

Bimodal Ultrasound and Optical Approach for Breast Cancer Imaging without Coregistration

ABSTRACT

The aim of this investigation is to test the potential and efficiency of a bimodal ultrasound and optics probe in locating a breast cancer lesion in standard breast tissue. Traditionally, there exist many separate techniques that achieve this said task: ultrasound scanning, diffuse optical spectroscopic imaging (DOSI), MRI, CAT scans, etc. Our novel approach combines the strengths of the ultrasonography and optical imaging techniques into one multi-capability probe. It was hypothesized that we would be able to locate a cancerous lesion in breast tissue, and that the results from our bimodal optical and ultrasound (DOSI/UZ) approach would follow expected biomarker trends. The probe was designed and manufactured with black delrin plastic, steel 5 cm. screws, steel 0.32 cm. set screws, silicone rubber, a clinical ultrasound probe and machine, and DOSI optical fiber imaging technology. Measurements of biomarker concentration, which provide information about the tumor cell biology, and tumor size, position, and depth were then obtained from a breast cancer patient with the help of a trained clinician using our bimodal probe. Consequently, the capabilities of the probe were analyzed using MATLAB software by comparing the biomarker levels of lipid, water (H₂O), tissue optical index (TOI), hemoglobin (HbO₂), and deoxyhemoglobin (HHb) to the theoretical trends found in our research. As tumor depth increased and the amount of light from the optical instrument interacting with the tumor decreased, we expected, based upon our research, TOI to decrease, lipid levels to increase, hemoglobin levels to decrease, and water levels to decrease. Our results followed these expected trends for a comparison between biomarker concentration in the tumor and the depth of the tumor. Our results show that our bimodal ultrasound and optics probe was successful in locating the breast tumor and that the data obtained from our bimodal device was conclusive. Further patient tests will confirm the overall superiority of our technique to conventional ones.