Standard tracking ... a CPU intensive task

Finding tracks in an event is a complex and computationally intensive task. The number of hits need to be identified from a near infinite number of hit permutations that were created by charged particle trajectories, bent by the magnet field.

Fast hit reconstruction

Hit reconstruction is emulated using parameterized resolution functions. Pixel modules use resolution histograms depending on incident angle of simulated particles. Strip modules use tuned Gaussian smearing functions.

Planned add-on: Reconstruct only 1 hit if simulated hits are close to each other.

Fast trajectory seeding

At the seeding stage, doubts or tracks of hits need to be identified that fulfill certain quality criteria which depend on the track generator's output, e.g., distance to beam spot. Speed is gained by only testing the acceptance of finding a seed inside a proper hit combination.

Performance & Validation

A comparison of the obtained tracking efficiency against the standard simulation shows only a small bias compared to the approximations used.

The fast simulation of tracking comprises one of the major speedups of the Fast Simulation package of CMS. It can simulate an event in only 5s whereas the corresponding Geant4 based simulation on standard reconstruction workflow would require 20x more time.

Fast finding of proper hit combinations

Hit permutations are eliminated by restricting seeding & trajectory finding to only a core subset of hits using MC truth information.

Nonessential "fake" tracks from wrong hit combinations are neglected.

Fast trajectory finding

Instead of standard reconstruction, trajectory finding nangoes complex algorithms based on Kalman filters and pattern recognition when the involved combinatorial problem does not arise when considering only a subset of hits per track finding step. This makes track finding trivial.