Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Flow Velocity Computation, from Temperature and Number Density Measurements using Spontaneous Raman Scattering, for Supersonic Chemically Reacting Flows. NIGIL SATISH JEYASHEKAR, Research Assistant, JOHN SEINER, Associate Director of Applied Research, 1 Coliseum Dr., National Center for Physical Acoustics, University of Mississippi, University, MS-38677, USA — The closure problem in chemically reacting turbulent flows would be solved when velocity, temperature and number density (transport variables) are known. The transport variables provide input to momentum, heat and mass transport equations leading to analysis of turbulence-chemistry interaction, providing a pathway to improve combustion efficiency. There are no measurement techniques to determine all three transport variables simultaneously. This paper shows the formulation to compute flow velocity from temperature and number density measurements, made from spontaneous Raman scattering, using kinetic theory of dilute gases coupled with Maxwell-Boltzmann velocity distribution. Temperature and number density measurements are made in a mach 1.5 supersonic air flow with subsonic hydrogen co-flow. Maxwell-Boltzmann distribution can be used to compute the average molecular velocity of each species, which in turn is used to compute the mass-averaged velocity or flow velocity. This formulation was validated by Raman measurements in a laminar adiabatic burner where the computed flow velocities were in good agreement with hot-wire velocity measurements.

Nigil Satish Jeyashekar
Research Assistant, Aeroacoustics Engineering

Date submitted: 05 Aug 2006 Electronic form version 1.4