C19 Scatter Enhanced X-Ray Imaging – A New Tool in the Fight for Aviation Security

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After attending this presentation, attendees will gain an appreciation for the problems faced by airports to identify concealed items such as knives, explosives, and narcotics before their placement onboard an aircraft. The attendees will be made aware of the current state of the art technology before being introduced to a relatively immature screening technique that could aid in combating the problem.

This presentation will impact the forensic science community by revealing the current limitations in the threat detection performance of security screening systems. Attendees will be introduced to a new technique at an early stage in its development that one day could be routinely used as a diagnostic tool in the forensic community. Although marketed here primarily toward its use as a screening system, it should be noted that this new technique could conceivably have applications in numerous forensic fields where the ability to rapidly visualise volumes in three dimensions as well as chemically identify their contents would be advantageous.

A single approach that can effectively and non-destructively screen volumes for illicit materials is yet to be adopted by the security screening industry. In the wake of the 9/11 attacks, items of most concern include weapons (such as knives and scissors) that could be used for the implementation of a hi-jacking. However, the dangers of other materials such as concealed explosives, and in the long term the illegal trafficking of narcotics (both domestically and internationally) cannot be overlooked. To combat this issue we introduce a new diagnostic technique brought about by the amalgamation of two existing technologies. The 3D power of Kinetic Depth Effect X-ray (KDEX) developed by collaborators at Nottingham Trent University is united with the materials discriminating ability of angular dispersive X-ray diffraction (ADXRD).

KDEX utilizes multiple X-ray transmission images captured at differing perspectives to the inspection volume. Displaying the images in sequence provides depth perception to the screener via motion parallax. This technology has been shown to increase threat detection performance of familiar threat shapes in cluttered environments. Angular dispersive X-ray diffraction can provide materials identification of any material of a crystalline nature (which includes the majority of explosives and narcotics). The amalgamation of these techniques provides unprecedented specificity. This is because KDEX increases the likelihood of identifying threat shapes where as X-ray diffraction can identify chemical threats, which may have an innocuous shape.

Although these techniques are generated from a similar source, they are fundamentally different. To bridge the gap an extensive body of work has already been conducted by this research group to combine them. Contrastingly to KDEX, angular dispersive X-ray diffraction typically describes a single known point in space. To combine these techniques the research group has already investigated novel scatter sensor geometries that work to pinpoint the locations of threat scatter signatures within the inspection volume. These geometries simultaneously decipher the source to sample distance and the angle of the materials scattered radiation (indicative of the material and usually referred to as 2θ). In principle diffraction patterns are 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 provides the actual 2θ 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) traveling with respect to its measured 2θ. This latest body of work involves a quantitative review of the KDEX images to compute object disparity (where by the relative movement of object gives an indication of its location in depth. This provides an alternate measurement of the locations of objects inside the inspection volume which is paramount for the correct interpretation of the scatter signatures. It is hoped that should a successful corroborative relationship be built between these techniques then the forensic community will have a new diagnostic tool in their fight against crime.

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Security Screening, Narcotics, Explosives

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