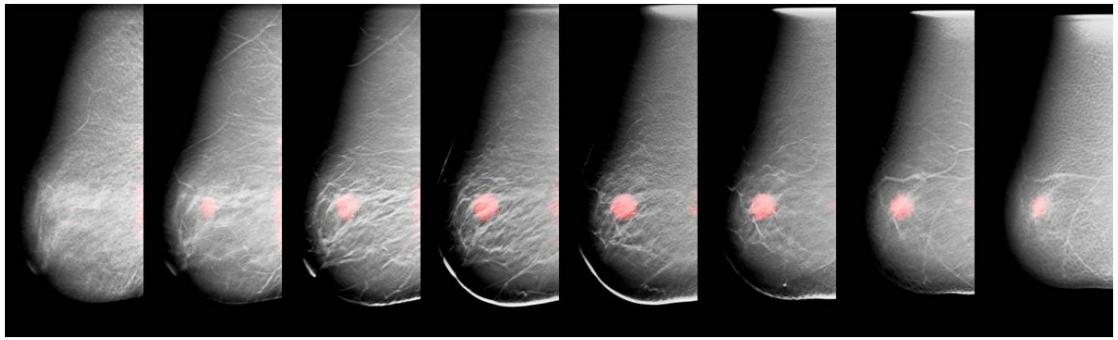
Medical Imaging Research Detector Lab



Dual Modality Breast Tomosynthesis

Dedicated Breast PET (positron emission tomography)

We are developing and evaluating the basic performance characteristics and efficacy of new medical imaging systems with the goal of improving disease detection and treatment. Of particular interest are imaging systems utilizing x-rays (i.e. radiography, x-ray tomosynthesis, x-ray computed tomography (CT)) and/or nuclear medicine (i.e. scintigraphy, gamma ray emission tomosynthesis, single photon emission computed tomography (SPECT), and positron emission computed tomography (PET)). In recent years we have focused on the development of multimodal hybrid systems that integrate spatially correlated anatomic and functional image sets. Current focus application areas include breast cancer detection and characterization and intraoperative image guidance.

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"Quantitative molecular imaging is a central component of the next generation of health care."

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Dual Modality Tomosynthesis Breast Imaging (DMT)

The DMT scanner combines the sensitivity of digital breast tomosynthesis with the specificity of molecular breast imaging (breast-specific gamma imaging) in a single upright unit. The system is designed to obtain diagnostic information regarding suspicious or radiographically occult mammographic findings, and functions by obtaining sequential series of x-ray transmission and gamma emission images over a limited range of viewing angles with the breast in a single configuration.

Tomographic Molecular Breast Imaging

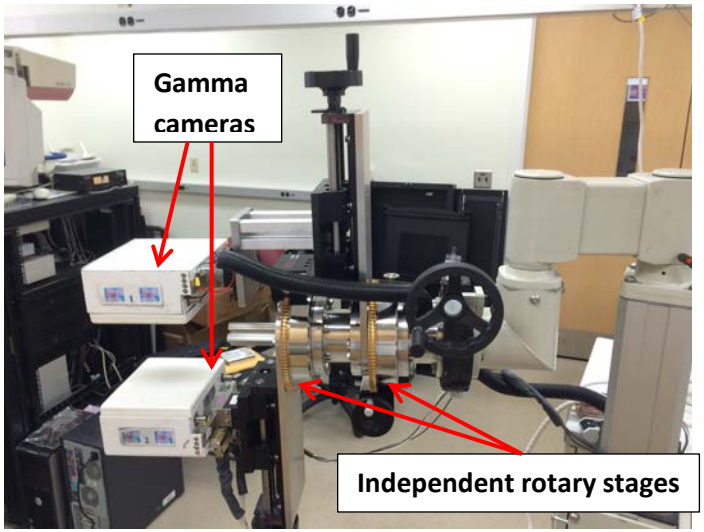
Imaging must be quantitative to meet the demands of future health care requirements such as personalized medicine and the clinically minable databases of radiomics. We are adapting a two-head gamma camera designed for conjugate imaging of the breast to permit dedicated breast tomography. Iterative image reconstruction incorporates resolution recovery and attenuation correction, and results in nearly isotropic spatial resolution and quantitative accuracy.

Dedicated Breast Ring PET

Clinical whole body PET scanners have inadequate spatial resolution to reliably detect primary breast malignancies smaller than 1 cm. Our group is developing and evaluating a breast ring PET (BRPET) scanner to improve spatial resolution by more than a factor of three. The scanner is designed to maximize visualization of the entire breast, including the difficult to image posterior portion near the chest wall. It is being compared to breast MRI in a pilot study.

Intraoperative 3-D Imaging Using a Handheld Gamma Camera

In collaboration with corporate and national laboratory partners we are developing and evaluating a system for radio-guided surgical procedures such as sentinel lymph node biopsy. The system uses infrared tracking of a handheld gamma camera to create a 3-D map of the distribution of gamma-emitting compounds (e.g. lymphatic or tumor-targeting radiotracers) during surgery. The system is being evaluated among melanoma patients undergoing sentinel lymph node biopsy. It is anticipated that, compared to current practice utilizing pre-operative 2-D lymphoscintigraphy using large area, general purpose gamma cameras followed by intraoperative node excision using non-imaging gamma probes, the handheld SPECT system will result in more accurate node localization, less ambiguity for the surgeon, and greater comfort for the patient.



Single Photon Emission Breast Tomography

RECENT RESEARCH DEVELOPMENTS

- We have completed accrual of nearly 100 DMT scans in an NIH-funded human study.
- In addition to the ongoing human observer analysis of DMT, we are exploring the use of model observers as an additional means of quantitative assessment of DMT performance.

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