UCLA Electrical Engineering ARR 2011

Session 13. Novel Photonic and High-Energy Techniques
South Bay Room

3:15-3:40

"Lensfree Optical Tomographic Microscopy"

Serhan O. Isikman, Waheb Bishara, Sam Mavandadi, Steve Feng,Frank Yu, and Aydogan Ozcan

Abstract:
Tomographic imaging of biological specimen provides detailed volumetric information regarding their internal structure. Nevertheless, existing three-dimensional microscopy (3D) modalities are relatively costly and bulky, and they can probe limited imaging volumes. To provide an alternative microscopy tool that enables depth-resolved imaging of orders of magnitude larger samples in a compact and simple architecture, we have recently developed lensfree optical tomography. In this platform, holographic shadow images of micro-objects are recorded for different illumination angles to compute slice images (tomograms) with micrometer-scale 3D resolution. Lensfree optical tomography can be a particularly useful sectional-imaging tool for lab-on-a-chip applications and telemedicine microscopy.

3:40-4:05

"Developing a Compact Source of High Energy Protons for Cancer Therapy"

Dan Haberberger, Sergei Tochitsky, Chao Gong, Chan Joshi, Warren Mori,Frederico Fiuza

Abstract:
Over the past decade, laser driven ion acceleration (LDIA) has drawn great interest from the scientific community due to the promise of a cheap and compact source of high quality ion beams for a myriad of applications including hadron cancer therapy. Towards this end, at the UCLA Neptune Laboratory we have investigated LDIA using a high-power CO2 laser pulse in a H2 gas jet. This unique interaction produces a shock wave which

accelerates protons to energies up to 22MeV contained within an energy spread of E/EFWHM~1%.With a modest extrapolation of state-of-the-art laser technology, it may be possible to reach 100-200 MeV proton beams that are needed for the treatment of many types of cancerous tumors.

4:05-4:30

"Lensfree Fluorescence Microscopy"

Ahmet F. Coskun, Ting- Wei Su, Ikbal Sencan, Aydogan Ozcan

Abstract:
We review a recently introduced wide-field on-chip fluorescence microscopy platform that can *simultaneously* monitor fluorescent micro-objects or labeled cells/model animals over >0.6-8 cm2 imaging field-of-view without the use of any lenses, thin-film interference filters or mechanical scanners. In this platform, the fluorescence emission from the objects is collected by a fiber-optic faceplate and is delivered to an opto-electronic sensor-array (e.g., a CCD chip). These recorded lensfree fluorescence images are then rapidly decoded using a compressive sampling algorithm to achieve ~4µm spatial resolution over entire chip area (e.g., >0.6-8cm2). Such an on-chip lensfree imaging platform could be very useful for high-throughput cytometry, rare-cell analysis, and microarray research.

4:30-4:55

"Active terahertz quantum-cascade leaky-wave antenna"

Amir A. Tavallaee, Benjamin S. Williams, Philip W. C. Hon, Tatsuo Itoh, and Qi-Sheng Chen

Abstract:
We present an active leaky-wave metamaterial antenna realized in terahertz quantum-cascade (QC) structures that exhibits frequency-dependent direction of radiation. The metamaterial antenna is fed by a master oscillator QC-laser with a mode that propagates with an effective phase index smaller than unity such that it radiates in the surface direction due to a leaky-wave mechanism. The direction of emission of main beam is governed by the antenna dispersion characteristic. 25 degrees of beam steering is observed as the lasing frequency of the QC-laser is varied from 2.65-2.81 THz.

4:55-5:20

"Automated On-Chip Semen Analysis using a Handheld Lensfree Holographic Microscope"

Ting-Wei Su, Anthony Erlinger, Derek Tseng, and Aydogan Ozcan

Abstract:
We demonstrate automated semen analysis using a lensfree on-chip microscope. This compact holographic microscope weighs ~46 grams and does not require any lenses, lasers or other bulky optical components to achieve phase and amplitude imaging of sperms over ~24 mm^2 field-of-view with a numerical aperture of ~0.2. Such a compact and light-weight automated semen analysis platform that can investigate both sperm concentration and motility over a large field-of-view is especially important for fertility clinics, personal male fertility tests, as well as for field use in veterinary medicine such as in stud farming and animal breeding applications.