SA/MA

Area:
Aeroelastic analysis

Load Analysis and Alleviation of the Dry Wing Concept for a Hydrogen Aircraft.

Technical University of Munich

Department of Aerospace and Geodesy
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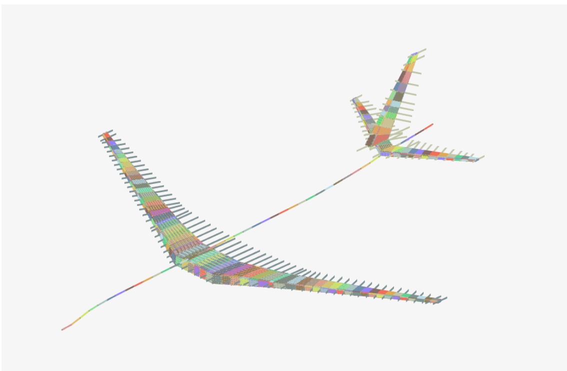
Description

As climate change gains increasing attention, reducing carbon emissions has become an urgent priority in the aviation industry. Hydrogen-powered aviation is considered the most cost-effective and sustainable pathway to achieving carbon neutral air travel in the long term [1]. However, storing hydrogen in gaseous form at 164 bar and 288.15 K requires 5.6 times the volume of kerosene to provide the same energy content [2]. This low volumetric energy density makes storing fuel in the wings impractical, leading to a "dry wing" configuration. The absence of fuel in the wings eliminates the inertial relief present in conventional designs, potentially resulting in a heavier wing structure.

The DWiTE project focuses on finding solutions to mitigate the weight penalties associated with the absence of wing fuel. Load alleviation using control surfaces is considered one of the most promising technologies [3]. Trailing edge control surfaces can be deflected in such a way that lift is shifted inboard, reducing the wing bending moments.



This study aims to systematically evaluate the effects of load alleviation on dry wing configurations for hydrogen-powered aircraft. The research will begin with a load analysis and the derivation of critical load cases using the LoadsKernel tool [4]. Subsequently, load alleviation will be implemented to reduce the structural loads on the aircraft. The load analysis will then be repeated with load alleviation enabled, and the critical loads will be compared. All findings will be thoroughly documented, with particular emphasis on the alleviated loads, providing actionable insights for the development of future hydrogen-powered aircraft.

Student Profile

We are seeking motivated students who possess an interest in aeroelastic analysis. The candidate should be capable of working independently and maintaining a systematic approach to their work. A fundamental understanding of aeroelasticity is required, and any prior experience with Python is highly valued.

Scope of Work

WP1: Familiarization with the tool and configuration
WP2: Performing load analysis and its postprocessing
WP3: Implementation of load alleviation
WP4: Comparative evaluation of load alleviation effects
WP5: Documentation

Literature

[1] D. Timmons *et al.*, "Economics of aviation fuel decarbonization: A preliminary assessment," *Journal of Cleaner Production*, vol. 369, p. 133 097, Oct. 2022.

[2] D. Silberhorn *et al.*, "Assessment of Hydrogen Fuel Tank Integration at Aircraft Level," 2019.

[3] V. Handojo *et al.*, "Potential Estimation of Load Alleviation and Future Technologies in Reducing Aircraft Structural Mass," *Aerospace*, vol. 9, no. 8, p. 412, Jul. 29, 2022.

[4] A. Voß, "Loads Kernel User Guide," Institut für Aeroelastik, Deutsches Zentrum für Luft- und Raumfahrt, 2020.

Time Frame

Start immedietly. 6 months.

Supervision

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