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Track Finding in the COMET Experiment using Boosted Decision Trees

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The Coherent Muon to Electron Transition (COMET) experiment is designed to search for muon to electron conversion, a process which has very good sensitivity to Beyond the Standard Model physics. The first phase of the experiment is currently under construction at J-PARC. This phase is designed to probe muon to electron conversion 100 times better than the current limit. The experiment will achieve this sensitivity by directing a high intensity muon beam at a stopping target. The detectors probe the resulting events for the signal 105 MeV electron from muon to electron conversion.

A boosted decision tree (BDT) algorithm has been developed to find this signal track. This BDT is used to combine energy deposition and timing information with a reweighted inverse hough transform to filter out background hits. The resulting hits are fit using a RANdom SAmple Consensus (RANSAC) fit, which chooses the best fit parameters for an optimized selection of the filtered hits.

These hits are then passed to the track fitting algorithm. Results show that using a BDT significantly improves in background hit rejection when compared to traditional, cut-based hit rejection methods. At 99% signal hit retention, a cut on the energy deposition is able to remove 65% of background hits. By combining more multiple features, the BDT is able to remove 98% of background hits while still retaining 99% of signal hits.

Primary authors: GILLIES, Ewen (Imperial College London); ROGOZHNIKOV, Aleksei (Yandex School of Data Analysis (RU))

Presenter: GILLIES, Ewen (Imperial College London)

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