A next generation tomosynthesis (NGT) system has been proposed to achieve higher resolution than traditional digital breast tomosynthesis (DBT) by achieving subpixel resolution. Resolution can be further optimized by creating customized multiplanar x-ray tube acquisition paths, which are dependent on patient breast anatomy. This requires synchronization of an x-ray generator, x-ray detector, and motion controller for an x-ray tube motion path composed of arbitrarily spaced x-ray acquisition points. We have implemented a state machine run on an Arduino microcontroller that synchronizes the system processes through the handling of hardware interrupts. The desired x-ray acquisition points are converted into two dimensional motion segments, which are compiled into the motion controller’s memory. The state machine then signals the x-ray tube to move from one acquisition point to another, exposing x-rays at each point, until every acquisition is made. The effectiveness of this design was tested based on timing and accuracy of movement, using an x-ray tube path with 15 acquisition points from start to finish. The results show that the average procedure time, over 15 test runs, took 18.22 +/- 0.37 seconds. The accuracy of each movement was tested over four separate trials, consisting of 56 movement segments. The average difference between the expected and estimated locations of the x-ray tube position was 0.23 +/- 0.03 mm for both the lateral and posterior or anterior movements along the chest wall. In conclusion, this study shows that a state machine implementation is viable for fast and accurate acquisitioning in NGT systems.

Jeff Eben is currently enrolled at Case Western Reserve University as a computer science major. Jeff spent his SUPERS time in the lab of Dr. Andrew Maidment.