Abstract ID: 15850 Title: A spatially distributed x-ray source array for high resolution digital breast tomosynthesis

Purpose:
The current digital breast tomosynthesis (DBT) scanners are based on regular full-field digital mammography systems and require partial isocentric motion of an x-ray tube over certain angular range to record the projection views needed for reconstruction. This prolongs scanning time and degrades imaging quality due to motion blur. The purpose of this study is to evaluate the feasibility of improving spatial resolution and scanning speed of the current DBT device by replacing mammography tube with a stationary carbon nanotube (CNT) based x-ray source array.

Methods:
A spatially distributed multi-beam field emission x-ray (MBFEX) source array was designed for DBT. Electrostatic simulations were carried out to design the electron focusing optics to achieve the desired x-ray focal spot size. Finite element analysis was performed to determine the x-ray source anode heat load. A control electronic system was developed to scan and to regulate the imaging dose from each beam by compensating the driving voltages and by modulating the exposure time from each beam. The x-ray flux, lifetime, focal spot size, variation between different beams, etc were characterized.

Results:
A MBFEX source array with 31 individually controllable beams covering 30 degrees viewing angle was fabricated. It is operated up to 50KVp anode voltage and 30mA tube current per beam at an effective focal size comparable to that of the traditional mammography tube. Consistency in the beam-to-beam performance was achieved by optimizing the CNT cathodes and by electronic compensation. Tomosynthesis images of a breast phantom were obtained using the new source array.

Conclusions:
These preliminary results demonstrate the feasibility of CNT x-ray source array for stationary DBT to eliminate image blurring from tube motion. With a fast detector the device can provide a higher spatial resolution at a reduced imaging time compared to the current rotating gantry DBT systems.

Funding Support, Disclosures, and Conflict of Interest:

This research is currently supported by the following grants：NCI Grant No. U54CA119343, NIH R01 Grant No. CA134598-01 and the University Cancer Research Fund at the University of North Carolina. Dr. Xin Qian, was supported by a fellowship from DoD Grant No. BC087505.