Journal of Aeronautics & Aerospace Engineering
ISSN: 2168-9792

OPEN ACCESS Freely available online

Commentary

Aircraft Design Optimization with High Aspect Ratio Wings

Sunil Sihag*

Department of Engineering and Architecture, University of Parma, Parma, Italy

DESCRIPTION

Aims to optimize novel transport aircraft configurations in which drag reduction is assumed to be the result of High Aspect Ratio Wings (HARW). The work described in this paper is a component of the project's outcome.

Aeroelastic effects, both static and dynamic, are amplified by the increased flexibility of the thinner wings in order to reduce the structural weight penalty. These, in turn, may compromise the aircraft's performance through reduced stability margins, such as the flutter margin, or increased fuel consumption. After that, a combination of structural and aerodynamic analysis is required to evaluate the result of such flexibility.

Higher fidelity aerodynamic analysis, on the other hand, is required to evaluate drag accurately enough to allow comparisons between configurations in a situation where benefits may be less than 10%.

As a result, a Multidisciplinary Design Optimization (MDO) procedure to improve HARW aircraft configurations will typically be computationally demanding and call for significant resources or time.

In the context of a surrogate-based MDO that uses Fluid-Structure Interaction (FSI) analysis to evaluate the operational and manufacturing costs (fuel consumption and structural mass), the structural constraints (stress), and an Aeroelastic stability margin constraint, the paper describes an evaluation of the differences between Higher Fidelity (HF) and Lower Fidelity (LF) CFD analysis results. This assessment is used to determine which evaluations permit using only LF CFD and how likely it is that some of the constraints will be active close to the optimum, saving computations in the long run. The fact that such differences can be quantified is a novel feature of this paper. The use of LF CFD for the FSI analysis and one iteration of HF CFD FSI suffice to determine cruise drag within 1% of a difference from a fully converged HF CFD FSI run, despite the fact that deformation and its effects are not negligible for the quantification of drag. The used LF CFD method the Panel Method with compressibility correction proved to be accurate enough to provide the wing's deformed shape following an FSI run because it was primarily influenced by the lift distribution. When compared to a converged HF CFD FSI run, it was confirmed that the high load factor stress calculations made with LF CFD FSI are not conservative, requiring at least one HF CFD FSI run to predict stress conservatively.

The optimization result, which demonstrates that fuel consumption improvements of -4.5 percent can be achieved with a relatively low increase in structural mass (2.7 percent) and a more significant increase in AR (16.8%), all in comparison to the baseline aircraft, is another novel aspect of this work. In terms of the benefits that can be gained from increasing AR in a cantilevered wing, we believe that this result is very close to what can be achieved under the working assumptions.

Last but not least, the outcomes of this flutter margin analysis shed light on the process of optimizing HARW. Even though the flutter margin gets smaller as the deformation gets bigger, the configurations with potential benefits still have flutter margins that are much larger than they should be. Because of this, putting a flutter margin constraint in the MDO procedure probably wastes computational effort.

Correspondence to: Sunil Sihag, Department of Engineering and Architecture, University of Parma,Parma, Italy, E-mail: sunil554@gmail.com

Received: 21-Nov-2022, Manuscript No. JAAE-22-21628; **Editor assigned:** 23-Nov-2022, PreQC No: JAAE-22-21628 (PQ); **Reviewed:** 08-Dec-2022, QC No: JAAE-22-21628; **Revised:** 15-Dec-2022, Manuscript No: JAAE-22-21628 (R); **Published:** 22-Dec-2022; DOI: 10.35248/2168-9792.22.11.294.

Citation: Sihag S (2022) Aircraft Design Optimization with High Aspect Ratio Wings. J Aeronaut Aerospace Eng. 11:294.