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Development of a MEMS shear stress sensor for use in wind tunnel applications[1] CASEY BARNARD, JESSICA MELOY, MARK SHEPLAK, University of Florida, INTERDISCIPLINARY MICROSYSTEMS GROUP TEAM
— The measurement of mean and fluctuating wall shear-stress in laminar, transitional, and turbulent boundary layers and channel flows has applications both in industry and the scientific community. Currently there is no method for time resolved, direct measurement of wall shear stress at the spatial and temporal scales of turbulent flow structures inside model testing facilities. To address this need, a silicon micromachined differential capacitance shear stress sensor system has been developed. Mean measurements are enabled by custom synchronous modulation/demodulation circuitry, which allows for measurement of both magnitude and phase of incident wall shear stress. Sizes of the largest device features are on the order of relevant viscous length scales, to minimize flow disturbance and provide a hydraulically smooth sensing surface. Static calibration is performed in a flow cell setup, and an acoustic plane wave tube is used for dynamic response data. Normalized sensitivity of 1.34 mV/V/Pa has been observed over a bandwidth of 4.8 kHz, with a minimum detectable signal of 6.5 mPa. Initial results show qualitative agreement with contemporary measurement techniques. The design, fabrication, support electronics, characterization, and preliminary experimental performance of this sensor will be presented.

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