Contribution ID: **128** Type: **Oral**

Next-Generation Fast-Neutron/X-Ray Scanner for Air Cargo Interrogation

Wednesday, 26 April 2017 09:00 (20 minutes)

There is a growing need for improved methods for rapidly inspecting bulk air cargo, the majority of which is currently subjected to no physical inspection or scanning. Fast-neutron/X-ray radiography provides a method to produce images that show the shape, density and composition of objects in cargo. These can be used to identify a wide range of threat materials, including organic substances such as explosives and narcotics that can be hard to resolve using conventional, X-ray only scanning technology.
Following initial development and demonstration by CSIRO of a fast-neutron/X-ray scanner at Brisbane Airport in Australia, the technology was commercialised with the Chinese security technology firm Nuctech Company Ltd. First-generation air cargo scanners combining neutron and dual-energy X-ray imaging are operating at airports in the Middle East and China.
In this paper, we present the latest technical developments, which have focussed on reducing the footprint, cost and complexity of the technology, whilst improving image quality and performance. We have developed a completely new plastic-scintillator neutron detection system with silicon photomultiplier (SiPM) readout. The low-noise characteristics of SiPMs allow much lower energy neutron interactions to be detected that was possible using our previous photo-diode based readout, increasing detection efficiency for 14 MeV to 30%. The small form-factor and simple signal amplification and processing requirements allow detectors to be tightly packed; the complete detection system includes 1440 elements and has a 5 times higher detection efficiency than the array used in the first-generation scanner.
This efficiency has allowed us to significantly decrease the size of the neutron source. The first-generation scanner used a liquid-cooled, deuterium-tritium (DT) neutron generator producing 5×109 n/s to image air-cargo at scan speeds of up to 6 m/s. The latest system uses an air-cooled, laboratory-scale neutron generator with an output of just 3×108 n/s. With advanced image processing, image quality and scan speeds can be maintained despite the reduced neutron output. The smaller generator is also considerably easier to install and maintain in airport environments.
We also report on the development of novel, low-cost and compact neutron shielding, that allows a combined neutron/X-ray scanner to be deployed within a footprint similar to that of conventional X-ray only cargo screening systems.
Figure 1 shows a typical image of various test and cargo objects, obtained using the first model of the new scanner operating in Nuctech's factory. Colours indicate material type, with metals in blue, mixed materials, ceramics and glass in green, and organic substances in yellow, orange, red and pink. The scanner was subsequently installed and operated at Beijing International airport, and we report on results of this trial.

Country/Organization invited to participate

Australia

Primary author: Mr CUTMORE, Nicholas George (Commonwealth Scientific and Industrial Research Organi-

sation (CSIRO), Australia)

Co-authors: Mr ZONG, Chunguang (Nuctech, China); Mr TICKNER, James (Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia); Mr LI, Jianmin (Nuctech, China); Mr EBERHARDT, John (Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia); Mr PRESTON, Rhys (Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia); Mr LIU, Yi (Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia); Mr LI, Yuanjing (Nuctech, China)

Presenter: Mr CUTMORE, Nicholas George (Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia)

Session Classification: B08

Track Classification: RADIATION TECHNOLOGIES FOR MEASUREMENT