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CFD-BASED DESIGN OPTIMISATION METHODS

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ABSTRACT

The future development of many complex products and processes will be based on a systematic, model-based process where computational design optimisation methods will be a key enabling technology [1]. Although the latter have long been used to optimise structures, it is only relatively recently that Computational Fluid Dynamics (CFD)-based optimisation methods have become widely used to optimise complex flow and heat transfer problems. This mini-symposium will combine presentations from industry and academia to review the state-of-the-art of CFD-based design optimisation techniques and present the results of their application to a range of important design problems in the aerospace, automotive, electronics and nuclear industries.

The presentations will consider the key aspects affecting the computational efficiency of CFD-based design optimisation methods and their effectiveness for practical design problems. The potential of High Performance Computing techniques will be assessed, together with the algorithmic challenges of achieving good levels of solution speed-up from the application of parallel computing and Graphical Processing Units [2]. The challenges of using adjoint methods for the efficient calculation of gradients for use in gradient-based design optimisation methods will also be explored and recent successful applications in automotive design will be demonstrated.

Since effective design parametrisation and design of experiments methods are crucial to the overall performance of the optimisation process, ecent progress in developing efficient methods for representing complex geometries, such as promising node-based parametrisation methods, and efficient design space exploration strategies, will be explored. The role of surrogate modelling, when complex responses are approximated from data generated at a series of Design of Experiment design points, in efficient optimisation methods will be considered and appropriate methods for dealing with numerical noise will be identified.

It is inevitable that any product or process will be subject to some degree of variability (in e.g. component geometry or operating conditions) practical optimisation methods have to be able to identify robust optima which guarantee an acceptable level of performance under all feasible

conditions. The mini-symposium will conclude by examining robust optimisation methods which can be embedded effectively within industrial design optimisation work-flows [3].

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