Paper 30.1

Study of a Lifted-Jet Flame using a Stereoscopic PIV System

by
Donghee Han[1], L. K. Su[2], R. K. Menon[3] and M. G. Mungal[1]
[1] Mechanical Engineering Department, Stanford University,
Stanford, CA 94305, USA
[2] Center for Turbulence Research, Stanford University,
Stanford, CA 94305, USA
[3] TSI Incorporated, St. Paul, MN 55126, USA

ABSTRACT

Three components of the velocity field at the base of a lifted flame have been measured using stereoscopic particle image velocimetry (SPIV). The validity of applying the SPIV technique in the presence of a flame has been assessed. It has been found that the change of the index of refraction due to the presence of the flame, when compared to a non-reacting flow, can distort the PIV image as much as 1 pixel. However, the distortion between consecutive PIV images could be greatly minimized if the time delay between the two images is within the order of milliseconds. In this work, the instantaneous and the ensemble averaged three-component velocity and the turbulent quantities at the flame base of a lifted flame have been measured. Complex three-dimensional structures are observed at the flame base including the meandering in both in and out of plane directions. Conditional axial velocity measurements at the flame base show similar results (mean speed of $2.4S_L$, where S_L is the laminar flame speed) with previous measurements. However, highest velocities in the radial and azimuthal directions are on the order of $2\sim3S_L$, which implies a possible role of these velocity components in flame stabilization. The turbulent kinetic energy distribution shows a sudden reduction when the flow encounters the flame base, which is thought to be due to the stabilizing effect of heat release.