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Compact Holographic PIV with Improved Signal-to-Noise Ratio

IP Status: Pending US Patent; **Application #:** 16/290,308

Analyzes movement characteristics of fluid flow

Digital Fresnel Reflection Holography (DFRH) offers a method for performing particle image velocimetry (PIV) using digital inline holography. The system uses backscattered light from particles as the signal and Fresnel reflection of the probe beam at the fluid-window interface as the reference. The signals are processed akin to an inline hologram to extract 3D positions from a single 2D image. The signal-to-noise ratio (SNR) can be tuned by changing the optical properties of the imaging window through specific dielectric coatings.

Uses inherent reflection at interface as reference beam

Performing in-situ 3D measurements of particles in air and water with a significantly larger depth of field and high particle concentration is limited by instrumentation design. Current techniques rely on scattering based intensity measurements requiring calibrations to standard or inline holographic microscopes, which work under very low particle concentrations. This new method uses the inherent reflection at the interface as a reference beam, significantly simplifying the hologram recording systems. This technique can be miniaturized into a probe works at much higher concentrations than other holographic techniques. DFRH provides a simple, compact, cost-effective approach with improved performance for analyzing fluid flow.

Phase of Development

- Performance quantified under laboratory conditions in flows that span a wide range of Reynolds numbers. Prototype probe designed.

Benefits

- improved signal-to-noise ratio (SNR)
- Fresnel reflection for reference: no secondary beam needed, and smaller form factor
- Suitable for particle concentration more than two orders of magnitude higher than conventional design

Features

- Particle image velocimetry using digital inline holography
- Uses backscattered light from particles
- Extracts 3D positions from a single 2D image
- Signal-to-noise ratio (SNR) tunable by changing optical properties of imaging window

Applications

Technology ID
20180243

Category
Engineering & Physical Sciences/Instrumentation, Sensors & Controls

Learn more

- Particle Image Velocimetry (PIV) Holography systems
- Imaging probes
- Optical instrument
- Measurement instrumentation

Researchers

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Publications

Digital Fresnel reflection holography for high-resolution 3D near-wall flow measurement

Optics Express, Vol. 26, Issue 10, pp. 12779-12789 (2018)

Interested in Licensing?

The University relies on industry partners to further develop and ultimately commercialize this technology. The license is for the sale, manufacture or use of products claimed by the patents. Please contact us to share your business needs and licensing and technical interests in this technology.