Scatter Enhanced X-ray Imaging

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The security screening industry is faced with the problem of developing technology that can provide high quality X-ray images containing materials specific information prior to placement of items onboard an aircraft. The Achilles heel of current airport screening technology lies in their inadequate ability to readily detect concealed threats such as knives as well as explosives which may have an innocuous shape. We demonstrate the first steps in the development of a new screening technique designed to alleviate this issue. The unique three dimensional power of kinetic depth effect X-ray images (KDEX), will be combined with the material discriminating capabilities of angular dispersive x-ray diffraction.

Before a threat material can be identified and thus accurately represented within KDEX imagery we must transform any measured diffraction pattern to that arising from a known spatial origin. We are therefore proposing a novel sensor geometry designed to simultaneously decipher the source to sample distance and the angle of the materials scattered radiation. In principle diffraction patterns will be obtained from a series of linear detectors arranged normal to the primary X-ray beam but at differing positions along it. The tangent of the gradient formed from the change in peak position from one detector to the next will provide the actual $2\Theta$ values. The location of the diffracting material is also derived as part of this process. The sample position is the point on the primary beam that would be intersected by a straight line originating from the peak position on the CCD (at a given detector position) travelling with respect to its measured $2\Theta$.

We shall present, for the first time, demonstrated proof of principle for this concept on a small scale in the laboratory. Samples were raster scanned in transmission mode and diffraction patterns collected on a CCD detector. The area detector was then translated to a different point along the primary beam so that the patterns could be compared. This information was then applied to the transmission imagery. For clarity a simulation of this effect has been included in figures A-D. Each image represents a different perspective. Areas identified from their diffraction patterns as containing threat materials have been colour coded.

In the future it is hoped that a more elegant implementation of this method could be realised. Opposite points on a Debye cone could be detected on linear arrays situated at differing distances along the primary X-ray beam. A direct comparison could then be made with no need for a detector to be translated.