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Simultaneous Velocity and Vorticity Measurement in Turbulence<sup>1</sup> HUIXUAN WU<sup>2</sup>, HAITAO XU, EBERHARD BODENSCHATZ, Max Planck Institute for Dynamics and Self-Organization — A new paradigm of simultaneous velocity and vorticity measurement is developed to study turbulence. Instead of deducing vorticity from velocities measured at neighboring points, this innovative approach detects the translations and rotations of micro-sized particles directly. These hydrogel particles are spherical, transparent, and encapsulate micro-mirrors. This method outstands conventional ones, e.g., hotwire arrays or PIV because its spatial resolution is much higher. It does not require a non-zero mean flow, and it can provide all three vorticity components, which is not available from planar PIV data. Its principle is to illuminate the mirror and utilize the variation of the reflection directions to deduce the local flow vorticity. Meanwhile, the particle position is recorded as in normal particle tracking. Therefore, the velocity and vorticity of a particle can be obtained simultaneously in Lagrangian framework. The authors have made benchmark experiments to evaluate this novel method in Taylor Couette flows. The results show that the instantaneous vorticity measurement is as accurate as 3%. We are now setting up a von Karman disk pair device to study the turbulent flow. This novel technique will provide unprecedented information of high Reynolds number turbulence

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