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P2.55: Development of prototype backscatter X-ray security scanner for luggage inspection

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Backscatter X-ray imaging techniques are sensitive to organic materials (i.e., low-Z elements) due to a larger Compton scattering cross-section than that of other photon interactions. Therefore, it has the potential to be used as a security screening system to detect organic compounds, such as drugs and explosives. Additionally, it is possible to make a compact device because the X-ray generator and detector are positioned on the same side of the object. Because of these favorable characteristics, backscatter X-ray detection systems have been widely used for detecting illegal items concealed in luggage, screening vehicles, and containers, including detecting landmines in military border areas.
In the present study, a prototype of a backscatter X-ray security scanner for luggage screening was developed, and its performance was evaluated at various tube voltages. This system consists of an X-ray generator, a disk-shaped rotating collimator (i.e., chopper wheel), monolithic large-area detectors with associated signal processing electronics, and a conveyor. By rotating the disk-shaped collimator with slits, a vertically-swept pencil beam is formed, and then the conveyor is moved horizontally to perform an overall scan of the object. To obtain backscatter X-ray images, we utilized phantoms fabricated in accordance with the international standard (ANSI N42.46) as well as actual contrabands provided by the Korea Atomic Energy Research Institute. Using the prototype system, the isolation contrast, which represents the thinnest discernible thickness of an object when the background material differs from the object to be imaged, was determined to be about 1 mm. As shown in Figure 1, the contraband items (i.e., methamphetamine and cannabis) randomly hidden inside the luggage were clearly visible at tube voltages ranging from 80 to 160 kVp. It is expected that the backscatter X-ray security scanner can provide improved detection efficiency for thin objects and/or organic materials.

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