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空间站姿态/动量联合非线性控制

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Nonlinear Control of Attitude and Momentum for Space Station

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摘要 从Lyapunov稳定性理论出发,设计了一个非线性控制器,实现了空间站姿态和控制力矩陀螺角动量的联合控制。在此基础上,为抑制周期性环境干扰力矩对姿态控制性能的影响,引入了周期性扰动抑制滤波器,对非线性姿态/动量控制器进行了改进。改进的控制器不但可以抑制空间站姿态的周期性波动,而且可在满足特定飞行任务的前提下,建立空间站指向和控制力矩陀螺动量管理间的折中。控制器参数物理意义明确,易于调整。对空间站姿态控制/动量管理系统的仿真结果表明,该控制器是可行的。

关键词: 飞行器控制 姿态控制 非线性控制 空间站 控制力矩陀螺

Abstract: Since space station is a nonlinear system in essence, it is difficult to realize the high-performance attitude control and momentum management using ordinary linear control strategies. In this paper, a nonlinear attitude/momentum controller is designed according to the nonlinear dynamics of space station. However, the periodic fluctuations still exist in the attitude and attitude rate due to the cyclic disturbances, such as the aerodynamic torque. Therefore, an improved nonlinear controller is presented for the extended attitude control/momentum management system after a cyclic-disturbance rejection filter is introduced. Using this controller, the attitude fluctuations can be restrained to great extent. Furthermore, this controller can establish a proper tradeoff between station pointing and momentum management of control moment gyroscopes, while satisfying the specific mission requirements. Controller parameters are easy to regulate since they have definite physical meanings. Simulation results of a certain space station indicate that the controller presented above is feasible.

Keywords: spacecraft control attitude control nonlinear control space station control moment gyroscopes

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