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A Novel Pixellated Spectroscopic Detector Combined With a Broadband Monochromator to Produce Scatter-Free Images for the Improvement of Breast Cancer Detection

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This work aims to investigate an alternative approach to the use of an anti-scatter grid for removing scatter in breast cancer screening. The successful removal of scatter will aid in improving image quality in mammography and therefore improve the detection of features that suggest the presence of cancer. The work uses a novel pixellated spectroscopic detector combined with a broadband crystal monochromator. We present here results from the characterisation of the system and preliminary images.
Compton-scattered X-rays that cause a reduced contrast on X-ray images have a lower energy than the primary beam. If the primary beam has a narrow energy band, the lower-energy scattered X-rays can be removed exploiting the spectroscopic capability of the detector, by simply windowing the detected spectrum around the range of the primary energy band. This essentially provides a scatter free image.
The detector used for this work is a pixellated spectroscopic detector that consists of a 1mm-thick, 2x2cm2 CdTe crystal with a pixel pitch of 250 μm and an energy resolution of 0.8 keV at 59.9 keV.
The monochromator used is a Highly Orientated Pyrolytic Graphite (HOPG) crystal that has a mosaic spread of 0.4°±0.1°. This mosaic spread allows for a good photon flux for X-ray imaging with a conventional source. Characterisation of the monochromator was performed and initial data gave a bandwidth ranging from 2.8keV at 18keV to 5.6keV at 28keV. The initial imaging data demonstrated the magnitude of the scattered component and also the improvement in image quality brought by scatter removal.
Existing work on the use of monochromatic radiation does not rely on scatter removal using spectrum windowing. This method has the benefit of reducing the delivered dose as virtually no primary radiation will be removed in the windowing process.
Future work will involve extensive optimisation of the primary monochromatic energy for various breast thicknesses/densities. A method for analysing the contrast improvement due to the scatter removal will be developed and evaluated for each of the breast thicknesses/densities.

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