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AERODYNAMIC OPTIMIZATION USING FSI COUPLED ADJOINTS IN SU2

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This paper will discuss the development of an aeroelastic optimization module in the open source SU2 package. SU2 is an actively developed, open-source multi-physics solver [1] with native Fluid-Structure Interaction capabilities. It incorporates an Algorithmic-Differentiation-based Discrete Adjoint (ADDA) method [2] for efficient calculation of sensitivities in coupled problems with complex physics, e.g., turbulence models, hyperelastic material model, etc, and those with a large number of design variables, e.g., shape or topology optimization. This approach can therefore obtain design sensitivities with material and fluid models of arbitrary complexity.

Previously, structurally focused test cases have been explored [2], and in this work, an aerodynamic objective function will be used. The objective is to maximize aerodynamic efficiency, in aeroelastic equilibrium, through the ADDA sensitivity analysis method. Compliant airfoil test cases will be investigated with a clamped leading edge and flexibility in the rest of the airfoil as dictated by the stiffness distribution. Design variables can be either the geometry of the wet surfaces or the structural material properties, with the latter as scope of this work. The paper will discuss the mathematical formulation of this problem, it's implementation in the SU2 suite, and results from optimal aeroelastic design of 12% thick airfoil.

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