Abstract:
Breast cancer is the leading cause of cancer deaths in women in the United States. Despite major strides in cancer prevention and treatment during the past decades, there is no known prevention for breast cancer, and treatment has a significant impact on mortality only if breast cancer is detected early. At present, X-ray mammography is the only screening tool used for detecting nonpalpable breast cancers because its resolving power is better than other imaging modalities. However, it is limited in its inability to distinguish between benign and malignant lesions because they may impart similar attenuation to the X-rays passing through them. MRI offers exciting potential for increased tissue characterization compared to other imaging modalities. It has the advantage of high soft tissue contrast that can demonstrate small breast lesions and lesion architecture. MRI, however, lacks the specificity in cancer detection and it is a rather expensive technology. Standard ultrasound is excellent in differentiating cysts from solid lesions and is routinely used in conjunction with x-ray mammography. However, ultrasound sensitivity and specificity are not high, which may be due to the fact that even when tissues are pathologically different, their ultrasound properties are often quite similar. Optical imaging using diffused light in near infrared (NIR) window is a new promising technique, which provides novel functional parameters that differentiate malignant tumors from normal breast tissue. However, NIR only imaging suffers low spatial resolution and target location uncertainty due the intense light scattering by tissue.

We have developed a novel imaging method that combines ultrasound and near infrared diffusive light techniques. The hybrid method utilizes high contrasts between benign and malignant tissues provided by NIR imaging and high spatial resolution inherent in ultrasound imaging. Currently, our combined system is being tested at the Cancer Center of UConn Health Center. The preliminary results are very encouraging. We have demonstrated that detailed heterogeneous distributions of wavelength-dependent optical absorption and hemoglobin concentration of breast carcinoma can be obtained. We have also demonstrated that small malignant lesions can be characterized in early stages.