



Contribution ID: 102

Type: Poster

Bias Reduction Using Expectation Maximization in the Optimization of an AI-Assisted Muon Tomography System

Wednesday 11 June 2025 17:30 (1h 30m)

Muon tomography is a powerful imaging technique that leverages cosmic-ray muons to probe the internal structure of large-scale objects. However, traditional reconstruction methods, such as the Point of Closest Approach (POCA), introduce significant bias, leading to suboptimal image quality and inaccurate material characterization. To address this issue, we propose an approach based on Expectation Maximization (EM), a probabilistic iterative method that refines the reconstruction by reducing bias in the inferred muon trajectories.

In this work, we present the implementation of an EM algorithm tailored for muon tomography and compare its performance against the POCA baseline. We analyze the improvements in reconstruction accuracy and discuss the impact of EM-based optimization in AI-assisted muon imaging systems. This approach has been integrated into the muograph package.

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Session Classification: Wine Tasting and Poster Session