Paper ID: 70129
student

20th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 20th IAA SYMPOSIUM ON SPACE DEBRIS (IP)

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COMPOSITE ACTIVE DISTURBANCE REJECTION CONTROL AND RESIDUAL VIBRATION SUPPRESSION FOR FREE-FLOATING SPACE ROBOTS WITH ELASTIC JOINTS AND FLEXIBLE LINKS COMPOUND ACTIVE DISTURBANCE REJECTION CONTROL

Abstract

Aiming at the elastic joints and flexible links free-floating space robots with parametric uncertainties and modeling errors, a motion and vibration suppression composite controller based on composite active disturbance rejection was proposed. First, the dynamical model of a free-floating space robot with elastic joints and flexible links is established by the Lagrange equations. Second, based on singular perturbation theory, the model of a rigid slow subsystem and a flexible fast subsystem are derived. An active disturbance rejection controller based on composite error is proposed for slow subsystem. The proposed method uses the extended state observer combined with composite errors to dynamically estimate the total disturbance terms of the system, which improves the anti-disturbance ability of the system. At the same time, the vibration suppression of the flexible links are realized by combining the virtual force. The linear quadratic optimal control is proposed to suppress the vibration of elastic joints and elastic base. In addition, in order to achieve the rigid desired trajectory tracking and actively suppress the vibration of the flexible links, the concept of virtual force was introduced to design a hybrid trajectory composite active disturbance rejection control scheme. The linear quadratic optimal control is used to suppress the vibration of elastic joints. Numerical simulation results show that the proposed control algorithm can accurately track rigid motion and effectively suppress multiple elastic vibration.