AbstractID: 10730 Title: Multimodal sono-contrast NIR spectroscopy system for breast cancer diagnosis

Purpose: To present a multimodal imaging system that combines three modalities, optical spectroscopy, ultrasonography and acoustic radiation force (ARF) for improved diagnosis of breast cancer based on noninvasive interrogation of vasculature.

Method and Materials:
The scanhead incorporates two 1MHz focused transducers aligned orthogonally to deliver ARF in a 2.4cm region. A commercial ultrasound probe is positioned to image the focal plane. The ultrasound probe and focused transducers have two degrees-of-freedom, so that the focal zone can be scanned in tissue depth-wise and laterally. Three force sensors are mounted on the breast compression plate to ensure consistent, slight compression. A fiber array (6 sources and 12 detectors) connects to the concave bottom plate of the scanhead. Sources are illuminated by two laser diodes (680 and 830nm) through a multi-channel optical switch. Diffuse reflectance signals are collected by 12 detectors, amplified by avalanche photodiodes, and transmitted through a multi-channel data acquisition card for analysis. The scanhead is mounted on a 360° ring gantry, which can rotate around the breast and move towards or away from the patient.
A software system was implemented in Visual C++ to perform real-time tasks, including acquisition of optical and force signals, control of optical switch and function generator, and data display.

Results: The maximum exposure to laser was controlled within $0.2 W \cdot cm^{-2}$ (ANSI Z136.1). The ARF fields were maintained below FDA diagnostic limits ($0.72 W \cdot cm^{-2}$) for manipulating blood flow and oxy-hemoglobin concentrations at the time and location of detection, causing measurable differences in the dynamic behavior of tissue blood supply as reported by optical spectroscopy. This technique was demonstrated to be highly diagnostic in a murine tumor model.

Conclusions: A multimodal system incorporating ARF, optical spectroscopy and ultrasonography has been developed to characterize breast cancers. Pilot clinical study is being carried out.

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