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A high-resolution velocimetry technique based on decaying streaks from individual phosphor particles[1] LUMING FAN, National Research Council Canada, GUANGTAO XUAN, Otto-von-Guericke Universitat Magdeburg, PATRIZIO VENA, National Research Council Canada, BRUNO SAVARD, Polytechnique Montral, BENOIT FOND, Otto-von-Guericke Universitt Magdeburg —
A new high-resolution two-dimensional velocimetry technique is presented which is based on decaying streaks formed by individual phosphor particles following pulsed excitation. Tin-doped micron-sized phosphor particles are dispersed into flows and excited by a pulsed UV laser light sheet. Emission streaks are recorded as a result of the particle motion during the persistence of the luminescence ($\sim$ 30 μs). The two components of the flow velocity are derived from the streaks without directional ambiguity by applying to each streak a two-dimensional fit describing a linearly moving point source with a mono-exponential decaying emission. In addition, the frequency shifted luminescence allows rejection of reflected laser light, e.g., very near walls. The approach is first validated against particle tracking velocimetry and PIV in turbulent and laminar jets, where uncertainties were below 5% in the 0.5 to 8 m/s range. Finally macroscopic velocity imaging measurements are presented in a boundary layer as close as 60 microns from the wall. This technique is particularly well suited for near-wall turbulent flow velocity measurements and, given the temperature dependence of the phosphor particles emission spectrum, it has the potential for simultaneous temperature measurements.

[1]Aerospace Futures Initiative

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