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Abstract for an Invited Paper
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Joseph F. Keithley Award For Advances in Measurement Science Lecture: Thermophotonic and Photoacoustic Radar Imaging Methods for Biomedical and Dental Imaging[1]

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In the first part of this presentation I will introduce thermophotonic radar imaging principles and techniques using chirped or binary-phase-coded modulation, methods which can break through the maximum detection depth/depth resolution limitations of conventional photothermal waves. Using matched-filter principles, a methodology enabling parabolic diffusion-wave energy fields to exhibit energy localization akin to propagating hyperbolic wave-fields has been developed. It allows for deconvolution of individual responses of superposed axially discrete sources, opening a new field: depth-resolved thermal coherence tomography. Several examples from dental enamel caries diagnostic imaging to metal subsurface defect thermographic imaging will be discussed. The second part will introduce the field of photoacoustic radar (or sonar) biomedical imaging. I will report the development of a novel biomedical imaging system that utilizes a continuous-wave laser source with a custom intensity modulation pattern, ultrasonic phased array for signal detection and processing coupled with a beamforming algorithm for reconstruction of photoacoustic correlation images. Utilization of specific chirped modulation waveforms ("waveform engineering") achieves dramatic signal-to-noise-ratio increase and improved axial resolution over pulsed laser photoacoustics. The talk will conclude with aspects of instrumental sensitivity of the PA Radar to optical contrast using cancerous breast tissue-mimicking phantoms, super paramagnetic iron oxide nanoparticles as contrast enhancement agents and in-vivo tissue samples.

[1]With N. Tabatabaei, S. Telenkov, and R. Alwi