Premixed Stagnation Flame Data - Explanation of Data Files

Jeffrey M. Bergthorson
jeffb@tyrvos.caltech.edu

Graduate Aeronautical Laboratories
California Institute of Technology
Pasadena, CA, 91125

General Notes:

This data is made available for use by chemical kineticists as validation and optimization targets for combustion modeling. The tables give the measured boundary conditions for experiments reported here. See [1] for description of boundary conditions. The Bernoulli velocity, U_B (see [1]), is also given for reference. Uncertainty analysis for each boundary condition is presented in [1].

Velocity profile information:

Velocity profile fits:

1) PSV raw data is fit using a 2 parabola/error-function fit

2) In regions of no velocity data (heat release zone of rich flames) fit is unreliable
- no constraint on the fit profile in these regions

3) Fit parameters given in tab delimited text file (see [1] for fit formulation)
- first column is run number
- second column is 1st fit parameter, $x_{0,p1}$
- third column is 2nd fit parameter, $a_{1,p1}$
- fourth column is 3rd fit parameter, $a_{2,p1}$
- fifth column is 4th fit parameter, $x_{0,p2}$
- sixth column is 5th fit parameter, $a_{1,p2}$
- seventh column is 6th fit parameter, $a_{2,p2}$
- eighth column is 7th fit parameter, $x_{0,e1}$
- ninth column is 8th fit parameter, b_{e1}
- tenth column is 9th fit parameter, $x_{0,e2}$
- eleventh column is 10th fit parameter, b_{e2}

Particle Streak Velocimetry (PSV) data:

1) PSV raw data (no averaging) are presented as tab delimited text files
- first column is location, x, in [mm]
- second column is velocity, u, in [m/s]
2) The text in the data table indicates the particle type:
- 3μm (micron) indicates ceramic microspheres
    * mean particle diameter = 3E-6 m
    * particle density = 2400 kg/m^3
- 1μm (micron) indicates alumina particles
    * mean particle diameter = 1E-6 m
    * particle density = 3830 kg/m^3

CH profile information:

CH profile fits:

1) PLIF data is fit using a "two-sided" Lorentzian (see [1] for fit formulation)
- fit parameters are taken as the mean of fits to 1000 images
- resulting fit profile utilizes full information content of data record

2) Fit parameters given in tab delimited text file
- first column is run number
- second column is 1st fit parameter, $S_{CH,max}$
- third column is 2nd fit parameter, x_{CH}
- fourth column is 3rd fit parameter, w_1
- fifth column is 4th fit parameter, w_2

Planar Laser Induced Fluorescence (PLIF) data:

1) CH radical profiles are presented from single shots (single images):
- profiles are averaged over the central 50 columns
2) These profiles allow for the signal-to-noise ratio to be assessed
- detailed comparisons with experiment should make use of the fit

3) PLIF profiles presented as tab delimited text files
- first column is location, x, in [mm]
- second column is relative CH signal (peak of profile has a value of 1)

References:

[1]   Bergthorson, J. M., 2005. "Experiments and modeling of impinging jets and premixed hydrocarbon stagnation flames". Ph.D. thesis, California Institute of Technology.