Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Bifurcation of Scramjet Unstart[1] IK JANG, Stanford Univ., JOSEPH NICHOLS, Center for Turbulence Research, KARTHIK DURAISAMY, PARVIZ MOIN, Stanford Univ. — We investigate the bifurcation structure of catastrophic unstart in scramjets. The bifurcation of quasi-one-dimensional Rayleigh flow is first analyzed, followed by a numerical investigation of a more realistic model scramjet isolator (Wagner et al., AIAA paper, 2010). We show that the quasi-one-dimensional model recovers a similar hysteresis behavior as that observed in steady Reynolds-Averaged Navier–Stokes simulations of the model scramjet isolator close to the onset of unstart. In the hysteresis zone, steady but unstable solutions are obtained by means of pseudo-arclength continuation. Automatic differentiation permits the use of fully discrete Jacobians that result in an accurate representation of functional dependencies and linearized dynamics. Furthermore, we use an Arnoldi method to extract the least stable direct and adjoint eigenfunctions spanning the system dynamics close to unstart and obtain the system response to both harmonic and stochastic forcing. This information, along with the final bifurcation structure, allows us to evaluate the effectiveness of different metrics as indicators of the onset of unstart.

[1]Supported by the PSAAP program of DOE

Ik Jang
Stanford Univ.

Date submitted: 05 Aug 2011 Electronic form version 1.4