Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Investigation of a Pulsating Channel Flow with Strong Bulk Flow Reversal Using Particle Image Velocimetry SEAN KEARNEY, THOMAS DIMIDUK[1], TIMOTHY O'HERN, JESSE ROBERTS, JEREMY BARNEY, THOMAS GRASSER, Sandia National Laboratories — Variable-time-delay PIV is used to characterize a pulsating channel flow with strong bulk reversal. Low- and high-magnification fields of view are used to reveal the nature of the flow across the full channel height and to resolve the velocity profile in the viscous sublayer. Results are presented for $Re_d = 1.1 \times 10^4$, based on the time-mean velocity, for two values of the forcing frequency (5 and 10 Hz or $\omega^+ \sim 2.5$ and 5.0×10^{-4}), and for two cases of strong bulk flow reversal ($(U_{\max} - U_{\min})/U_{\text{mean}} = 4$ and 8). The frequency is low enough for the pulsations to impact the turbulence across the full channel height. PIV realizations at low magnification reveal relaminarization during periods of strong acceleration which is followed by transition and turbulence during weakly accelerating and decelerating portions of the cycle. The phase-evolution of the velocity profiles, wall shear stress and turbulence quantities are discussed. The results show that logarithmic time-mean velocity profiles may persist in spite of the strong departure of the flow from equilibrium turbulence over much of the cycle, and that relaminarization weakens the wall shear stress modulation.

[1]Student Intern, Physics Department, Cornell University

Sean Kearney
Sandia National Laboratories

Date submitted: 01 Aug 2007 Electronic form version 1.4