Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

A Two Mixture Fraction Flamelet Model for Large Eddy Simulation of Turbulent Jet Flames with Inhomogeneous Inlets BRUCE A. PERRY, MICHAEL E. MUELLER, Princeton University, ASSAAD R. MASRI, The University of Sydney — A revised flamelet/progress variable (FPV) model in which two mixture fractions are defined has been developed to address the known limitation that single mixture fraction FPV models require there to be a single, compositionally uniform fuel stream. The revised model is applied in a large eddy simulation of a new turbulent jet burner with inhomogeneous partially premixed inlet conditions that was developed at the University of Sydney [S. Meares, A.R. Masri, Combust. Flame 161 (2014) 484-495]. Compositional inhomogeneity at the inlet is achieved by recessing a central tube that separates the fuel stream and a surrounding annular air flow to provide controlled mixing upstream of the nozzle. The first mixture fraction characterizes the mixing between the jet and surrounding air. The second mixture fraction tracks mixing of fuel and air upstream of the nozzle and defines the fuel side boundary condition for solution of the 1D flamelet equation in terms of the first mixture fraction. The predictions using both the single mixture fraction and the two mixture fraction FPV models are compared to recent experimental results. It is shown that use of a single mixture fraction is insufficient to accurately capture the structure of the flame with inhomogeneous inlet conditions.

Bruce Perry
Princeton University

Date submitted: 31 Jul 2015 Electronic form version 1.4