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Track reconstruction with the ATLAS Detector

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This talk presents new methods to address the problem of muon track identification in the monitored drift tube chambers (MDT) of the ATLAS Muon Spectrometer. Pattern recognition techniques, employed by the current reconstruction software suffer when exposed to the high background rates expected at the LHC. We propose new techniques, exploiting existing knowledge of the detector performance in the presence of background, in order to improve tracking efficiency. The efficiency of the MDT tubes is very high. However, in a high background environment, there are two possible cases, for which a signal might not be registered when a particle has passed through an active tube: the existence of a previous background hit, giving rise to electronic dead time, and insufficient ionization in cases where the track crosses (very close to) the tube wall. Taking this into account, we derive a mathematical expression for the effective muon hit probability. We then model the track identification problem as a two-hypothesis problem, and base the decision on a generalized likelihood ratio test (GLRT). Since the effective muon hit probability is very high, we can choose a higher likelihood threshold, reducing the probability of finding false tracks without reducing the probability of track detection. In order to solve the track detection problem, we employ a novel modification of the Hough transform, with several values in each cell, different for each potential case. These values are then used for calculating the muon track likelihood. Examining data from beam tests with realistic background levels, we show that the use of this technique results in a significant improvement of the muon track detection performance of the MDT.

Primary authors: Mr PRIMOR, David (Tel Aviv University, ISRAEL (CERN)); ELSING, Markus (CERN)

Co-authors: Prof. MIKENBERG, Giora (Weizmann institute, ISRAEL (CERN)); Prof. MESSER, Hagit (Tel Aviv University, ISRAEL)

Presenter: Mr PRIMOR, David (Tel Aviv University, ISRAEL (CERN))

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