MAR10-2009-020170

Abstract for an Invited Paper
for the MAR10 Meeting of
the American Physical Society

Medical imaging with optical coherence tomography

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Optical coherence tomography (OCT) is an emerging imaging modality which can generate high resolution, cross-sectional and three dimensional images of microstructure in biological systems. OCT is analogous to ultrasound B mode imaging, except that it uses light instead of sound. Imaging is performed by measuring the echo time delay of optical backscattering in the tissue as a function of transverse position. The penetration depth of OCT imaging is limited by attenuation from optical scattering to $\sim$ 2 to 3 mm in most tissues, however image resolutions of 1-10 um may be achieved. OCT functions as a type of "optical biopsy" enabling in situ visualization of tissue microstructure with resolutions approaching that of conventional histopathology. Imaging can be performed in real time without the need to remove and process a specimen as in conventional biopsy. OCT technology utilizes advances in photonics and fiber optics such as femtosecond broadband lasers, high speed wavelength swept lasers and line scan camera technologies. Recent developments using Fourier domain detection achieve dramatic improvements in resolution and imaging speed. Three dimensional, volumetric imaging with extremely high voxel density is now possible, enabling microstructure and pathology to be visualized and rendered in a manner analogous to MR imaging. OCT is now widely accepted as a standard diagnostic in clinical ophthalmology, where it can image retinal pathology with unprecedented resolution improving the sensitivity of diagnosis and monitoring response to treatment. OCT is also being developed for other applications ranging from intravascular imaging in cardiology to endoscopic imaging for cancer detection. This presentation will discuss OCT technology and its applications.