Abstract Submitted
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Simultaneous velocity and pressure quantification using pressure-sensitive flow tracers in air[1] PENG ZHANG, Department of Mechanical and Aerospace Engineering, New York University Tandon School of Engineering, SEAN PETERSON, Mechanical and Mechatronics Engineering, University of Waterloo and Department of Mechanical and Aerospace Engineering, New York University, MAURIZIO PORFIRI, Department of Mechanical and Aerospace Engineering, New York University Tandon School of Engineering — Particle-based measurement techniques for assessing the velocity field of a fluid have advanced rapidly over the past two decades. Full-field pressure measurement techniques have remained elusive, however. In this work, we aim to demonstrate the possibility of direct simultaneous planar velocity and pressure measurement of a high speed aerodynamic flow by employing novel pressure-sensitive tracer particles for particle image velocimetry (PIV). Specifically, the velocity and pressure variations of an airflow through a converging-diverging channel are studied. Polystyrene microparticles embedded with a pressure-sensitive phosphorescent dye-platinum octaethylporphyrin (PtOEP)-are used as seeding particles. Due to the oxygen quenching effect, the emission lifetime of PtOEP is highly sensitive to the oxygen concentration, that is, the partial pressure of oxygen, in the air. Since the partial pressure of oxygen is linearly proportional to the air pressure, we can determine the air pressure through the phosphorescence emission lifetime of the dye. The velocity field is instead obtained using traditional PIV methods. The particles have a pressure resolution on the order of 1 kPa, which may be improved by optimizing the particle size and dye concentration to suit specific flow scenarios.

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