

Holographic Particle Image Velocimetry: Computational Simulation and Reconstruction

by

Craig P. Earls

Submitted to the Department of Ocean Engineering
on June 1, 1999, in partial fulfillment of the
requirements for the degrees of
Naval Engineer's Degree
and
Master of Science in Aerospace Engineering

Abstract

Holographic Particle Image Velocimetry (HPIV) is a novel technique for measuring the complete fluid flow around a body. Advances in computing power make this technique practicable for the first time.

Currently popular techniques for experimentally determining fluid flow around a test body rely on measuring the flow at a single point and moving the sample point during the experiment. This implicitly time averages the data. HPIV can measure the flow field in a volume nearly instantaneously by sequentially "holographing" the seeded flow field.

Until recently the only practical method of processing the HPIV data was to physically reconstruct the optical image from the hologram and scan through the resulting volume using microscope optics. This is a very slow process.

Recent advances in computing power make it possible to directly analyze the digitized holograph (digitized using a high resolution scanner) This reduces the post-processing time from several hours to less than 1-hour with much less expensive equipment.

The primary contribution of this thesis is an advanced multi-platform graphical user interface hologram synthesizer for use in calibrating digital HPIV reconstruction algorithms.

Thesis Supervisor: Jerome H. Milgram
Title: Professor of Ocean Engineering