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### 基于SMDO的滑模控制器设计及其在导弹上的应用

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### Design of Sliding Mode Controller Based on SMDO and Its Application to Missile Control

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**摘要** 提出了一种基于滑模干扰观测器(SMDO)的滑模控制器(SMC)设计方法。针对一类级联多输入多输出(MIMO)非线性系统,根据奇异摄动原理将其分为内、外回路分别进行控制器设计。以外回路为例,分析了传统基于饱和函数的滑模控制的鲁棒性,针对其在面临干扰时鲁棒性较差的问题,在名义滑模控制律的基础上设计了基于超扭曲算法的SMDO以实现对于干扰的估计和补偿。将该方法应用于导弹控制系统的设计中,通过仿真表明,基于SMDO的滑模控制器(SMDO-SMC)有效提高了控制系统的鲁棒性和性能。

**关键词:** 滑模干扰观测器 滑模控制 超扭曲算法 导弹 鲁棒控制

**Abstract:** A sliding mode controller (SMC) design approach based on the sliding mode disturbance observer (SMDO) is proposed. A class of cascade multiple-input multiple-output (MIMO) nonlinear system is separated into outer and inner loops based on the singular perturbation principle, and the controllers are designed in the two loops respectively. The robustness of the traditional saturation-function-based sliding mode controller is analyzed in the outer loop, and it is found to be weak in the presence of disturbances. To overcome this problem, together with the nominal sliding mode control law, SMDOs based on the super-twisting algorithm are designed to estimate and compensate for disturbances. Finally, the approach is applied to a missile control system design. The simulation results demonstrate that SMDO-based sliding mode controller (SMDO-SMC) effectively improves both the robustness and control performance of the control system.

**Keywords:** sliding mode disturbance observer sliding mode control super-twisting algorithm missiles robust control

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