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高超声速滑翔飞行器摆动式机动突防弹道设计

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Weaving Maneuver Trajectory Design for Hypersonic Glide Vehicles

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摘要 为提高大升阻比高超声速滑翔飞行器机动突防能力,提出了一种侧向摆动式机动弹道的设计方法。基于动态逆的思想,建立了侧向摆动式机动弹道的弹道形式和所需倾侧角间的关系模型;在平衡滑翔假设下,将包括动压、过载和热流在内的飞行约束转化为迎角约束,从而确定了迎角-速度飞行走廊;在此基础上,设计了平衡滑翔情况下满足侧向摆动式机动及飞行约束所需的迎角变化规律。根据所设计的迎角和倾侧角,即可实现平衡滑翔情况下预定机动模式的侧向机动。以HTV(Hypersonic Technology Vehicle)为例进行仿真分析,结果表明该方法能够快速设计出预定机动幅度和机动频率的侧向摆动式机动突防弹道。

关键词: 高超声速飞行器 摆动式机动 动态逆 突防 迎角-速度飞行走廊 平衡滑翔

Abstract: A planning approach of lateral weaving maneuver trajectory is proposed to improve the penetrability of a hypersonic glide vehicle with relatively high lift-drag ratio. Dynamic inversion is employed to establish the relationship model between the lateral weaving maneuver trajectory and the bank angle. Then, flight constraints including dynamic pressure, overload, and heating rate are converted to angle of attack constraints on the equilibrium glide assumption, so that the angle of attack vs velocity flight corridor can be specified. Based on the flight corridor and equilibrium glide assumption, the angle of attack is determined which can realize lateral weaving maneuver and satisfy all the flight constraints. The required lateral maneuver trajectory on the equilibrium glide assumption is specified according to the designed angles of attack and bank. This trajectory planning approach is tested using the HTV (Hypersonic Technology Vehicle) model.Simulations demonstrate that the approach is applicable of maneuver trajectory planning for specified weaving-amplitudes and weaving-frequency.

Keywords: hypersonic vehicle weaving maneuver dynamic inversion penetration angle of attack vs velocity flight corridor equilibrium glide

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