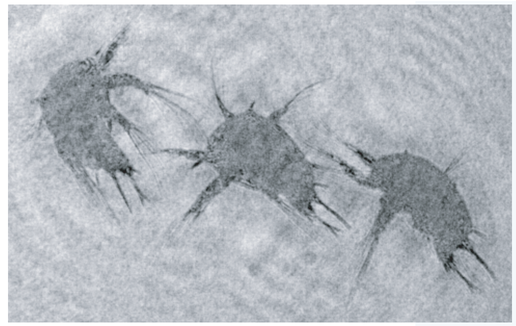
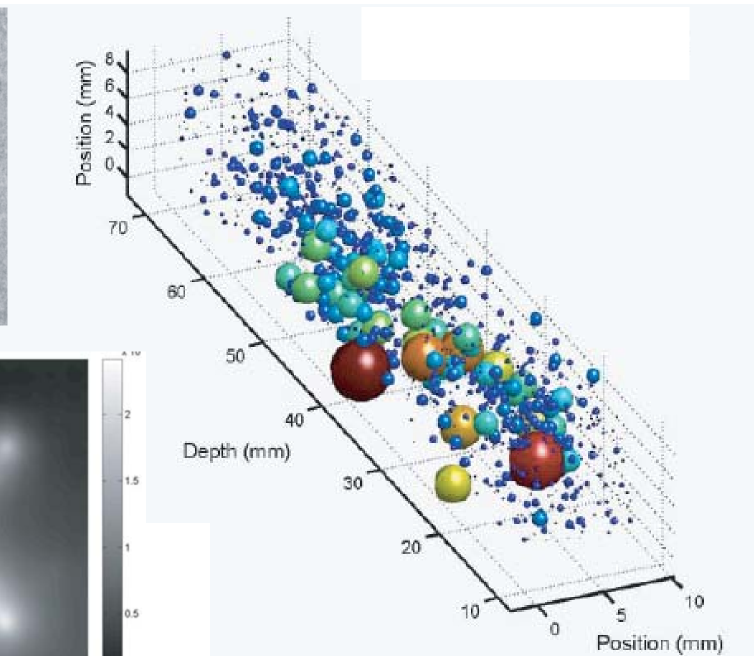
The Institute of OPTICS

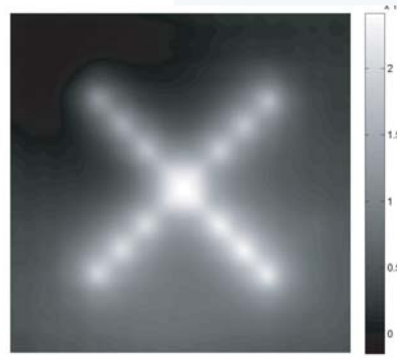
Colloquium

UNIVERSITY of ROCHESTER

3D imaging by holographic and intensity transport based methods







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Diploma, National Technical University Athens, 1993
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3:00 pm, Monday, Nov 16, 2009
Sloan Auditorium, Goergen Hall
Refreshments served.

In this talk, we describe three complementary methods of 3D imaging.

3D imaging by holographic and intensity transport based methods

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ABSTRACT

Imaging the internal structure of quasi-transparent three-dimensional (3D) objects is one of the most challenging tasks for optical systems. If the light propagates *coherently* through the volumetric object, then in the most general case, collection of phase projections from different angles and tomographic reconstruction are required. However, a single shot from a high space-bandwidth-product camera is often sufficient to yield 3D information if the object is sufficiently sparse. If instead the volumetric object can be thought of as a spatially *incoherent* 3D source, then in principle the mutual intensity of the propagated field has sufficient degrees of freedom to reconstruct the source but it is limited by the sensitivity (contrast) of the interferometric measurement. In this talk, we describe three complementary methods of 3D imaging. (1) For the coherent sparse case, which typically leads to rapid phase oscillations at the exit pupil, we have implemented several generations of digital holographic imaging systems which can be deployed underwater to image, e.g. aquatic organisms, seed particles, or bubbles in a flow. (2) For slowly varying optical density profiles, we have been investigating phase recovery via the Transport of Intensity Equation (TIE) and we have developed methods to improve contrast and eliminate the inherent scanning requirement by exploiting the (known) object dispersion. (3) For fluorescent objects, we have used the Bragg selectivity of volume holograms for scanning-free 3D imaging, and also to manipulate the partial coherence of the measurement and thus determine the distance of featureless objects (“white walls.”)

BIOGRAPHY

George Barbastathis is Associate Professor of Mechanical Engineering at MIT. He received the Diploma in Electrical and Computer Engineering from the National Technical University of Athens in 1993, and the M.Sc. and Ph.D. in Electrical Engineering from Caltech in 1994 and ’97, respectively. Between 1997-99 he was a Post-doctoral Research Associate with the Beckman Institute at the University of Illinois, Urbana-Champaign. He has been Visiting Scholar with the School of Engineering and Applied Science at Harvard University (2006-7) and Research Scientist with the Singapore-MIT Alliance for Research and Technology (SMART) Centre in Singapore (2008-9). His research is centered on the physics and engineering of 3D optical imaging systems based on phase recovery, volume holography and nanostructured gradient effective index optics with applications to optical imaging and metrology for biological, environmental, and energy related applications.