Inter-summer Research Proposal:
Calibrating the cone beam imaging system
on the Varian Trilogy linear accelerator

Because medical practice is an ever-changing field, the professionals involved are constantly conducting research and making improvements to increase the efficiency of the treatment they provide. For example, the linear accelerator used to administer radiotherapy has an imaging system that consists of an x-ray source and flat-panel detector. The detector is actually made up of an array of small detectors that each provide a part of the image acquired during the scan. Each small detector is an individual entity, so calibration, or accounting for those differences is required from time to time.

The process of calibration involves several steps. First a dark field image is acquired, which means a reading is taken with no radiation emitting from the x-ray source. An image will result that should be completely white, but when there are lines or spots on the image, it is an indication of dead detectors. Second, we acquire a flood field image, in which we expose the detector to a uniform, high level of radiation and analyze the image. Again, this image should be black, and any spaces that are not indicate dead detectors. Last, we acquire a *flat field* image, where a smaller amount of uniform radiation is administered which should result in a flat CT number profile from each detector. CT number refers to the amount of absorbed radiation a certain pixel represents, and in the case of a *flat field* all the detectors should result in an image whose pixels all have the same CT number.

After acquiring all these images, we then have to average them together to get an overall picture of where the dead spots are located on our detector. Each calibration requires a lot of work, so my task for this academic year is to perform an analysis on months of calibration data to find how often this calibration should be performed. The analysis will include investigating the differences from one calibration to the next, taking into account the number of procedures and amount of time between calibrations.

My main focus for the academic year, however, will be improving my programming skills in Matlab and learning how to program in C plus plus.