Picture credit: Smiths Detection

THE X-FACTOR:

Matt Clark *explains why the versatility, effectiveness and ever evolving nature of X-ray makes it the cornerstone security screening technology*

It is a sobering reality that we face an array of complex and evolving security threats, presenting real danger to lives and putting assets at risk. The good news is that there are multiple layers of security that can be applied to effectively tackle these threats. These approaches range from everything from trained sniffer dogs to manual inspections by security personnel and X-ray scanners. Each method has its benefits, but X-ray security equipment is the most commonly deployed due to its accuracy, ease of use and operational and cost effectiveness. By reducing manual processes, it increases efficiency and boosts security outcomes. Indeed, X-ray has been central in threat detection for many decades and with technological advancements enhancing the capabilities of X-ray based solutions, it continues to future proof security operations.

Put simply, X-ray detects hidden threats without intrusion. It uses radiation at safe levels depending on the application and environment, and is extremely versatile – in terms of its applications, scalability and the choice of low/medium/high energy levels in line with requirements. In essence, X-ray comes in many different shapes and sizes to answer different needs – and while some applications require certified systems, some don't. It is used for screening, mail and parcels, personal bags at checkpoint security, baggage or freight in containers, vehicles and trains. It helps with identifying explosives, dangerous goods, weapons and contraband in many different kinds of environment – and is safe, causing no harm to people or baggage.

X-ray security screening has developed since its inception. Early iterations of baggage screening systems had only a single stationary X-ray detector and were lower resolution – and while this is still the standard for many applications, increasing computing power has improved single-view system performance, while dual and multi-view systems have been developed to enable more sophisticated screening methods.

CT scanners eliminate the need to take liquids and electronic devices out of luggage, creating a more frictionless experience at the security checkpoint

Advancements in X-ray technology have solidified its essential role in screening for security threats. Computed Tomography technology is one such advancement for X-ray based security screening. CT has enhanced X-ray scan images – enabling high-definition, 3D, rotatable, full-colour imagery. The benefits of CT are wide-ranging – it speeds up evaluation time, delivers more accurate outcomes, low false alarm rates, minimises touch points and relieves operator burden.

Let's take airport security as a case study for the potential of CT-enhanced X-ray scanners. When it comes to the airport passenger journey, the security screening process is typically seen as one of the most stressful points. With the removal of shoes, belts and jewellery, having to separate belongings into trays and taking electronics and liquids out of bags, queues tend to build and so does passenger impatience. That's where computer tomography comes in. Typically employed in the medical sector, and as mentioned, CT technology generates 3D, volumetric x-ray images. In the context of airport security, CT scanners enable security operators to inspect baggage from every angle. The growing adoption of this technology by airports around the world is great news for passengers, with CT scanners eliminating the need to take liquids and electronic devices out of luggage, drastically cutting queuing times and creating a more frictionless experience at the checkpoint.

In the US for example, the Transportation Security Administration (TSA) is working to implement CT technology and has already installed over 300 scanners, allowing passengers to keep laptops and electronic devices in their carry-on bags to minimise touch points during the screening process. CT scanners – which are being adopted around the world – also support the enhanced health and safety measures implemented at airports, by decreasing the level of contact between passengers, screeners and surfaces, such as trays. With automatic detection capabilities and low false alarm rates, unnecessary interaction between passengers and operators is reduced and physical distancing among travellers can be more easily implemented with quicker screening. With liquids and laptops being allowed to remain in bags during screening, the number of trays handled by both staff and passengers is drastically reduced.

Further enhancements to X-ray capabilities are being unlocked through the deployment of artificial intelligence (AI), which can enable automatic object recognition. Through machine learning and its subset deep learning, algorithms can be developed that imitate the way the human brain processes data and identifies patterns based on examples to inform decision-making.

In this way, AI-based algorithms can detect prohibited or contraband items such as weapons, dangerous goods, currency or cigarettes and support operators in making fast and accurate decisions. This not only boosts operational efficiency, but also the security outcome. For the development of deep learning algorithms for security scanners, a library of X-ray images is shown to the algorithm so that it can learn to identify patterns in the shape of items, such as guns, gun parts, ammunition and knives or other potentially dangerous prohibited items such as lithium batteries. While the list of objects that AI algorithms can detect is ever expanding, deep learning is currently limited in that it cannot yet detect substances or items which are inconsistent in shape. However, traditional material property discrimination-based techniques, when combined with machine learning, can be powerful for detecting such objects. The use cases for AI-based algorithms are wide ranging. They can be deployed for screening systems at airports, in urban environments or public spaces and at ports and borders.

CT SCANNERS ENABLE SECURITY OPERATORS TO INSPECT BAGGAGE FROM EVERY ANGLE

AI algorithms are particularly helpful for less experienced image analysts. As algorithms cannot get tired or distracted and are impartial, they reduce the risk of human errors, resulting in improved security outcomes. More automated screening processes can also reduce operational expenditure, as with greater screening efficiencies and productivity fewer staff are required. By increasing throughputs and reducing manual processes requiring physical contact, the security screening experience becomes significantly less stressful for those being screened.

With a very high level of detection, these AI algorithms also drive down false alarm rates. There is also potential to combine the automatic explosives detection capability of a scanner with object recognition to enable 'alarm only viewing' of X-ray images, further accelerating throughput.

Another critical enhancement for X-ray based scanners is centralised networking or remote image evaluation. Although well established for airport hold baggage screening systems and border control, remote screening is not yet widely used for airport passenger checkpoints and cargo – and is particularly beneficial for major hubs, with high volumes of traffic or cargo. When a security network spans regional outposts – which see fluctuating volumes of either goods or traffic – it is advantageous to link all outlying locations to a centralised hub where volumes are more stabilised. This enables more efficient operator resourcing, meaning that staff do not have to stay onsite at smaller locations around the clock. At borders, a centralised screening and management system can allow X-ray images and associated data to be analysed online in a remote-control centre. On-site operators can therefore focus on the scanning process and completing the relevant dataset information, such as customs declarations and vehicle licence plates.

On a country-to-country or even continental level, image sharing via Wide-Area Networks (WANs) can be deployed to facilitate the real-time sharing of images between different sites, enabling greater resource prioritisation and operational efficiency. WANs enable detailed data analysis across global security networks to enhance security levels, with one set of scanned images for both outbound security and inbound customs clearance at the destination. As security outcomes can never be compromised, it is necessary for wide networks to be secure, with sufficient bandwidth for real-time distribution of the images. Establishing a viable, robust WAN is therefore no mean feat, with back-up solutions needed in the event of network failures.

X-RAY DEVICES HAVE BEEN CENTRAL IN THREAT DETECTION FOR MANY DECADES

At the most cutting-edge of X-ray systems development is Open Architecture (OA). OA allows security authorities to incorporate new security and technology components into their screening systems through 'standard interfaces', which means different systems can work in tandem. Principally, OA enables integration of third-party algorithms into X-ray based security scanners, delivering interoperability and system flexibility. This means different fleets can be updated with the most advanced and latest software to take advantage of new technologies, such as AI, to meet an ever-growing and changing list of potential threats. Not only does OA therefore have the potential to improve security outcomes, but also operational efficiency and the ability to meet evolving regulation. OA also can allow for screening results to be shared between different authorities, despite them having different fleets and service providers, and can enhance centralised image evaluation, enabling operators to review screening imagery in remote operator rooms, optimising the operator to scanner ratio through multiplexing. It should be noted, however, that best practices around OA are still to be universally agreed so that it can be deployed in a way which maximises its benefits and does not compromise screening data or system effectiveness.

Looking to the future, the introduction of X-ray diffraction scanners will enable more precise material analysis and further operational efficiency when scanning cargo and baggage. The use of diffraction as an orthogonal technology unlocks the benefits of a system of systems approach, vastly increasing scanning capabilities. The technology provides higher levels of accuracy in the material analysis and detection of substances, resulting in a reduction of manual intervention. This enables automated alarm resolution, so that operator resources can be more effectively prioritised. By extending the capability of scanners, diffraction can future-proof security operations against emerging threats and regulatory changes.

What is clear is that X-ray is here to stay. For many security operations designed to protect people, infrastructure and institutions, it is the most effective and efficient approach to tackling the threats of today – and with software and AI growing its capabilities, the threats of the future. With digital augmentation, X-ray will continue to be a cornerstone security technology – with increased automation paving the way to a fully contactless and highly efficient security process ●

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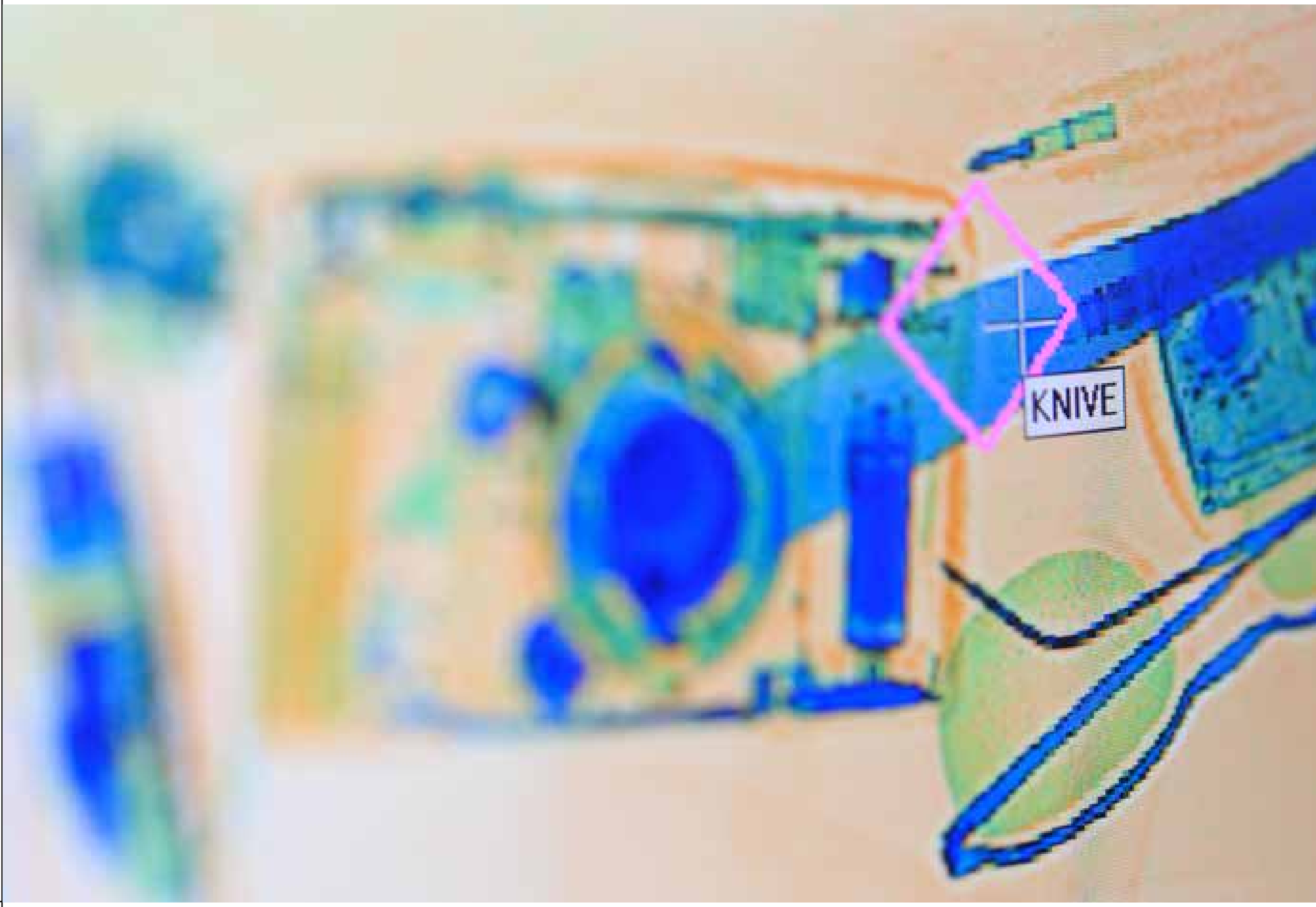

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