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ENERGY CENTERED DESIGN OPTIMIZATION OF HALE SOLAR-POWERED AIRPLANE

Abstract

The progresses of the high altitude long endurance (HALE) solar-powered airplane are reviewed for the present paper. The technical difficulties of the HALE solar-powered airplane are then analyzed. Analyzing result shows the HALE solar-powered airplane experiences energy emergency throughout every period, which is a main obstacle of bringing the HALE solar-powered airplane from laboratory into practical use. As a consequence, the energy centered design optimization of HALE solar-powered airplane is put forward. The general design model is constructed by integrating the disciplines such as aerodynamic, structure, propeller and energy, etc., with the energy centered principle. The disciplines equivalence theory is introduced with the idea that each discipline can be equivalence to energy (i.e., making a role of bridge to other disciplines). Afterwards, absorbing energy from the environment, such as gravity gliding and utilizing the updraft, is discussed with the aim of alleviating the energy emergency. Then, the impacts of some technical improvement (e.g., the graphene battery, the carbon fiber and the flexible wings etc.) on the performance of the HALE solar-powered airplane are discussed. Finally, the design optimization, by minimizing the current technical merit requirements, is brought forward. A design case shows the design optimization is feasible and efficient. The researches of the present paper can provide reference and guidance for making the HALE solar-powered airplane a practical used airplane.