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基于时滞不确定理论的导弹鲁棒控制系统设计

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Robust Control System Design for Missiles Based on Theory of Time-delay and Uncertainty

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摘要 针对含有参数不确定性、干扰和响应延迟的控制系统鲁棒性设计问题,采用状态反馈控制方法设计控制系统,使得闭环控制系统在保证渐进稳定的同时满足H_∞性能指标要求。建立导弹控制系统的线性离散模型,将提出的基于时滞不确定理论的设计方法应用于导弹俯仰-偏航通道的自动驾驶仪设计。通过仿真计算,验证了提出的控制系统设计方法在气动参数摄动±30%且时滞时间为1个采样周期时,能够保证导弹自动驾驶仪快速稳定地跟踪参考输入,具有良好的抗干扰特性,并且能够解决由于不确定性和响应延迟引起的不稳定问题。

关键词: 自动驾驶仪 鲁棒控制 H_∞控制 时滞不确定 线性矩阵不等式

Abstract: A state feedback controller is designed for a closed-loop control system with parameter and input uncertainty and time-delay which can meet the requirements of closed-loop asymptotic stability and satisfy H_∞ performance at the same time. A linear discrete model for a missile control system is built and the method proposed is applied to the missile pitch-yaw channel autopilot design. The simulation results show that the proposed control system design method can ensure that the missile autopilot track the reference inputs quickly and demonstrate good performance of anti-jamming under the condition that the aerodynamic parameter perturbation is ±30% and the delay time is a sampling period. In addition, the problem of instability caused by uncertainty and time-delay is solved.

Keywords: autopilot robust control H_∞ control time-delay and uncertainty linear matrix inequality

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