Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

One Dimensional Modeling of Vorticity in high Karlovitz Number Turbulent Premixed Flames CHANDRU DHANDAPANI, Graduate Aerospace Laboratories, California Institute of Technology, BROCK BOBBITT, GUILLAUME BLANQUART, Mechanical Engineering Department, California Institute of Technology — Turbulent combustion involves the interaction of two complex non-linear phenomena: turbulence and chemistry. The current study focuses on modeling the effects of the flame on the turbulence characteristics, more specifically on the vorticity ω, which is characteristic of the smallest turbulent scales. This is performed through an a-priori analysis of high Karlovitz number turbulent premixed flames. The objective is to derive a one-dimensional model equation for the transport of enstrophy, $\omega^2 = \omega \cdot \omega$. The terms in the enstrophy transport equation are modeled and scaled by a combination of flow properties. Results from a series of previously performed direct numerical simulations(DNS), spanning a range of Karlovitz number(Ka), Reynolds number(Re) and flame density ratios, are analysed to obtain the coefficients in the one-dimensional differential equation for enstrophy and demonstrate their dependence, or lack thereof, on Ka and Re. Lastly, the model equation is solved and the results are compared with the DNS results.

Chandru Dhandapani
Graduate Aerospace Laboratories, California Institute of Technology

Date submitted: 16 Jul 2015 Electronic form version 1.4