Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Flame hole dynamics simulation of Sandia Flame F ROBERT KNAUS, University of Illinois at Urbana-Champaign, JOHN HEWSON, STEFAN DOMINO, Sandia National Laboratories, CARLOS PANTANO, University of Illinois at Urbana-Champaign — The Sandia Flame "F" is a piloted methane/air diffusion flame containing high levels of local extinction. These regions of local extinction reduce the efficiency of combustion and can increase the production of certain pollutants (e.g. carbon monoxide) as well as limit the overall stability of the flame. We present a flame hole dynamics model describing evolution of local extinction zones (flame holes) in a turbulent diffusion flame and apply it to perform a direct numerical simulation of the Sandia Flame F using Sandia's "SIERRA low Mach Module, Nalu." The flame hole dynamics model is a phase-field model that describes the state of the flame (burning or extinguished) through a surface partial differential equation modeling extinction, reignition and advection of the flame state on the moving stoichiometric surface using edge flame properties. The solution of the surface equation is then extended away from the surface and used for state evaluations using a flamelet library with steady flamelets in the burning region and a transient solution in the quenched regions. The flame hole dynamics approach allows tracking extinction and reignition in turbulent diffusion flames without using the computationally costly detailed chemistry explicitly.

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Date submitted: 30 Jul 2014 Electronic form version 1.4