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Interferometry XIV: Techniques and Analysis

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Editors

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Introduction

We thank SPIE, the program committee, the authors, and everyone attending this conference. SPIE continues to provide a forum for exchange of ideas and dissemination of the latest research in interferometry and related fields. As a community we come together at conferences such as this one to share not only our work, but also our professional vision. We reacquaint ourselves with old friends and meet new colleagues. The value of these conferences comes from both the professional insight we gain and the relationships we foster.

Interferometry XIV, which is a continuation of the Interferometry series, consists of two complementary conferences, one dedicated to Techniques and Analysis and the other to Applications. These two conferences present recent developments in analyses and techniques that use interference and projection fringes for highly precise measurements of different objects and their application in a wide range of systems. The proceedings of the two conferences comprising Interferometry XIV are published in two separate volumes as *Interferometry XIV: Techniques and Analysis* (SPIE Proceedings Vol. 7063) and *Interferometry XIV: Applications* (SPIE Proceedings Vol. 7064).

The growing demand for accurate and repeatable measurements of increasingly complex devices, especially in the semiconductor and MEMS industries as well as biological and space sciences, has driven the field of optical metrology to develop innovative techniques that provide fast, precise, real-time assessments of industrial products. While the range of techniques and technologies in interferometry is already vast, researchers strive to find solutions to new challenges that help make invisible things visible and to extend our vision further into outer space as well as into the nano-world.

This conference on Interferometric Techniques and Analysis highlights developments in surface metrology, digital holography, speckle, pulsed and polarization techniques, temporal and spatial phase shifting, low coherence interferometry, multiple wavelength, and fringe projection techniques. Other topics include new developments in vibration insensitive techniques and techniques for the measurement of aspheric surfaces, film thicknesses, surface motion, and stress. In addition, we spotlight cutting-edge papers on optical fields manipulation in a session titled "On the Fringe."

We are pleased to present a conference with such a large number of excellent papers. This proceedings volume contains 50 papers presented at the SPIE Optics and Photonics Meeting in San Diego on August 11–13, 2008. 43 of these papers were presented orally. These papers represent the work of researchers from 20 countries and four continents with invited speakers from the United Kingdom, Japan, Germany, the United States, Poland, Norway, Portugal, and Australia.

During the last conference we had a great time choosing our favorite fringe patterns from those submitted by attendees. The favorite turned out to be distorted fringes reflected from a water surface and then analyzed by the fringe reflection technique presented by Thorsten Bothe from BIAS, Germany (Bremer Institute für Angewandte Strahltechnik) (see Figs. 1 and 2).

Fig.1 Periodic line structure on the side of the building. Top part of winning Fringe Art competition photo taken by T. Bothe from BIAS, Germany.

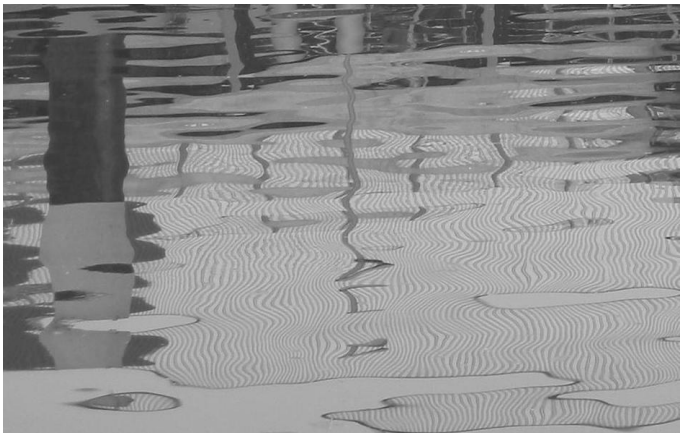

Fig. 2 Reflection fringes of periodic line structure on the building in Fig1. Bottom part of photo taken by T. Bothe.

Many of us are drawn to the images of fringes in our everyday lives, for observing fringes in our surroundings is, one may say, our professional deviation. With this conference we have continued the biannual "Fringe Art" competition to share our favorite fringe patterns. The winner will be announced in the next conference proceedings.

Until the next Interferometry conference, may you continue to see fringe patterns everywhere.

Joanna Schmit
Katherine Creath
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Advanced and shaped light fields for the biosciences

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Advanced photonics using novel holographic beam shaping and interferometry has proved to be a powerful and emergent area in biophotonics. Light may be used in various guises. A prime example is optical micromanipulation. This is a powerful non-contact technique where micrometre sized particles can be grabbed, moved and generally manipulated solely with light. Optical tweezers is the most popular way to implement these forces using a single tightly focused light beam. They have forged an important bridge between physics, chemistry and biology. In recent years there has been a proliferation of activity in this area, fuelled, in part, by the recognition that we need to advance the "optical toolkit". This essentially means creating more elaborate 2D and 3D light patterns (beam shaping) that can create an optical landscape. Particle and cellular motion on such a landscape will enhance our ability to move and sort particles and importantly, create 2D and 3D arrays of particles [1].

Advanced beam shaping may also be considered useful for the topic of cell transfection. Here we consider the cell membrane which represents the outer extremity of all eukaryotic cells. In mammals, this is a thin (5nm) bi-layer film of lipids, embedded with various protein molecules at interspersed locations. Under normal circumstances, the lipid nature of the cell membrane acts as an impermeable barrier to the passage of most water-soluble molecules. Thus, the selective introduction of therapeutic agents to the inside of dysfunctional or diseased cells remains problematic. Methods for puncturing the cell membrane without causing any collateral damage have been devised and importantly, this includes laser-assisted techniques particularly using multi-photon processes. Bessel modes can be used for "focus-free" photoporation (see fig.1) and offer new opportunities for the field [2]. This talk will cover both aspects of optical trapping, sorting and cell transfection using advanced beam shaping and interferometry.

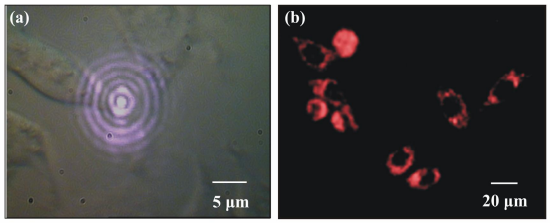

Figure 1. (a) The Bessel beam "focus" is positioned on the cell plane. (b) Upon successful transfection, the cells express the red fluorescent protein and fluoresce red (adapted from reference 2)

[1] "Optical Micromanipulation" K. Dholakia, P Reece and M Gu Chem. Soc. Rev, **37**, 42 - 55 (2008)
[2] "Femtosecond cellular transfection using a non-diffracting light beam" X. Tsampoula, V. Garcés-Chávez, M. Comrie, D. Stevenson, M.B. Agate, F.J. Gunn-Moore, C.T.A. Brown and K Dholakia, Appl Phys Lett **91**, 053902 (2007).