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Measurement of Dynamic Wall-Shear Stress using the Micro-Pillar Sensor MPS^3 SEBASTIAN GROßE, WOLFGANG SCHRÖDER, Institute of Aerodynamics, RWTH Aachen University, 52062 Aachen, Germany — The micro-pillar shear stress sensor MPS^3 will be presented. The sensor is based on flexible cylinders that protrude into the viscous sublayer. The sensor concept allows the easy assessment of the two-dimensional wall-shear stress distribution in turbulent flows with a spatial resolution of approximately five viscous units. Both, the streamwise and spanwise wall-shear stress components can be detected simultaneously. The sensor response is detected optically and depending on the optical resolution the system allows to determine the wall-shear stress within 3% accuracy. The static sensor calibration in linear shear flow will be presented and an analytical estimate of the pillar dynamic response will be compared to experimental calibration results. Depending on the sensor structure, turbulent fluctuations up to $1000 - 2000\ Hz$ can be detected. Measurements of the mean and fluctuating wall-shear stress in fully developed turbulent pipe flow at Reynolds number Re_b based on the bulk velocity U_b and the pipe diameter D ranging from $Re_b = 5000 - 20000$ were performed. The results demonstrate a convincing agreement of the mean wall-shear stress obtained with the new sensor technique with analytical and experimental results from the literature. First results of the dynamic wall-shear stress will be discussed and compared to results from the literature.

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