Contribution ID: **240** Type: **Poster**

Differentiable Optimization of Muon Scattering Tomography Detector Design for Border Control Applications

Wednesday 10 September 2025 11:00 (30 minutes)

Recent years have seen growing interest in leveraging secondary cosmic ray muons for tomographic imaging of large and unknown volumes. A key area of application is cargo scanning for border security, where muon tomography is used to detect concealed hazardous or illicit materials in trucks and shipping containers. We present recent developments in TomOpt, a Python-based, end-to-end software framework for optimizing muon scattering tomography systems. Current work on TomOpt is specifically focused on advancing its capabilities for cargo scanning detector applications.

Significance

This presentation introduces novel results from the ongoing development of TomOpt, focusing on its application to the optimization of muon scattering tomography systems for cargo scanning. Unlike previous reports, which presented the initial framework, this work demonstrates new capabilities enabled by a fully differentiable modeling of the detectors, overcoming past limitations and enabling more direct and quantitative comparisons with baseline detector systems that are currently designed using modular units. This allows for a systematic evaluation of design trade-offs and paves the way for informed improvements to existing cargo scanning architectures.

References

https://doi.org/10.5281/zenodo.14214373

Experiment context, if any

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Session Classification: Poster session with coffee break

Track Classification: Track 2: Data Analysis - Algorithms and Tools