

AUTOMOTIVE APPLICATIONS OF ADJOINT-BASED TOPOLOGY AND SHAPE OPTIMIZATION

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ABSTRACT

The current working horse algorithms for CFD optimization in the automotive industry are still evolutionary strategies, while the incorporation of adjoint-based techniques into the car development process is still in its infancy – despite their apparent superiority at least for certain applications. This is mainly due to the only recent availability of an adjoint code within a professional CFD solver. However, since the implementation of a basic adjoint solver into the well-validated open source CFD solver OpenFOAM® [1], the development of adjoint-based optimization techniques for automotive applications has seen some major progress, ranging from a straightforward realization of topology optimization to the implementation of an adjoint turbulence model [2] and to a linkage between optimization and CAD [3]. While advancements of this kind have contributed to establishing topology optimization as a standard tool for ducted flows in the Volkswagen development process, the application of shape optimization is still very delicate and, so far, hardly fulfills the requirements of a robust industrial process. The talk will present recent applications of adjoint-based topology optimization of ducted flows as well as examples of shape optimization for external aerodynamics, and will point out current challenges of the further industrialization of adjoint-based optimization.

REFERENCES

- [1] C. Othmer, A continuous adjoint formulation for the computation of topological and surface sensitivities of ducted flows, *Int. J. Num. Meth. Fluids*, **58**: 862-877, 2008.
- [2] A.S. Zymaris, D.I. Papadimitriou, K.C. Giannakoglou, C. Othmer, Continuous adjoint approach to the Spalart-Allmaras turbulence model, *Computers and Fluids*, **38**: 1528-1538, 2009.
- [3] T.T. Robinson, C.G. Armstrong, H.S. Chua, C. Othmer, T. Grahs, Sensitivity-based optimization of parameterised CAD geometries, *8th World Congress on Structural and Multidisciplinary Optimization*, Lisbon, Portugal, 2009.