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Improved Differentiation of Breast Tumors Using Laser Opto-acoustic Ultrasonic Imaging System

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**Background**

This study was performed to provide preliminary clinical feasibility of a noninvasive hybrid imaging modality, Imagio, that uses combination of real-time laser opto-acoustic and ultrasound for improving diagnostic accuracy in the evaluation of breast masses. The system characterizes and differentiates breast tumors based on the concentration of blood and its oxygen saturation in the tumor angiogenesis while also showing structural information based on traditional ultrasonic imaging methods. Opto-acoustic imaging uses pulses of laser light in the near-infrared spectral range to illuminate tissues and detects the resulting pressure with arrays of ultrawide-band ultrasonic transducers. After image reconstruction, tumor location, shape and dimensions are determined with a spatial resolution of better than 1 mm.

**Materials & Methods**

Laser illumination at the wavelength of 757 nm provides contrast based mainly on the hypoxic blood of breast carcinomas, while a wavelength of 1064 nm produces contrast dominated by the enhanced water content and normally oxygenated blood in benign fibroadenomas. Detection of the resulting ultrasonic signals with a commercial hand-held ultrasonic probe preserves qualitative information about the tumor optical absorption. Two opto-acoustic measurements yield solutions for the concentrations of hemoglobin and oxygenated hemoglobin in pixels within the field of view. In the same location, ultrasonic images are generated to provide structure information. The optoacoustic information is displayed with the ultrasonic image to provide coregistered images containing morphological and functional information.

**Optical Absorption of Hemoglobin**

Figure 4. Optical absorption spectra of 3 major substances in tissue that contribute to opto-acoustic image brightness.

**References**