6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 15 June 2018, Glasgow, UK

AERODYNAMIC OPTIMIZATION OF A PARAMETRIZED ENGINE PYLON ON A MISSION PATH USING THE ADJOINT METHOD

Damien Guénot*[1,2], François Gallard[1], Joël Brézillon[3,1] and Yann Mérillac[2]

[1] IRT Saint Exupéry
B 612 - 3 Rue Tarfaya - CS 34436 - 31405 Toulouse CEDEX 4 (France)
email : francois.gallard@irt-saintexupery.com
[2] Altran Technologies
4 Avenue Didier Daurat - 31700 Blagnac (France)
email : {damien.guenot,yann.merillac}@altran.com
[3] Airbus Operations SAS
316 Route de Bayonne - 31060 Toulouse (France)
email : joel.brezillon@airbus.com

Key words: *CAD parametrization, Engine pylon, MDO, CFD, Adjoint*

In the frame of the MDA-MDO project at IRT Saint-Exupery, an aircraft engine pylon multidisciplinary optimization is performed[1]. The MDO process uses industrial tools for aerodynamic, structural and overall aircraft design disciplinary optimization. A bi-level MDO formulation is selected, enabling the reuse of the disciplinary optimization software while ensuring the convergence to a true MDO optimum. This study focuses on the adjoint-based aerodynamic multi-point optimization part of the MDO study. Thereby, a fully parametrized pylon CAD has been developed. More than 400 variables are required to obtain an accurate shape representation of the pylon and to take into account for various design constraints such as system integration or slats deployment, while giving enough degrees of freedom to optimize the complete 3D pylon shape. A particular challenge of the engine integration test case is the computation of many complex intersections : wing with pylon, pylon with engine nacelle and pylon with fan exit. These intersections must be deformed according to the new pylon shape at each optimization iteration, while keeping the exact shape of the nacelle and wing constant. The parametrization and mesh deformation are therefore largely impacted by these intersections. The overall process must be differentiated to benefit from the discrete adjoint of the CFD solver. First, an optimization in cruise condition ($C_L = 0.47 - Mach = 0.83$) is performed. Then, multiple operating conditions are added in the optimization formulation, in order to get a robust design. Finally, a trade off is performed with a design of experiments study on the engine position, where a local optimization is performed for each of them. These results demonstrate that the capability is able to handle the 3D complex pylon geometry with its full intersections with the nacelle and the wing.

REFERENCES

[1] F. Gallard, C. Vanaret, D. Guénot et al., *GEMS: A Python Library for Automation of MDO Process Generation.* AIAA Scitech, 8−12 January 2018, Florida.

[2] A. Gazaix, F. Gallard, V. Gachelin et al., *Towards the Industrialization of New MDO Methodologies and Tools for Aircraft Design.* 18^{th} AIAA/ISSMO MDA−MDO Conference, 5−9 June 2017, Colorado.