Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

High-precision image-based tracking of a rigid body moving within a fluid STUART LAURENCE, JAN MARTINEZ SCHRAMM — Precise measurement of the displacement, velocity and acceleration of a moving rigid body is of interest in many applications. The use of imaging techniques to obtain such information is an attractive option, particularly for movement within a fluid, as such measurements are inherently non-intrusive. Here we describe a class of imaging techniques based on edge detection and least-squares fitting for determining the displacement of a body, from which velocities and accelerations are readily derived. The use of edge-detection allows for potentially higher precision than correlation-based techniques. The accuracy of the techniques is estimated using both artificially generated images and calibrated measurements, and displacement errors of the order of a few thousandths of a pixel are shown to be obtainable for camera noise levels of a few percent. The resulting uncertainties in velocity and acceleration measurements are also analyzed. Several applications are then described, with particular emphasis on force measurements in short duration supersonic and hypersonic wind tunnels.

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Date submitted: 06 Aug 2010 Electronic form version 1.4