CFD based ROMs for Aeronautical Applications

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The advent and development of large-scale high-fidelity computational fluid dynamics (CFD) in aircraft design is requiring, more and more, procedures and techniques aimed at reducing its computational cost in order to afford accurate but fast simulations of, e.g., the aerodynamic loads. The adoption of reduced order modeling techniques in CFD represents a promising approach to achieve this goal. Several methods have been developed to obtain reduced order models (ROMs) for the prediction of steady and unsteady aerodynamic flows using low-dimensional linear subspaces (cf. [4, 2]) as well as nonlinear manifolds (cf. [1]), whose performances may be further improved by applying hyper-reduction procedures (cf. [3]).

In this talk, it is presented the activity done at the German Aerospace Center (DLR) in the context of model order reduction and surrogate modeling for multidisciplinary applications, design and optimization. Different examples are shown to demonstrate the use of the ROMs in aeronautical applications, as for fusing experimental and CFD data, accelerating CFD computations, obtaining a fast loads prediction across the flight envelope, or accelerating multidisciplinary optimizations. The ROMs approches are demonstrated for airfoils, wings and aircraft in subsonic and transonic flows.

References

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