Throughput revolution with state-of-the-art inspection system

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Overview

As the wheels of the global shipping industry spin faster and faster, the needs for high throughput inspection systems are increasing continuously. Eliminating throughput as the bottleneck of the global supply chain, the THSCAN® FS3000 Fast-Scan Container/Vehicle Inspection System (hereinafter referred to as the THSCAN® FS3000), a new generation inspection system designed and manufactured by Nuctech, has arrived. Presently, the THSCAN® FS3000 functions reliably and effectively in many countries such as Malaysia, Poland, and the UAE.

The THSCAN® FS3000, based on linear electron accelerator (LINAC) technology, is a revolutionary model compromising extremely high throughput, high penetration and excellent image quality. Differering greatly from other types of THSCAN® inspection systems and counterparts of other manufacturers, any human intervention which may cause the interruption of the traffic flow can be reduced to a minimum. At speeds up to 15km/hr, the THSCAN® FS3000 supports a drive-through scanning mode with a throughput of over 200 vehicles per hour with excellent image quality. Moreover, the THSCAN® FS3000 can be applied with an integral solution for various functions such as License Plate Recognition (LPR), Container Code Recognition (CCR), and Radioactivity Monitoring (RM).

Main features

With more than 210 security inspection systems that carry the name and reputation of Nuctech installed in more than 50 countries and regions, Nuctech has become one of the world's largest suppliers of container security inspection systems. Proficient in providing highly safe and reliable non-intrusive solutions for many years, Nuctech successfully developed the THSCAN® FS3000 which has the following key features:

- Highly safe and reliable non-intrusive: by adopting a low energy (2.5 MeV) linear electron accelerator as the kernel radiation source, the THSCAN® FS3000 has the following outstanding features:
  - Extremely low boundary radiation level: the dose leakage is constrained at a stringently low level. The strongest radiation dose rate can not be over 2.5μSv/hr at any point of the exclusion zone boundary, which conforms to the most local or international radiation safety regulations.
  - Low absorbed dose: the cargo will absorb no more than 2μSv per scan, so the negative effect is negligible.
  - No induced neutrons: it is possible for any X-ray which energy is above 7 MeV to induce the reaction of extracting an ejected neutron from a nucleus inside the atom, which is

Figure 1. Overview of the THSCAN® FS3000.

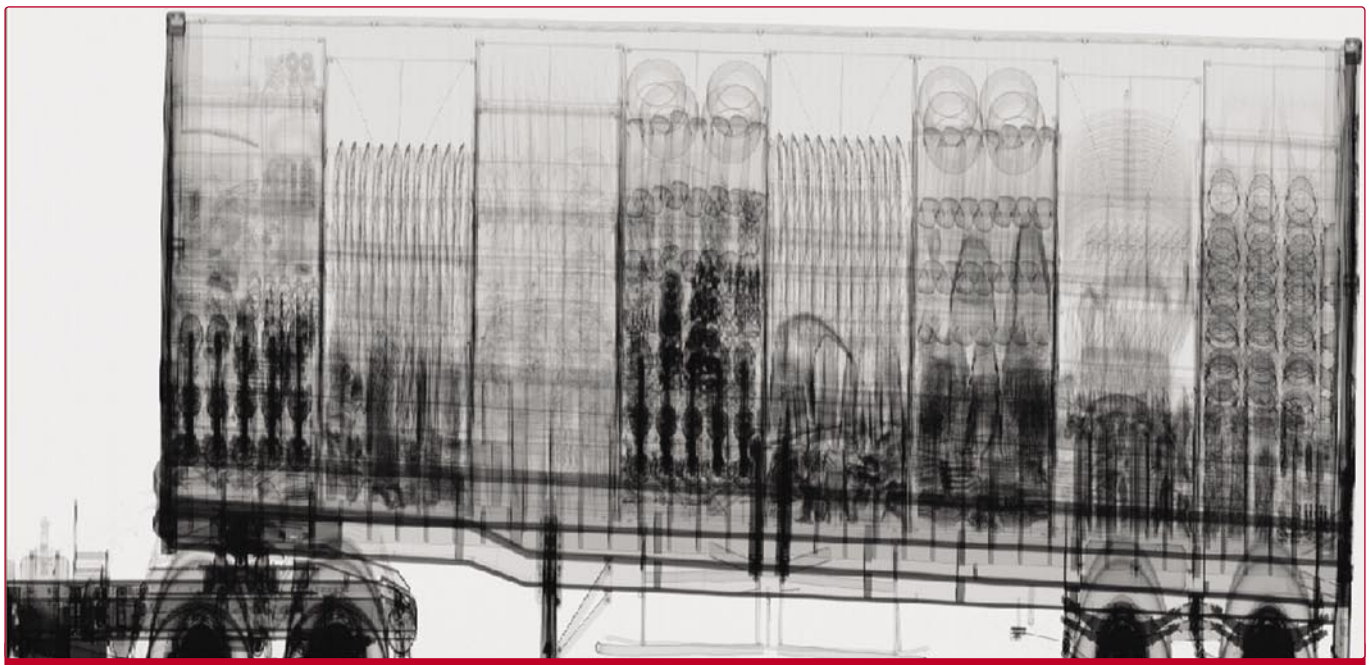

Figure 2. Typical scanning image of the THSCAN® FS3000.

extremely harmful for humans. However, the 2.5 MeV X-ray is absolutely unable to eject a neutron out.

- Compact footprint: by virtue of the leading radiation safety measures, the footprint of the FS3000, within which the whole physical structure is placed, is 16m x 7m, only occupying two lanes.

Besides the normal treatment for the radiation protection purpose, an additional technology is complemented to ensure the X-ray can be terminated automatically when the cab passes by the X-ray beam position. Thus, a driver absorbs no more than 0.02μSv dose per scan, which only equals to 0.01 per cent of dose received from a chest fluoroscopy.

- High throughput: thanks to its drive-through operation mode allowing the vehicle to be driven through the portal configuration directly, the traffic flow will not be impeded by the inspection process. Usually, the recommend passing speed is no more than 15km/hr, which is no doubt less than the standard speed limit in any port.
- Optimal balanced system specifications: Due to the highly sensitive detector modules complementing the deficiency of X-ray energy fairly, the penetration of the THSCAN® FS3000 can reach 220mm of steel, meanwhile the resolution of the image is three mm (the diameter of the iron wire), which is perfect for inspecting most containerided cargoes. Experienced in the fields of radiographic security for many years, Nuctech is good

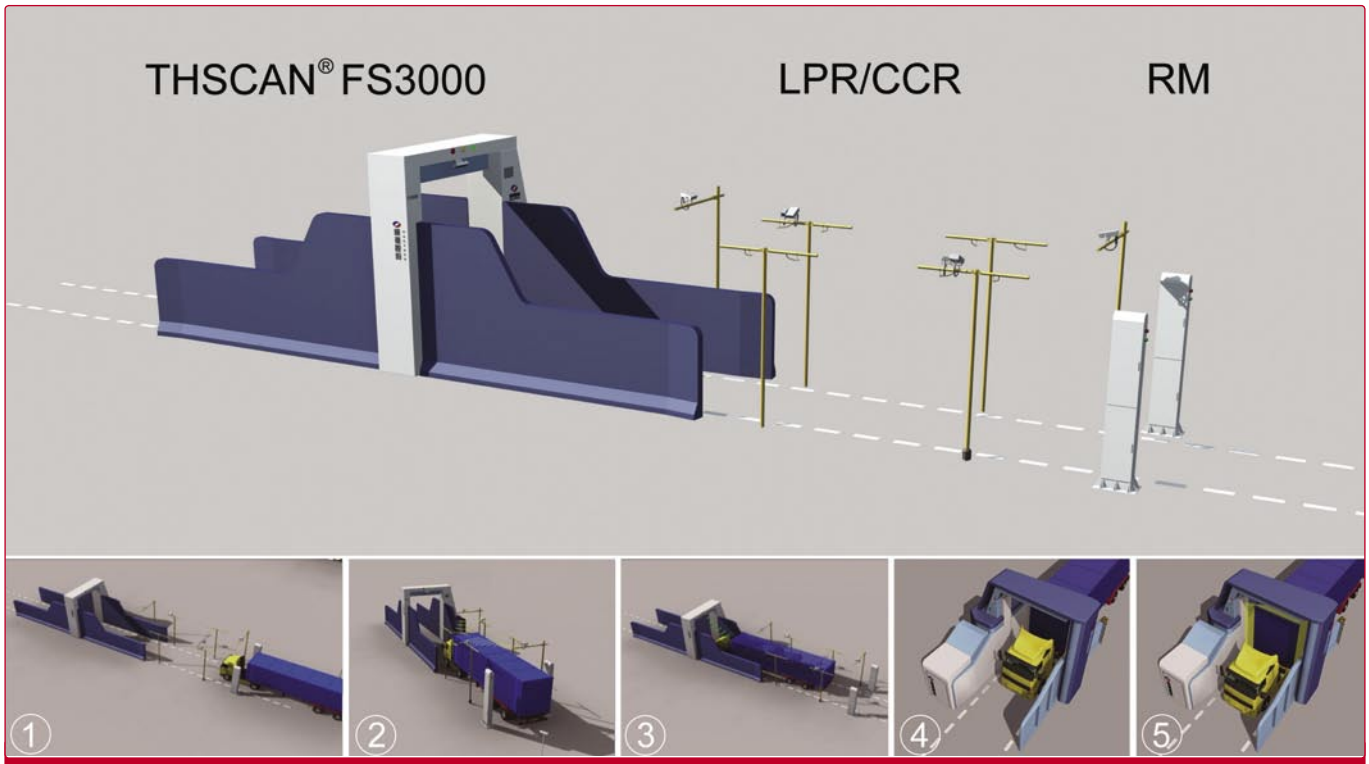

Figure 3. The integral solution with the THSCAN® FS3000.

at balancing the system specifications. Thus the THSCAN® FS3000 features high throughput as well as high penetration and resolution.

- Frequency self-adjusting technology: the X-ray source of the THSCAN® FS3000 can adjust the output frequency automatically according to the sampled speed of the passing vehicle, thus maintaining the image quality and control the dose level absorbed by the cargo, which means all the image specifications and doses received by the cargo will be the same within declaimed vehicle velocity range.
- Seamless integration: the THSCAN® FS3000 provides standard industrial interfaces for other subsystems or equipment that can be integrated into a more comprehensive inspection system. Together with the THSCAN® FS3000, not only optical character recognition (OCR) technology but also radio frequency identification (RFID) technology can be implemented seamlessly. Additionally, High-speed data transfer and mass data backup make the integral system more efficient. As shown in the Figure 3, an integral solution including multiple subsystems can be applied to implement various functions including:
  - LPR subsystem: to take the photo of the license number and recognises each individual character by the software.
  - CCR subsystem: to identify the container code.
  - RFID subsystem: to receive the radio frequency signals sent from the electric tag attached on the vehicle body to read and verify the relevant information about driver, vehicle's ID, the relevant cargo manifest, onboard port, and transit port etc.
  - RM subsystem: to detect the gamma rays or neutrons released from the unshielded or light shielded radioactive material.

These subsystems and the THSCAN® FS3000 build a robust and solid multi-function 'layered defense line' to protect the security of ports or checkpoints.

Prospect

After the first generation cargo X-ray scanners were deployed globally, customs authorities and shipping industry never stoped attempting to seek a more comprehensive system which delivers high throughput, non-intrusive inspection, occupies a small space, has low radiation leakage and radioactivity monitoring. Now, the breakthrough has arrived with the success of the THSCAN® FS3000.

The THSCAN® FS3000 is not only a competitive non-intrusive scanner candidate for efficiently inspecting loaded vehicles (containers or general cargo) and unladen vehicles, searching contraband, narcotics, arms and explosives, radioactive materials, and illegal immigrants, reducing the need to manually inspect the cargo and causing minimal impact on the flow of commerce, but also provides fast-scan technology that may initiate the next generation of cargo inspection systems.

ABOUT THE AUTHORS

Dr Chen Zhiqiang, is the Associate Professor of the Department of Engineering Physics, Tsinghua University and the Director of the Institute of Nuclear Technology of Tsinghua University. He has profound researching experience in the field of Particle and Radiation Imaging and Data Acquisition and Signal-Processing.

Peng Hua, is the General Manager of the R&D division of Nuctech Company Limited. He has contributed to the development and strategy of the comprehensive product family. Recently, he is the Project Leader and System Engineer for the THSCAN® FS3000.

ABOUT THE COMPANY

Nuctech Company Limited is a high-tech company originating from Tsinghua University. Possessing all the intellectual property rights of core technologies in radiation applications, Nuctech has become an internationally leading company specialising in research & development of X-ray inspection technology, as well as system design, manufacturing, engineering and customer service. So far, with nearly 200 sets of its systems and services place in roughly 40 countries and regions in Europe, America, Asia, Oceania and Africa, Nuctech has become highly regarded by customers all over the world.

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