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论文

带有广义不确定性的导弹非线性控制系统设计

胡云安[1,2], 晋玉强[2], 崔平远[1]

1. 哈尔滨工业大学航天工程与力学系, 黑龙江哈尔滨 150001;2. 海军航空工程学院自动控制系, 山东烟台 264001

Nonlinear Controller Design for Missile System with a General Set of Uncertainties

HU Yun-an[1,2], JIN Yu-qiang[2], CUI Ping-yuan[1]

1. Department of Astronautics and Mechanics, Harbin Institute of Technology, Harbin 150001, China;2. Department of Automatic Control, Naval Aeronautical Engineering Academy, Yantai 264001, China

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摘要 在导弹系统存在广义不确定性情况下,提出了一种基于反演设计技术和RBF神经网络的导弹非线性自适应控制系统设计方法。设计过程中将不确定性对系统的影响合成为一项,然后应用RBF神经网络消除了其对系统的影响,有效地解决了控制系数矩阵未知时控制器设计问题,同时放松了现有文献中对控制系数矩阵不确定性的要求。应用Lypunov稳定性定理推导出神经网络权重矩阵的自适应调节律,并证明了闭环系统的所有信号均有界且指数收敛至系统原点的一个邻域。最后给出的BTT导弹非线性六自由度数字仿真结果验证了该算法的有效性。

关键词： RBF神经网络 非线性系统 反演 广义不确定性

Abstract： Based on RBF neural networks and backstepping control techniques, a nonlinear adaptive controller design method is proposed for missile control systems with a general set of uncertainties. The effect of the uncertainties is synthesized into one term in the design procedure. Then RBF neural networks are used to eliminate its effect. The control problem is resolved while the control coefficient matrix is unknown. At the same time, the rigorous conditions on the uncertainties, which exist in the literature at the present stage, are relaxed. The adaptive tuning rules of RBF neural network weight matrix are derived by the Lyapunov stability theorem. All signals of the closed-loop system are bounded and exponentially converge to the neighborhood of the origin globally. Finally, nonlinear six-degree-of-freedom （6-DOF） numerical simulation results for a bank-to-turn （BTT） missile model are presented to demonstrate the effectiveness of the proposed method.

Keywords： RBF neural networks nonlinear system backstepping general set

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