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High-Fidelity Multidisciplinary Design Trade Study of Short-Medium Range Aircraft with High Aspect-Ratio Wing

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Decarbonizing the air transport requires efficient tools that can robustly guide aircraft designers towards improved and fuel-efficient designs. Multidisciplinary design analysis and optimization (MDA/MDO) methods [1,2] are expected to be key technologies for accelerating the design process and for coming up with less conventional designs, that perform better or can accommodate environment-friendly fuel.

Being a promising candidate to face the aforementioned challenges, aircraft configurations with high aspect-ratio wings (HARW) are currently gaining increasing attention at the industry. Such airframe technologies are expected to improve the aircraft efficiency and significantly reduce fuel burn and, therefore, CO_2 and NO_X emissions. Airframes with HARWs are, however, expected to be highly flexible and, hence, their design requires tighter cooperation among the airframe aerodynamics and structure experts. Here reliable MDA and MDO, based on high-fidelity numerical models, can play a vital role in supporting the disciplinary experts to design efficient aircraft.

The target of this study is to explore the design space of the HARW short-medium range aircraft configuration; DLR-F25[i], via high-fidelity MDA and MDO chains. After defining the main set of design and trade parameters for the configuration at hand, MDA and MDO tools will be used to perform multidisciplinary trade studies. The set of design and trade parameters investigated here will include outer shape parameters as well as structure design parameters, defining the inner topology of the wing box structure. In addition to the direct benefit of investigating the different trades, the output of such a study will assist the designer in understanding the main design parameters that drive the defined figure of merit.

REFERENCES

[1] R. Olivanti and J. Brézillon. On the Benefits of Engaging Coupled-Adjoint to Perform High-Fidelity Multipoint Aircraft Shape Optimization, AIAA 2021-3072
[2] M.Abu-Zurayk et al. Sensitivity-based Generation of Pareto Fronts for Design of Powered Aircraft Subject to a Comprehensive Set of Loads, AIAA 2021-3025

[i] DLR-F25 is a conceptual design of an advanced short-to-medium range airliner, employing a very high-aspect ratio wing. It was made as a challenge for high-fidelity disciplinary and multi-disciplinary preliminary design. Development of DLR-F25 was funded by the German Federal Ministry for Economic Affairs and Climate Action.