On the efficient adjoint computation for flow control problems

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The efficient provision of adjoint information is indispensable for numerous applications in flow control. The complex physical background necessitate a very fine mesh. Thus a corresponding high number of timesteps is required to simulate flows accurately. We want to combine advanced methods of numerical models and methods of mathematical control to improve the flow qualities. For that purpose we modify the common flow simulation software SEMTEX based on a spectral element method. We present a new approach for the exploitation of structure in time and space. For this purpose, recent results for the algorithmic differentiation of finite element discretization and implicit time stepping procedures are combined with appropriate checkpointing strategies.

Adapted to the given structure different techniques for the adjoint calculation are applied to minimize the effort. For flexible parts, like the target function, we use algorithmic differentiation. On the other hand, the timestepping loop of the simulation code is hand adjoint, because this part will remain constant for the considered applications.

Numerical results for a flow control problem illustrate the resulting numerical effort for the computation of the required adjoint information.

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