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论文

空空导弹大角度姿态反作用喷气控制

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Large Angle Attitude Reaction Jet Control for an Air-to-air Missile

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摘要 为研究具有大离轴角及越肩发射能力的先进空空导弹初始段敏捷转弯方法,研究了装有反作用喷气控制系统的空空导弹的大角度姿态过失速机动控制律。反作用喷气控制系统用来提供大角度敏捷转弯时大攻角飞行的控制力矩。利用时间尺度分离的方法将导弹的姿态动力学和运动学系统分别看作快子系统和慢子系统。用李亚普诺夫方法设计了慢子系统控制律,利用滑动模态方法设计了快子系统控制律,在该控制律作用下,导弹闭环系统不仅是稳定的而且其动态品质也可以得到保证。分析了控制系统的鲁棒性,结果表明所提控制方法能够有效消除空空导弹大角度姿态机动时转动惯量变化以及各种力矩干扰的影响。最后给出了一个实例来说明姿态控制在空空导弹敏捷转弯中的应用。

关键词： 空空导弹 大角度姿态机动控制 反作用喷气控制 滑动模态控制

Abstract: This paper investigates the large angle attitude post stall maneuver control for the agile turn phase of an air-to-air missile that has high off-boresight capability and head reverse maneuverability. Reaction jet control system is used on this type of missile since the controllability of the fins is almost zero when the angle of attack is large during the agile turn post stall maneuver. The attitude dynamical and kinematical systems of the missile are divided into fast subsystem and slow subsystem by time scale separation. The control law for fast subsystem is designed by sliding mode method, and the slow subsystem control law is designed by Lyapunov method, which can stabilize the slow subsystem and ensure the response performance. The robustness of the control law is analyzed. The result shows that the control law can completely eliminate the effect of the variation of moment of inertia and the moment disturbance if the reachability condition of the sliding mode is met. An example of the application of the attitude control law in the agile turn of an air-to-air missile is given at the end.

Keywords: air-to-air missile large angle attitude control reaction jet control sliding mode control

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