Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Measurement of turbulent wall shear stress in air using micro-pillars EBENEZER GNANAMANICKAM, University of Melbourne / Embry Riddle Aeronautical University, KEVIN KEVIN, JASON MONTY, NICHOLAS HUTCHINS, University of Melbourne — The measurement of unsteady wall shear stress in a turbulent boundary layer, especially when the working medium is air, has been a historically challenging problem in experimental fluid mechanics. Recently the micro-pillar shear stress sensor (MPS3) has shown promise in this regard. The MPS3 is an array of micro-pillar mounted on the wall of a model. These micro-pillars deflect an amount proportional to the drag force it experiences. This drag force is proportional to the wall shear stress. The micro-pillar tip deflection is thus tracked using high-speed imaging to yield the unsteady wall shear stress. Here, the MPS3 is used to carry out unsteady wall shear stress measurements in a fully developed channel flow. Both static and dynamic calibrations of the sensor are presented. The wall shear stress statistics obtained in the fully developed channel flow are compared with those obtained from Direct Numerical Simulations (DNS) to provide an assessment of the sensor capabilities. Exemplary measurements such as two-dimensional temporal distribution of the wall shear stress are presented to highlight the capabilities of the sensor.

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Date submitted: 02 Aug 2013 Electronic form version 1.4