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Corresponding author: Shuanghou DENG
e-mail of corresponding author: shuanghoudeng@nuaa.edu.cn
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Title

A Conceptual Design Methodology for Hybrid Aircraft using Multiple Disciplinary Optimization

Authors

Shuanghou DENG [1], Sichen SONG [1],Hongyu QIAO [1]*

** Corresponding author*
[1] Nanjing University of Aeronautics and Astronautics, 210016 Nanjing, P.R. China, shuanghoudeng@nuaa.edu.cn

Abstract

The global requirement of greenhouse gases reduction is a concern in today's air mobility. Electric propulsion is regarded as a potential solution for achieving emissions reduction and simultaneously minimizing using the fossil fuel. However, the current battery technologies are not mature enough with sufficient energy density, the hybrid-electric powered aircrafts become a better candidate between the traditional fuel powered and further fully electric aircrafts.

Conceptual design as one of the most important design stages during the aircraft design process has been well documented and applied on conventional aircrafts with fossil. However, there are two dilemmas when directly applied the archived conceptual design methodologies on hybrid-electric aircrafts particularly in the sizing process. The first one is lacking sufficient aerodynamic data for novel aerodynamic configurations, such as distributed propulsion, titled-wing and titled-propeller, etc, which could in principle influence the accuracy in constraint analysis for estimating the wing loading and T/W. Secondly, the novel powertrain of hybrid-electric for both serial and parallel configuration cases the traditional weight estimation using mission segmented fuel friction not applicable anymore.

In view of the aforementioned problems, a novel conceptual design methodology for hybrid-electric aircraft is developed in the present study. Additionally, Multi-disciplinary Design Optimization (MDO) framework is used for the sake of integrating the design, performance evaluation and iterating optimization. It is therefore, the present study will be dedicated into three main tasks, viz., establishing a conceptual design methodology considering the unique powertrain of hybrid-electric configuration, establishing the dual-pression performance evaluation including aerodynamics, dynamics and energy disciplinaries and integrating the relative functions or modules using MDO framework. Validations will be given to ensure the feasibility and accuracy of the proposed method and planform.

References

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