Contribution ID: **79** Type: **not specified**

Linear Accelerator Requirements for Next-Generation Cargo Inspection Systems

Typical COTS mobile cargo non-intrusive inspection (NII) systems use pulsed dual-energy x-ray sources where the energy switches between ~4 and ~6 MeV on alternate pulses. The pulse width is usually around 4 μs, and the pulse rate is about 200 pps. The x rays generated by the source are detected by a linear array of scintillation detector "pixels", often made of cadmium tungstate (a slow scintillator). The signal in each detector is integrated over the pulse width, and the sum total of the energies of all x rays detected during a pulse in a given pixel is used to make images. Two images, a low-energy image (from 4-MeV source pulses) and a high-energy image (from 6-MeV source pulses), are produced and combined into a colorized image depicting low-Z and high-Z cargo areas in different colors.

These COTS systems work pretty well, but have a number of shortcomings. Therefore, much R&D has gone into next-generation NII systems that would improve performance significantly. This has led to a number of experimentally demonstrated technologies, including Z-SPEC (essentially x-ray spectroscopy) and Z-SCAN (a statistical method). Both methods have the advantage of requiring only a single source energy, improving system stability and removing imaging artifacts. Both methods would benefit from specific linear accelerator improvements, including pulse-to-pulse intensity and/or energy modulation, and, in particular, increased duty factor. This presentation will discuss required linear accelerator properties for such next-generation NII systems.

Summary

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Session Classification: Session 5