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多操纵面飞翼布局作战飞机的控制分配方法

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Control Allocation Method for Combat Flying Wing with Multiple Control Surfaces

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摘要 飞翼布局作战飞机取消了升降舵和常规方向舵,采用冗余的新型多操纵面配置新方案,并使用大偏角的阻力方向舵来实现其偏航操纵。阻力方向舵的偏转会同时引起3个轴向的附加力和力矩,且具有单侧偏转为偏航操纵、双侧偏转为增阻减速的功能特点。为了解决这类新布局飞机操纵面多于控制指令的冗余设计和操纵面无明确功能轴向的新问题,在其飞行控制系统中引入了控制分配环节。通过数学仿真和计算,进行了广义逆方法、直接分配方法和基于非线性规划的优化方法在飞翼布局作战飞机控制分配上的应用对比研究。仿真结果表明,基于非线性规划的优化方法能够较好地解决操纵面模型非线性、阻力方向舵的双侧偏转和阻力控制等问题,更适用于飞翼布局作战飞机使用。

关键词: 飞翼 多操纵面 阻力方向舵 控制分配 优化 非线性规划 飞行控制

Abstract: With no elevator and conventional rudder, a combat flying wing is mounted with redundant innovative control surfaces, and uses drag rudders to realize directional control. The drag rudders can generate three-axis forces and moments, with features of single side deflect to fulfill directional control, and both side deflect to increase drag and decelerate the aircraft. In order to solve the new problems of the number of control surfaces exceeding the control commands and the lack of clear axial direction of the control surfaces, control allocation is introduced to the the flight control system of the combat flying wing. Through simulation and calculation, a comparative study is made of the implementation on the control allocation of a combat flying wing by the three methods of generalized inverse, direct allocation and optimization based on nonlinear programming. The results indicate that optimization based on nonlinear programming could comparatively better solve the problems of the nonlinearity of the control model, both-side-deflect and drag control of the drag rudders. It is concluded that this method is more suitable for implementation on a combat flying wing.

Keywords: flying wing multiple control surfaces drag rudder control allocation optimization nonlinear programming flight control

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