Baseline Flight Control System for High Altitude Long Endurance Aircraft

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High Altitude Long Endurance (HALE) aircraft consist of extremely light-weight structures in combination with a high wingspan and high aspect ratio. The coupling of these properties results in a dynamic behavior of the aircraft system which is different to classical transport or unmanned aircraft configurations. The key finding in the analysis of the dynamic behavior of the aeroelastic HALE aircraft is a strong interaction of structural and rigid body eigenmodes. This leads to challenges in the design of a robust flight control algorithm for the full flight envelope with state-of-the-art techniques. This work addresses these difficulties and proposes a generic design process which can be used to develop flight control algorithms for HALE aircraft. The design process starts with the definition of specific performance and robustness criteria for HALE flight control laws which emerge from the combination of general aircraft design standards with the limitations and capabilities of the HALE configuration. Subsequently, a gain-scheduled, fixed structure control design architecture is proposed. The inner loop control design is enriched with envelope protection functionalities. The design process concludes with an extensive validation and verification process to clear the baseline flight control system for flight testing. The proposed design process is applied to the German Aerospace Center's newly developed HALE platform.

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