



MMAE SEMINAR

Monday, September 28, 2009
E-1 BUILDING – CRAWFORD AUDITORIUM
3:30 – 4:30 PM

Experimental characterization of buffer layer structures associated with extreme wall stress events in a smooth wall turbulent boundary layer

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Abstract

Three dimensional velocity distributions and wall stresses are measured concurrently in the inner part of a smooth wall turbulent boundary layer using digital holographic microscopy. Conditional sampling based on local shear stress maxima and minima reveals two types of dominant buffer layer structures. The first develops as spanwise vorticity lifts abruptly from the wall, creating initially a vertical arch, which is then stretched to forms a pair of counter rotating vortices inclined at an angle exceeding 45° . A wall-stress minimum forms under the point of initial lifting, while two stress maxima develop 35 wall units downstream due to vortex-induced entrainment. The second characteristic structure is a single, slightly inclined but predominantly streamwise vortex. It generates a strong elongated stress maximum on one side, and a weak minimum on the other. The presentation will conclude with several other examples of applications of cinematic digital holography, such as breakup of crude oil droplets treated with dispersants, as well as swimming behavior and interactions among organisms located in dense suspensions.