory track is guaranteed just by inputting one control, and at the same time, active suppression on flexible vibration is made. And for motor moment power subsystem, a moment differential feedback controller is designed to inhibit system elastic vibration that caused by joint flexibility. Computer numerical simulation comparison experiment testifies the reliability and availability of this scheme.