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SENSITIVITY ANALYSIS AND OPTIMIZATION OF AEROELASTIC SYSTEMS USING A DATABASE OF REDUCED-ORDER MODELS

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High-fidelity design optimization of aeronautical systems under fluid/structure interaction constraints is computationally expensive as it typically requires repeated solutions of the coupled aeroelastic equations resulting from a CFD/Finite Element formulation. These solutions are computed every time the design of the system changes in the optimization loop. Furthermore, in a gradient-based optimization context, solutions of the aeroelastic equations are also required to compute sensitivities.

To alleviate the computational burden associated with these repeated high-fidelity solutions, a strategy based on a database of reduced-order models (ROMs) parameterized by the design parameters as well as operating conditions is presented. This strategy relies on the pre-computation of projection-based reduced-order models at a few values of these parameters and a consistent interpolation procedure [1] to predict the aeroelastic behavior of the coupled fluid/structure system at new values of the parameters. Because of the small dimensionality of the aeroelastic ROM, aeroelastic parameters and their sensitivities can be computed very efficiently. The capability of the proposed computational strategy will be demonstrated on the sensitivity analysis and design optimization of the ARW-2 aeroelastic wing [2].

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