NANOHOUR

Wednesday, October 4, 2006

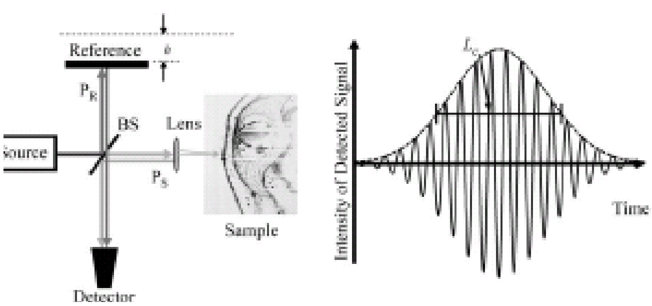
3:00 PM

Beckman Institute - Room 3269

Interferometric Synthetic Aperture Microscopy (ISAM)

Tyler S. Ralston – Graduate student in Electrical and Computer Engineering

State-of-the-art methods in high-resolution three-dimentional (3-D) optical microscopy require that the focus be scanned through the entire region of interest. It is believed that features outside of the focus are inherently unresolvable. We develop a mathematical model connecting the experimentally acquired signal with the three-dimensional object structure, taking into account the finite beam width, diffraction and defocus effects. Using our model, we derive the solution to the inverse scattering problem for coherence microscopy. By implementing our solution, resolution produced by conventional coherence microscopy at the focus can be achieved for all planed outside of the focus. Explicitly, we determine the structure of an imaged object using all the data collected from the illuminated volume. Furthermore, the volumetric data can be acquired with only 2-D scanning resulting in an improved acquisition speed. Numerical simulations show that scatterers can be resolved outside of the confocal volume. Verification with experimental implementations demonstrate spatially-invariant resolution. These results improve the high-resolution cross-sectional imaging capabilities for 3-D micrscopy.

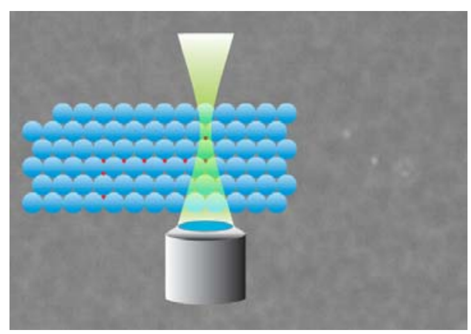


We describe and demonstrate a novel computational image-formation technique called interferometric synthetic aperture microscopy (ISAM). We apply this new modality to the 3-D imaging of a tissue phantom and of human breast tissue. ISAM has the potential to broadly impact real-time 3-D microscopy and analysis in the fields of cell and tumor biology, as well as in clinical diagnosis where *in vivo* imaging is prefereable to biopsy.

AND

Laser Tweezer Manipulation of Nanoscale Particles in Photonic Crystals

Dr. Ryan J. Kershner – Postdoctoral Fellow



Photonic crystals have received a great deal of attention in recent years for their remarkable ability to harness and control light. One significant challenge remains the ability to controllably place individual defect states within an ordered lattice, with specific control over composition. Solving this problem is essential to realizing photonic waveguides three dimensional in periodic structures. This talk will present a promising approach for control of individual features using laser tweezers. Synthetic opals were produced from 1.58-um silica particles using a standard flow cell method. ZnS nanoparticles having an index of refraction on the order of 2 were produced by controlled aggregation of seed nanocrystals. Arrays of optical traps were utilized to grab individual nanoparticles (<150 nm) and guide them through the pore structure (~ 250 nm) of the synthetic opal to pre-determined locations. By filling the opal with an index-matching solvent, scattering from the silica particles was reduced while still maintaining an index contrast between the medium and ZnS particles sufficient for trapping. Simple structures were successfully fabricated as a proof of concept, and methods for producing more complicated structures will be proposed. More recent results using Au nanoparticles will be shown to demonstrate the flexibility of this technique for controlling composition.

Coffee and cookies will be served.

http://nanohour.beckman.uiuc.edu