Susan G. Komen
Research Grants – Fiscal Year 2014

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Optimization of calcification imaging in digital breast tomosynthesis

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Public Abstract:
The current standard for breast cancer screening in women is 2D x-ray mammography. This imaging technique has helped to reduce breast cancer mortality over the past 20 years by detecting cancer in its early stages. However, since radiologists view a 2D image of a 3D breast, the overlap of normal anatomical structures over a tumor can potentially hide the cancer. A new 3D imaging alternative to mammography is digital breast tomosynthesis (DBT). The University of Pennsylvania is one of the first large hospitals to use DBT for all screening. Penn has found that DBT detects more cancers than mammography, and it requires follow-up testing in fewer patients. Despite these benefits, it has been shown that images of calcifications suffer from blurring in DBT. Calcifications are small, milk-like secretions that can act as an early sign of cancer. My PhD thesis showed that super-resolution is a mechanism for improving calcification visibility. Super-resolution is a well-known technique in satellite imaging. Multiple pictures of an object are recorded as a camera is moved in fine increments. In the resulting image, objects much smaller than a single pixel in the camera can be clearly visualized. I showed that DBT is capable of super-resolution based on similar principles. To assess the clinical impact of super-resolution, I am proposing a pilot clinical trial drawing upon images of calcifications. The pilot trial will allow me to determine statistical models that I can use in the future to design clinical trials on super-resolution as an independent investigator. My mentor (Dr. Emily Conant, Chief of Breast Imaging) will train me based on her extensive experience in clinical trials. For supplemental training, I will complete courses leading to a Clinical Research Certificate. In addition to the pilot trial, I will develop new designs for DBT systems that will improve super-resolution further. The new designs will be evaluated using computer breast models. I project that the new designs will show dramatic improvements in calcification visibility. An important benefit of the new designs will be to reduce the number of patients recalled for additional tests due to an inconclusive mammogram. Currently, a large number of women are recalled for additional tests, yet only 4% of those recalled are found to have cancer. A common additional test after screening is magnification mammography; one can think of super-resolution as introducing magnification into the original screening exam. Another anticipated benefit of super-resolution will be to detect calcifications earlier and thus to diagnose more cancers while they are treatable. Reducing the need for additional tests will minimize costs, lower patient anxiety, alleviate the potential for pain and scarring from biopsy, and minimize the total x-ray radiation dose. Young women in particular will benefit from a lower call-back rate; half of women screened annually between 40 and 49 may be called-back at least once.