

Frequency-Domain Photothermoacoustics: Alternative Imaging Modality of Biological Tissues

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Frequency-domain photothermoacoustic (FD-PTA) imaging of biological tissues is presented and compared with the conventional time-domain (pulsed laser) methodology. We demonstrate that tissue imaging can be performed with high axial resolution without the necessity to employ short-pulse and high peak-power laser systems to generate acoustic transients. The presented analysis shows that depth information in the FD-PTA method can be recovered by using linear frequency-modulated (chirped) optical excitation and frequency-domain signal processing algorithms. The signal-to-noise ratio can be increased significantly using correlation processing which can compensate for the small amplitude of acoustic waves typical to the periodic excitation mode. Additionally, narrow-band signal demodulation enables depth-specific and confocal tissue imaging using the optically-induced photothermoacoustic effect. Application of the FD-PTA is demonstrated in experiments with turbid phantoms and ex-vivo tissue specimens.