Evolutionary Optimization of Benchmark Aerodynamic Cases using Physics-based Surrogate Models

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The paper proposes the application of evolutionary-based optimization coupled with physics-based and adaptively-trained surrogate model to the solution of two aerodynamic benchmark problems defined within the AIAA Aerodynamic Design Optimization Discussion Group. The benchmark problems are represented respectively by the drag minimization of the RAE 2822 airfoil in transonic viscous flow and of the NACA 0012 airfoil in transonic inviscid flow. The shape parameterization approach consists of the Class-Shape Transformation (CST) method with a sufficient degree of Bernstein polynomials to cover a wide range of shapes. Mesh convergence is demonstrated on single-block C-grid structured meshes. The in-house ZEN flow solver is used for Euler/RANS aerodynamic solution. Results show that, thanks to the combined usage of surrogate models and adaptive training, optimal candidates may be located in the design space even with limited computational resources with respect to brute force optimization approaches.

I. Background and introduction

The solution of aerodynamic shape optimization problems by high-fidelity Navier-Stokes models requires a huge amount of computational resources even on modern state-of-art computing platforms.

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