FLOWHEAD - Conference on industrial design optimisation for fluid flow, Munich, March 2012

Development and Application of Continuous AdjointMmethods

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The continuous adjoint method, developed for either compressible or incompressible flow problems, is presented. The method is used to compute first- or higher-order derivatives of the objective function where the latter are used either to support Newton (or truncated-Newton) optimization methods or to compute the function to be minimized in robust design problems (such as the variance of drag, lift, losses, etc) and its gradient. The first part of this lecture focuses on the need to differentiate the turbulence model pde's, a task which is routinely undertaken by those developing discrete adjoint methods but is quite new in continuous adjoint. The development of the adjoint to turbulence models assisted by the wall function technique is also shown, with applications in internal aerodynamics. Among other, the use of the continuous adjoint method for determining the optimal location of jet-based flow-control systems and in topology optimization is demonstrated. Finally, regarding the computation of higher-order derivatives, the continuous adjoint method is related its discrete adjoint counterpart (which has also been developed by the same group) in order to show existing strong similarities.

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