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REVIEW ARTICLE

Holographic particle image velocimetry

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Abstract
Holography is truly the key to three dimensions in particle image velocimetry, i.e. the measurement of all spatial components of the velocity vector—and this over a deep measuring field. Sophisticated instruments have been designed that successfully tackle practical problems such as the low scattering efficiency of particles, the inferior depth resolution or the aberrations and distortions in the reconstruction. Furthermore, efficient strategies are introduced to interrogate the holographic storage and process the huge amount of data towards a final flow field representation. Recently, phase-sensitive metrology, familiar in many fields of experimental mechanics, has been examined for use in particle velocimetry. Suitable methods are holographic and speckle interferometry or the optical processing of data for three-dimensional correlation. While in these techniques the power of optics is unrivalled, the practical advantage of video and digital techniques over photographic recording is obvious. The electronic version of speckle interferometry (ESPI/DSPI) is a well-established method used in laser metrology and has received further exploitation for applications in flow analysis recently. Finally, the state-of-the-art of digital particle holography is reviewed to allow estimates of its future in experimental flow analysis.

Keywords: fluid flow velocity, holography, holographic interferometry, speckle interferometry, flow diagnostics, particle image velocimetry (PIV)

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