Department of Mathematical Sciences Colloquium

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On Numerical Simulation of Aeroelastic Problems

In this lecture we focus on the numerical simulation of mutual interaction of fluid flow and elastic structure. The relevant air flow velocities for the selected class of problems are in the range of 0–120 m/s. The fluid flow is described by the incompressible Navier-Stokes equations. The finite element method is employed for the spatial discretization of the problem. In this case several sources of instabilities have to be faced. First, in order to guarantee the stability of the scheme, the finite elements for velocity and pressure need to be selected in a proper way to satisfy the Babuška–Brezzi condition. Moreover, very high Reynolds numbers result into the appearance of spurious oscillations.

In this lecture the stabilization based on the SUPG (streamline upwind/Petrov-Galerkin) method together with grad-div stabilization is employed. Moreover, in order to capture the turbulence phenomena, numerical simulations of Reynolds Averaged Navier-Stokes (RANS) equations are performed. The Reynolds stresses involved in the RANS equations are modeled with the aid of the Spallart–Almaras turbulence model. Further, the structure motion is simulated with the solution of system of nonlinear ordinary differential equations. The motion of the airfoil causes deformations of the computational domain, which are treated with the aid of the Arbitrary Lagrangian-Eulerian (ALE) method.

In order to validate the method, two-dimensional viscous incompressible air flow past an airfoil is simulated and the results are compared with experimental data and with NASTRAN aeroelastic computation. Also the comparison of both the NS and RANS simulations to the NASTRAN computation will be given.

Friday, August 26, 2005 at 3 pm. in Bell Hall 143
The University of Texas at El Paso

Refreshments will be served in front of the colloquium room, 15 minutes before the start of the colloquium.

For further information, please contact Dr. Pavel Šolín, Bell Hall 220. Phone: (915) 747-6770, email: `solin@utep.edu`.