

Computational Fluid Dynamics-Coupled Optimisation Strategy for Aerodynamic Design

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Abstract : In this paper, we present results obtained from optimising the aerodynamic performance of aerostructures in external flow. The optimisation method used was developed to efficiently handle multi-variable problems with numerous black-box objective functions and constraints. To demonstrate these capabilities, a series of CFD problems were considered; (1) a two-dimensional NACA aerofoil with three variables, (2) a two-dimensional morphing aerofoil with 17 variables, and (3) a three-dimensional morphing aeroplane tail with 33 variables. The objective functions considered were related to combinations of the mean aerodynamic coefficients, as well as their relative variations/oscillations. It was observed that for each CFD problem, an improved objective value was found. Notably, the scale-up in variables for the latter problems did not greatly hinder optimisation performance. This makes the method promising for scaled-up CFD problems, which require considerable computational resources.

Keywords : computational fluid dynamics, optimisation algorithms, aerodynamic design, engineering design

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