

Unsteady Aerodynamic Sensitivity Analysis with FEniCS

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Sensitivity analysis is considered a fundamental tool in aerospace engineering, allowing to evaluate the impact of parameters variations and optimize the aerodynamic and structural design. There has been much effort on the development of both theoretical [1] and numerical [2] frameworks for sensitivity calculations through adjoint solutions. Regarding the implementation of these analyses into agile and versatile numerical tools, the use of scalable and transferable libraries has become of particular importance. FEniCS [3], a popular open-source computing platform for solving partial differential equations (PDEs), gathers a series of libraries for numerical optimization based on adjoint solutions. In particular, it implements a wide variety of methods that allow obtaining several parameters, such as the Jacobian for modal stability analysis, or the sensitivity of the observables with respect to certain parameters of the problem.

In this work, FEniCS is employed for the calculation of the sensitivity of aerodynamic observables in different flow scenarios. A comparison with different theoretical and benchmark cases is used to validate the methodology before applying it to further and more complex configurations, expanding the scope of the analyses to unsteady flows.

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