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High-resolution compact shear stress sensor for direct measurement of skin friction in fluid flow[1] MUCHEN XU, CHANG-JIN "CJ" KIM, University of California, Los Angeles — The high-resolution measurement of skin friction in complex flows has long been of great interest but also a challenge in fluid mechanics. Compared with indirect measurement methods (e.g., laser Doppler velocimetry), direct measurement methods (e.g., floating element) do not involve any analogy and assumption but tend to suffer from instrumentation challenges, such as low sensing resolution or misalignments. Recently, silicon micromachined floating plates showed good resolution and perfect alignment but were too small for general purposes and too fragile to attach other surface samples repeatedly. In this work, we report a skin friction sensor consisting of a monolithic floating plate and a high-resolution optical encoder to measure its displacement. The key for the high resolution is in the suspension beams, which are very narrow (e.g., 0.25 mm) to sense small frictions along the flow direction but thick (e.g., 5 mm) to be robust along all other directions. This compact, low profile, and complete sensor is easy to use and allows repeated attachment and detachment of surface samples. The sheer-stress sensor has been tested in water tunnel and towing tank at different flow conditions, showing high sensing resolution for skin friction measurement.

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