# High-Speed MeV-Energy X-ray Helical CT for Container Inspection Using Sparse Multi-row Detectors

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**Abstract**

X-ray non-destructive inspection systems are widely used in railway, aviation, and customs for cargo and container screening. Existing systems primarily employ Digital Radiography (DR) or circular trajectory Computed Tomography (CT). While DR imaging is fast, it cannot effectively distinguish overlapping objects. Circular CT enables 3D reconstruction, but its limited axial coverage prevents full inspection of large containers in a single scan. To address this limitation, we develop a high-speed helical CT system specifically designed for container inspection. Given the large volume of containers and the restricted rotation speed of large accelerator systems, achieving complete high-speed scanning would require an extremely large detector area, which is impractical due to cost. To mitigate this, the proposed system adopts a large-pitch helical scan combined with a sparse multi-row detector layout to reduce detector size and cost. This results in highly undersampled projection data, where traditional analytical reconstruction algorithms fail. To overcome this, we employ a fast iterative reconstruction method based on a hybrid model to achieve high-quality image recovery. This work presents the physical design of the helical CT system and the sparse detector configuration, along with reconstruction results from numerical simulation. The simulated reconstructions agree well with the ground truth, demonstrating the feasibility of the proposed approach. Furthermore, we have constructed a small-scale prototype system and conducted preliminary experiments, successfully obtaining reconstruction results of real phantoms. These results will be reported in this presentation and form the basis for further validation of the system design.

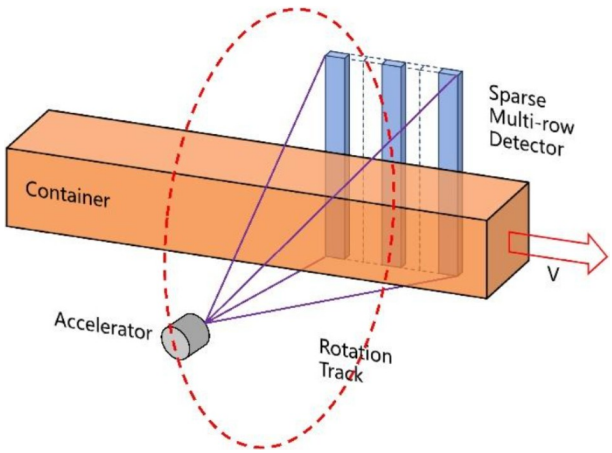


Figure 1. Schematic diagram of High-Speed MeV-Energy X-ray Helical CT.