Title: **Solution-limited time stepping to enhance reliability in CFD applications**

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Obtaining reliably converged solution in CFD simulations is a problem of practical relevance. Practitioners know all too well that with the exception of a few well behaved problems, a solution that smoothly converges without the need for user intervention is very seldom the case once the RUN command is issued.

The authors propose a time stepping strategy based on limiting the pseudo-time step advance at each iteration by an estimate of the change in the solution. The limit to the advance in time take into account the values of all the variables at all the grid points. It then conservatively selects the time increment such that it will produce a change equal to a suitable fraction of a reference value for each variable. The minimum time step for all grid points and all variables is used to advance the solution using an implicit scheme. This method has the advantage to provide stable convergency by ensuring that the changes in the solution do not induce non-physical situations or numerical instability in the Newton-like iteration.

As the solution converges to steady state, the criteria allows for increasingly larger time steps (up to an upper limit of 1000 CFL). The key contribution of the paper is the selection criteria for the reference solution. The way the authors set the criteria for choosing the reference solutions represent a departure from the traditional approach of looking at the evolution of the error in the solution from step to step.

From the analysis of several prototypical problems in CFD and numerical examples the authors conclude that the criterion to that limits the permissible changes is pressure is often the most restrictive.

Results for more than a dozen numerical examples of problems with increasing complexity are presented. In these the authors emphasize the reliability of the time marching process in achieving convergency. Certainly this type of strategy for the time stepping mechanism will be of interest for developers of industrial codes in order to increase the reliability of the convergence for highly non-linear problems.

See also:

1. Vanderstraeten, D., Csk, A. and Roose, D., *An Expert-system to Control the CFL number of implicit upwind methods*, TM304 Universiteit Leuven, 2000, available on-line at:
`http://www.cs.kuleuven.be/publicaties/rapporten/tw/TW304.ps.gz`