Shape Optimization and CFD RANS Codes: an Adjoint-based Strategy for Drag Reduction in Automotive Applications

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Introduction. Looking at the evolving technology trends in CFD-based shape optimization chains, there is a strong request for robust and flexible Adjoint Optimization based solutions. In external aerodynamics shape optimization the most convenient approach relies on the use of some aerodynamics indices as targets (drag for instance). The overall desired effect is to improve aerodynamic efficiency (drag reduction) using the outcomes of an Adjoint CFD RANS simulation to drive the CAD morphing.

Main Targets of the Project. For these reasons, within a Master Thesis, an Adjoint Solver for turbulent external aerodynamics problems has been developed in the open-source CFD Toolbox (OpenFOAM). The main target is to perform a single shot Adjoint CFD computation and verify to which extent Drag reduction is obtainable.

Discussion & Conclusion. The application presented herein shows how a more than 5% drag reduction can be obtained in a single shot adjoint-driven shape optimization for a state of the art automotive CAD definition. This is a relevant result that could be exploited introducing an optimization engine to drive an optimization loop. The workflow is built on top of an existing HPC platform and is therefore suitable to be exploited on more demanding CFD problems.