Purpose: To create projection x-ray images by capturing pencil-beam scattered radiation patterns step-by-step.   Each scatter profile is integrated to generate an image of scatter cross section versus position. Such a system could improve x-ray contrast or reduce dose using information currently discarded in radiological images to augment the transmitted radiation information.

Method: Scatter patterns of several plastics, water, grocery-store tissues, and plastic phantoms were captured. Both high count (good statistics) and low count (realistic of clinical use) images were made using a Laue monochromator (33.17 keV) at the Canadian Light Source synchrotron. The primary beam was stopped with a tungsten bar. Arrays of up to 32x32 scatter patterns on a 1.25 mm pitch were recorded on a C9252DK-14 Hamamatsu flat panel sensor. A MATLAB routine was written to generate the profile of each scatter pattern and integrate over a given range to generate the pixel value.

Results: Phantom images were generated with low count statistics. Different angular ranges provide different maximum tissue contrast. For example if fat-muscle contrast was important we would integrate from 2.25 to 4.00 degrees; similarly to maximize tissue-bone contrast we would integrate over the entire angle range (about 2.25 to 18.14 degrees, the angle limits determined by the acquisition geometry). The ideal angles are dependent on the beam energy. Images for a phantom composed of five plastics had significant contrast between each plastic. In a porcine sample there was significant contrast between muscle, fat and bone.

Conclusions: Significant coherent scatter contrast between tissues has been demonstrated. Next, higher resolution images will be made. For comparison, conventional images will be generated simultaneously using a primary pencil beam detector. Additionally a multiplexed system comprising several pencil beams will be implemented to reduce the exposure time. Ultimately we will transfer the technology to standard hospital x-ray sources and detectors.

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