Linear And Nonlinear Solver Issues In Navier-Stokes Solvers

V. Venkatakrishnan, S. R. Allmaras, J.E. Bussoletti, C. L. Hilmes, F. T. Johnson, D. S. Kamenetskiy and L. B. Wigton

Boeing Commercial Airplanes, P.O. Box 3707, M/S 67LF Seattle, WA 98124-2207, USA

The talk will address some of the issues arising in the solution of the compressible turbulent Navier-Stokes equations. These equations are discretized using a stabilized Finite Element method on a tetrahedral mesh using linear basis and test functions. The system of nonlinear equations that results is solved by a damped Newton's method. The problem sizes are large (of the order 50-100 million degrees of freedom) necessitating the use of large distributed memory parallel computers. While the residual and Jacobian generation operators are easily parallelized, the solution of the linear system of equations on these machines is non-trivial. We use an incomplete LU factorization as a domain preconditioner and consider an additive-Schwarz method driven by GMRES as the baseline algorithm. We seek improvements to this method by considering a Schur-complement method and an alternative to Schur complement method that reverses the role of inner and outer iterations. Issues that arise such as ordering and load balancing will be addressed.