BME Seminar

Photothermoacoustic imaging of biological tissues: Signal generation and maximum depth characterization comparison of time- and frequency-domain measurements

By

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Abstract:

The photothermoacoustic (PTA) or photoacoustic (PA) effect induced in light absorbing materials can be observed either as a transient signal in time domain, or as a periodic response to modulated optical excitation. Both techniques can be utilized for creating an image of subsurface light absorbing structures (chromophores). In biological materials, the optical contrast information can be related to physiological activity and chemical composition of a test specimen. The presentation will discuss signal generation principles and imaging capabilities of the frequency (or Fourier) domain method (the "photoacoustic radar") and will compare experimentally the two photoacoustic imaging modalities with respect to the maximum imaging depth achieved in scattering media with optical properties similar to biological tissues. Depth profilometric measurements were carried out using a dual-mode laser system and a set of aqueous light-scattering solutions mimicking photon propagation in tissue. Various detection schemes and signal processing methods were tested to characterize the depth sensitivity of photoacoustic measurements. The obtained results demonstrate the capabilities of both techniques and can be used in specific PTA imaging applications for development of image reconstruction algorithms aimed at maximizing system performance. Distinct advantages of the frequency domain technique include superior signal-to-noise ratio and efficiently suppressed baselines underscoring the high potential of this technique for depth-selective imaging of deep lying tissue chromophores.

Biography:

Andreas Mandelis is a Full Professor of Mechanical and Industrial Engineering; Electrical and Computer Engineering; and the Institute of Biomaterials and Biomedical Engineering, University of Toronto. He is also the Chairman, and CTO of Photo-Thermal Diagnostics, Inc., Toronto, ON, Canada and the President and CTO of Quantum Dental Technologies, Inc., Toronto, ON, Canada. He received his BS degree (Magna cum Laude) in physics from Yale University in 1974, and MA, MSE, and Ph.D. degrees from the Applied Physics and Materials Laboratory, Department of Mechanical and Aerospace Engineering, Princeton University. He is the Director of the Center for Advanced Diffusion-Wave Technologies (CADIFT) at the University of Toronto. He is the author and co-author of more than 260 scientific papers in refereed journals; he is the author of the book Diffusion-Wave Fields: Mathematical Methods and Green Functions.

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