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Another approach to track reconstruction: cluster analysis

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A novel combination of data analysis techniques is proposed for the reconstruction of all tracks of primary charged particles, as well as of daughters of displaced vertices (decays, photon conversions, nuclear interactions), created in high energy collisions. Instead of performing a classical trajectory building or an image transformation, an efficient use of both local and global information is undertaken while keeping competing choices open.

The measured hits of adjacent tracking layers are clustered first with help of a mutual nearest neighbor search in angular distance. The resulted chains of connected hits are used as initial clusters and as input for cluster analysis algorithms, such as the robust k-medians clustering. This latter proceeds by alternating between the hit-to-track assignment and the track-fit update steps, until convergence. The calculation of the hit-to-track distance and that of the track-fit χ^2 is performed through the global covariance of the measured hits. The clustering is complemented with elements from a more sophisticated Metropolis-Hastings MCMC algorithm, with the possibility of adding new track hypotheses or removing unnecessary ones.

Simplified but realistic models of today's silicon trackers, including the relevant physics processes, are employed to test and study the performance (efficiency, purity) of the proposed method as a function of the particle multiplicity in the collision event.

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