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Optoacoustics for biomedical sensing, monitoring, and imaging

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Optoacoustics can provide diagnostic information with high optical contrast and ultrasound resolution. It is based on detection of broadband ultrasound induced by short optical pulses and utilizes absorption contrast in tissues. We proposed and developed sensing, monitoring, and imaging optoacoustic systems for in a variety of biomedical applications including pulsed laser tissue ablation, accurate measurement of tissue optical properties, tumor detection, monitoring of tissue hyperthermia, coagulation, freezing, and important blood parameters such as oxygenation and hemoglobin concentration. Recently, we built a novel, portable, multi-wavelength optoacoustic system which includes optical parametric oscillator operating in the range from 680 to 2400 nm and sensitive, broadband optoacoustic probes developed in our laboratory. We tested the system performance in animal and clinical studies. We monitored continuously and in real time cerebral blood oxygenation and total hemoglobin concentration. Direct probing of blood vessels with high contrast and resolution allowed for monitoring of these parameters with accuracy approaching that of the standard invasive techniques. Results on other important clinical applications of the optoacoustic technique will be presented as well.