Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Linear Stability Analysis of Fully Three-Dimensional Boundary-Layers WEI LIAO, National Institute of Aerospace, Hampton, VA 23666, MUJEEB MALIK, FEI LI, MEELAN CHOUDHARI, CHAU-LYAN CHANG, NASA Langley Research Center, Hampton, VA,23681 — Stability and transition of three-dimensional (3D) finite-span swept-wing boundary layers is of interest here. It is common practice to use quasi-3D boundary-layer codes for generating mean flows for stability analysis of swept-wing flows because of their efficiency and simplicity. However, the use of infinite span approximation or the spanwise conical flow assumption in these codes becomes questionable for fully three-dimensional boundary layers. In this work, the results of stability analysis based on mean flows generated by a quasi-3D boundary layer solver and an unstructured-grid Navier-Stokes solver (FUN3D[1]) are compared for a swept wing-glove assembly.[2,3] The N-factor evolution based on the full-Navier-Stokes computation is shown to differ significantly from that based on the quasi-3D boundary layer codes owing to the un-sweep of the isobars caused by the limited glove span. This points to the need for stability analysis based on Navier-Stokes solutions or possibly fully 3D boundary layer codes when the underlying flow develops strong three-dimensionality. The substantial reduction in maximum N factor (from about 20 to 12 for the case studied here) also indicates the possibility of stabilizing crossflow instability by using fully 3D design methods.

[1]http://fun3d.larc.nasa.gov/
[2]Belisle et al., AIAA-2012-2667.
[3]Liao et al., AIAA-2012-2690.

Wei Liao
National Institute of Aerospace

Date submitted: 08 Aug 2012 Electronic form version 1.4