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Sensor-Free Surface Density Detector HUIXUAN WU, University of Kansas — We have developed an optical-based method to measure the absolute air density on a wall surface in compressible turbulent boundary layers. The temporal resolution can be higher than 1MHz, and the spatial resolution can research 10 micron. For isothermal flows, our system can also be used to obtain the wall pressure distributions or volume-ratio of two-species gas. It is a powerful tool for observing turbulent fluctuations and flow separations in sub-, trans-, and supersonic airflows. The working principle of our method is to detect the air density by measuring the refractive index, which linearly depends on density and determines the transmission coefficient at the interface. For single- or multiple-point measurements, we do not need to install sensors on the wall surface, which is a big advantage compared to conventional methods. In 2D cases, a layer of anti-reflection coating is needed. The optical measurement range is not limited by the surface material or sensor. These advantages make our method a good complement or better alternative to the other approaches, such as focused laser differential interferometry technique, which provides density gradient, and pressure (temperature) sensitive paints, which depends significantly on the material properties.

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