Advances with adjoint CFD solvers for unsteady flow

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Adjoint-based methods have become the most interesting approach in CFD optimisation due to their low computational cost compared to other approaches. The development of adjoint solvers has seen significant research interest, and a number of EC projects have been funded in this area, in particular, the EC FP7 project FlowHead which has developed complete adjoint-based design methods for steady-state flows in automotive design.

In industrial practice most industrial flows have small levels of instability, which leads to a lack of robustness and instability of the adjoint, such as trailing edge vortex shedding in turbo-machinery or secondary flow motion and flow separation in ducted internal flows. Many industrial applications are also partly unsteady such as bluff body separation in cars or fully unsteady such as vertical-axis wind turbines. The now 'standard' steady-state adjoint approach that linearises the flowfield around a 'converged' state clearly is no longer appropriate for these unsteady flows and alternative methods of linearisation need to be developed.

The presentations in the minisymposium will report on the latest advances in this area. Most presentations will stem from the work in the EC-funded About Flow project on unsteady adjoint solver development. The project works on continuous, as well as discrete adjoint solvers. Topics covered range from improving sovler robustness, implementation and application of efficient checkpointing schemes for unsteady adjoints, advances with automatic differentiation tools and application to industrial testcases in automotive and turbomachinery design.
Contributions from outside the About Flow project on these topics is encouraged.