Improving the landing control capability of blended wing body configuration solar-powered UAVs by using swallow tail and distributed propellers

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Abstract

Aiming at the problem of weak yawing controllability of solar-powered Unmanned Aerial Vehicles (UAVs) with low-speed and high aspect-ratio Blended Wing Body (BWB) configuration, based on the large-scale aerodynamic characteristics of the biomimetic swallow tail, the influence of different opening methods and angles of the swallow tail on the aerodynamic characteristics and stability and controllability of an UAV was derived. The mechanism of the higher yawing control efficiency of the differential throttle compared to the conventional rudder is analyzed in order to significantly decrease the control efficiency at small throttle. We innovatively propose a yawing control method combining the opening of the swallow tail to a moderately separation state of local airflow and we validate it for the case of the landing control of a solar-powered UAV. The flight dynamics mode characteristics show that this control method has little impact on the lateral-directional stability of the UAV and that the control efficiency can be reserved to the same level of cruise state. Therefore, the control law of cruise state can be applied to landing state with swallow tail open directly, which enhances the lateral-directional control ability of the UAVs in a simple but efficiently way. Flight simulation and flight test results show that the proposed bionic control method of the swallow tail combined with differential throttle can effectively enhance the landing control ability of the UAVs, improve the response speed, and reduce the trajectory error.

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