Improved Velocity Measurement for Rocket Exhaust and Other Gases

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- Aeronautics
- Mechanical Engineering

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- Engines
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Researchers at Purdue University have developed a new method of measuring velocities in supersonic flows using particle seeding and a digital streak camera. Streak cameras work by converting inputted light into electrons and using an electric field to linearly divert that signal across a charged coupled device (CCD). The rate of this sweep in the streak tube can be tuned to capture a wide range of velocities as the scattered light signal moves across the 1-D field of view. It can enable measurement of flow velocities in excess of 2000 m/s, beyond the limits of traditional shutter straddling technologies. The sweep of the streak tube also provides finer time resolution, limited by the CCD pixel dwell time rather than shutter speed. In traditional PIV, pulsed laser systems typically allow 10 kHz sampling with some experimental burst methods achieving 0.5-1 MHz. The streak diagnostic system developed at Purdue can use a long pulse or continuous light source and achieve flow field sample rates from 40 kHz to 4.2 GHz, allowing essentially continuous tracking of the entrained particles for short durations. This unique velocimetry method can be used in high-temperature, high velocity aerospace and energetic materials applications.

Advantages:
-High-Velocity Detection
-1-D Spatial Interrogation
-Fine Time Resolution

Potential Applications:™
-Rocket Exhaust Plumes
-Hypersonics
-Detonation Engines
-Energetic Materials

Recent Publication:
"Demonstration and Characterization of Particle Streak Velocimetry in Supersonic Nozzle Flows"
2018 Joint Propulsion Conference, Cincinnati, Ohio
DOI: 10.2514/6.2018-4471

Innovator Biography:
Dr. Jared Willits earned his B.S, M.S, and Ph.D from the School of Aeronautics and Astronautics at Purdue University. He is a former NASA Space Technology Research Fellow, and his research at Zucrow Laboratories and Marshall Space Flight Center focused on novel storable rocket propellants and diagnostic techniques to characterize their performance. He is currently a Responsible Engineer at SpaceX supporting the Dragon capsule.

People:

- Pourpoint, Timothee L Louis (Project leader)
- Willits, Jared D

Intellectual Property:

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