Application of fluorescent particles for particle tracking velocimetry in wind tunnels

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HIGHLIGHTS

• Polystyrene latex spheres (PSL) were doped with Kiton Red 620 (KR620) fluorescent dye, making this a safe approach for wind tunnel applications.
• A long pass filter was used to filter the incident laser light (527 nm) while transmitting the fluorescent light (580-600 nm), enabling particle imaging within the particle spot size of the surface.
• Particle tracking velocimetry (PTV) was used to resolve velocities of particles as close as 30 𝜇m from the flat plate surface, while PIV results were limited to 100 𝜇m.

ABSTRACT

Laser flare from surfaces is one of the most common issues encountered in near surface measurements using optical techniques [1]. By using polystyrene latex spheres doped with Kiton Red 620 (KR620) fluorescent dye, the flare issue is largely mitigated by optically filtering the incident scattered light. These particles have been well characterized in past work; however, previous velocimetry has been conducted using purely particle image velocimetry, demonstrating velocity measurements within 100 𝜇m from the surface [2]. The use of a particle tracking velocimetry approach provides the opportunity for measurements as close as approximately 30 𝜇m of the surface with the same imaging parameters. Results for laminar boundary layer flow over a flat plate illustrate that PTV with fluorescent particles for near surface measurements in wind tunnels is a valuable approach for resolving very near surface flow.

Fig. 1 Overlapped frames showing fluorescent particles for one instantaneous image (top left); vectors obtained after PTV processing (bottom left); scatterplot of particle position and particle velocity (right).

References: