AbstractID: 12872 Title: Monte Carlo Simulation of Coherent Scatter Computed Tomography (CSCT)

Purpose: To determine the design characteristics of a new tissue-specific x-ray computed tomography (CT) system that may potentially improved tumor specificity in CT imaging of similar Z-material through detection of coherently scattered photons.
Methods & Materials: Utilizing the open source Monte Carlo code system Electron Gamma Shower 5 (EGS5), we simulated coherently scatted photons for the purpose of investigating coherent scatter computed tomography (CSCT). Unlike other simulation systems, ESG5 allows for correlation effects between molecules, which properly simulate coherent scatter. The simulated geometry mimics a "3rd generation" fan beam acquisition with a post-scatter collimator (multi-slit linear grid), which only permits scatter from a specific vertical segment of the phantom to be detected. The simulation consisted of a 10cm diameter cylindrical phantom of fat enclosing two 3.75cm diameter off-center cylinders of muscle and air, centered midway between a monoenergetic (70kV) fan beam source and a bank of detection elements, which were located at a distance of 60 cm. The simulated detection elements were 1x1mm^2 in area and covered a horizontal distance equivalent to a 55 degree arc centered on the source and a vertical distance of 175 mm.
Results: Reconstruction of coherently scattered data was performed using filtered back projection and is comparable to previously published empirical results. Several material enhanced contrast images were generated from a single data acquisition (one tube rotation), with image intensity proportional to the amount of coherent scatter originating from a particular material at a particular location.
Conclusion: These results demonstrate the utility of EGS5 to generate coherent scatter data for CSCT image investigation. Simulating scatter allows for a more feasible means to optimize acquisition parameters (photon spectrum, setup geometry, object attenuation) to create a CSCT system capable of exploiting the forward peaked nature of coherently scattered photons for discriminating similar Z-material in topographic images.