Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Simulations of airfoil static and dynamic stall[1] SANTHANAM NAGARAJAN, SANJIVA LELE, Stanford University — Simulations of separated flow over stalled airfoils are conducted with an aim to understand post stall flow including separation and transition. A high-order accurate numerical methodology in curvilinear coordinates, along with overlapped zonal meshes is used to solve the compressible flow equations. The simulations resolve the boundary layer and are therefore a DNS in that region, while away from the airfoil, they reduce to LES. For a NACA 0012 airfoil at a high angle of attack (15°) and low Reynolds number ($Re = 135,000$), boundary layer separation is laminar, while breakdown to turbulence occurs through Kelvin-Helmholtz instabilities in the separated shear layer on the suction side of the airfoil. Boundary layer separation close to the leading edge leads to a significant region of recirculation where most of the turbulent fluctuations are concentrated. Turbulence escapes into the wake when larger vortices detach from the airfoil and convect downstream. The lift coefficient fluctuates in a chaotic manner, typical of stalled airfoils. A simulation of a pitching airfoil is being conducted to throw light on the phenomenon of dynamic stall and the ability of LES to predict large scale unsteady separation. Higher Reynolds number simulations, while not amenable to true LES, will be conducted using wall models.

[1]Supported by DARPA under the Helicopter Quieting Program

Santhanam Nagarajan
Stanford University

Date submitted: 12 Aug 2005 Electronic form version 1.4