Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Implications of a wavepacket formulation for the nonlinear parabolized stability equations to hypersonic boundary layers.[1] JOSEPH KUEHL, Baylor University — The parabolized stability equations (PSE) have been developed as an efficient and powerful tool for studying the stability of advection-dominated laminar flows. In this work, a new "wavepacket" formulation of the PSE is presented. This method accounts for the influence of finite-bandwidth-frequency distributions on nonlinear stability calculations. The methodology is motivated by convolution integrals and is found to appropriately represent nonlinear energy transfer between primary modes and harmonics, in particular nonlinear feedback, via a "nonlinear coupling coefficient." It is found that traditional discrete mode formulations overestimate nonlinear feedback by approximately 70%. This results in smaller maximum disturbance amplitudes than those observed experimentally. The new formulation corrects this overestimation, accounts for the generation of side lobes responsible for spectral broadening and results in disturbance saturation amplitudes consistent with experiment. A Mach 6 flared-cone example is presented.

[1]Support from the AFOSR Young Investigator Program via Grant FA9550-15-1-0129 is gratefully acknowledges.

Joseph Kuehl
Baylor University

Date submitted: 27 Jul 2016 Electronic form version 1.4