

Aerospace Engineering Seminar

“Minimum weight structural optimisation procedure for the preliminary sizing of a composite wing of a compound Helicopter”

Speaker: Andrea Cini

Senior Research Fellow, Aerostructures Theme Lead.
The University of Nottingham (U.K.)

Abstract: Aircraft design methodologies have to evolve, to fully benefit from the implementation of novel light-weight structural solutions and assess their weight saving opportunities. In this respect, structural optimisation can be a valuable and effective tool since the early design stage.

The material distribution of a joined-wing, characterised by extensive use of composite material, has been optimised in order to minimise the structural weight, improving the performance of an innovative compound helicopter demonstrator. The optimisation procedure is capable of calculating shape, number, stacking sequence and occurrence of predefined ply orientations in composite components as well as thickness distributions in metallic parts, fulfilling most of the design constraints and requirements of a flying demonstrator even during preliminary sizing.

The procedure, where ply shape, number and stacking sequence were defined in three sequential optimisation steps was developed on the commercial software Altair Optistruct. Every step was characterised by the introduction of selected stiffness, strength, stability, damage tolerance and manufacturing constraints to facilitate the problem convergence. The methodology allowed iterations among the steps to mitigate the weight penalty caused by the sequential constraint introduction. The transition between iteration stages was automatized and strategies to implement the search of the absolute minimum weight were investigated as well.

The developed optimisation procedures proved to be a valuable tool to perform preliminary sizing of metallic and composite non-conventional structures and identify weight saving opportunities of innovative configurations.

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