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DYNAMIC MODELING AND CONTROL OF FREE-FLOATING SPACE MANIPULATOR SYSTEM WITH LINKS AND JOINTS

Abstract

Space robot are proposed for assisting the outer space explorations. Their dynamic modeling and control problems have been the challenging research topics of human beings. The flexibility of space robot system mainly embodies in arm bar of space robot and hinge joints that connect with each arm bar. Because of the complexity of space robot system structure, previous researchers paid less attention on the system which both have flexible joint and flexible arms.Thus this paper discusses dynamics simulation of flexible joints and flexible arm space robot system, motion control algorithm design and hierarchical points order active inhibition problem of arm and joints double flexible vibration that all under the situation of parameter uncertain. For the flexile manipulator , rigid-flexible coupling dynamics model is established based on the lagrange equations by regarding the flexible joints as a linear torsional spring model and the approach of assumed modes is adopted to describe the deformation of the flexible link. Then discusses the trajectory tracking and vibration suppression of space manipulator when the base's attitude is controlled. First of all, to reduce the influence of joint flexibility , a joint flexibility compensator was introduced which can increase the equivalent joint stiffness of systems. Secondly, with the help of singular perturbation technique , two subsystems including the fast subsystems which expressed the torque dynamics equation and slow subsystems which expressed space manipulator with flexible link only. A kind of torque differential feedback controller is proposed for stabilize the fast subsystem . In order to track the desired tacjectories and damp out vibration at the same time , the conception of virtual control force is used to design virtural desired trajectory which integrate both flexible mode and rigid motion. Then let the designed controlled of continuous terminal sliding mode for slow subsystem to track this virtual desired tracjectories. Simulation results are given to illustrate the feasibility and effectiveness of the proposed control scheme. Acknowledgement This paper work is supported by the National Natural Science Foundation of China (Grant No.11072061)