Near Infrared Diffused Light Imaging with Ultrasound Guidance
(Funded by National Institute of Biomedical Imaging and Bioengineering, R01EB002136, 2013-2017, PI: Quing Zhu)

In this project, an ultrasound-guided near infrared tomography technique will be refined and validated for imaging locally advanced breast cancers in patients who are undergoing neoadjuvant chemotherapy. Approximately, 80 patients will be recruited from three hospitals and their responses to neoadjuvant treatment will be assessed pretreatment, at early treatment cycles, and prior to surgery. This larger patient pool will be used a) to determine the best time-window to assess response based on cycle 1 %tHb for different treatment regimens; b) to validate the prediction model developed from pilot data based on tumor pathological variables (tumor type, grade and mitotic count), tumor molecular markers of estrogen receptor (ER), progesterone receptor (PR), and HER-2/neu, and pretreatment NIR functional parameters as well as response rate based on one cycle of %tHb. The successful completion of the project will provide a means to improve the current clinical practice by accurately predicting an individual patient's response.

Co-registered photoacoustic and ultrasound imaging for non-invasive ovarian cancer detection and characterization

(Funded by National Cancer Institute, 1R01CA151570, 2011-2016, PIs: Quing Zhu and Molly Brewer)

In this project, a new transvaginal imaging device optimized for ovarian cancer detection and diagnosis will be developed and validated from *ex vivo* and *in vivo* clinical studies. We will study ovaries from both premenopausal and postmenopausal women with normal, abnormal and malignant ovarian tissue in an attempt to provide a more cost effective and accurate diagnostic technique to aid doctors and patients in determining the need for surgery. Current technologies (ultrasound, CT, MRI, PET, CA125 and physical exam) provide insufficient data to determine whether an ovary must be removed or is likely cancerous; therefore, a better method is needed to determine if ovarian tissue is malignant or benign. The successful completion of the project will provide a means to improve the current clinical practice; it will provide necessary technology to improve early ovarian cancer detection; and it will be an effective means to avoid surgery in most patients with a normal ovary. It is also a relatively inexpensive technology and, if accurate, would substantially reduce medical costs and provide women with a better determination of their risk of cancer and thus improve their quality of life.

Targeted Probes for Breast Tumor Hypoxia Imaging

(Funded by Connecticut Public Health, 2010-2014, Co-PIs: Michael Smith, University of Connecticut, Liisa Kuhn, University of Connecticut Health Center)

The tumor microenvironment is recognized as a critical factor that influences not only the response to conventional anti-cancer therapies, but also helps define the potential for malignant progression and metastasis. In particular, tumor hypoxia is now considered a fundamentally important characteristic of the tumor microenvironment. We hypothesize that the novel ICG-2-nitroimidazole conjugate that we have developed will provide the means to image tumor hypoxia in tumor-bearing mice using near-infrared techniques. The ultimate goal of the project is to develop an *in vivo* molecular probe, as well as associated imaging hardware, that can directly image tumor hypoxia of breast cancer patients who may be resistant to traditional therapies and can benefit from hypoxia-targeted therapies.

A near Infrared Imager as aa Add-onunit to Standard Ultrasound for Breast Cancer Treatment Prediction and Monitoring
(Funded by CT Bioscience Fund, 2014-2017, PI: Quing Zhu)
This project involves the development of a handheld near-infrared imager as an add-on unit to commercial ultrasound systems for use in breast imaging. The device is intended to help predict and assess neoadjuvant chemotherapy response.