Subject: Benchmark Tables and plots for tracking performance
Posted by Gianluigi Boca on Tue, 19 Oct 2010 20:18:21 GMT
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Dear all,
with this rather long message, following up the discussion at the last EVO meeting, I would like to suggest some Tables
and plots to use for benchmark of a global tracker
algorithm(s).

1- Benchmark Table concerning hits and tracks.

For this type of Benchmark, only the Pattern Recognition is necessary, not the subsequent track fitting.

I would generate tracks with 5 degrees< Theta < 120 degrees, in the full Fi range, with the Box Generator.
The vertex could be randomly distributed at +/- 0.4 cm from (0,0,0).

The benchmark procedure would consist of :

a) Generation of events with 1 track, 5 tracks, 10 tracks at different total momenta with the Box Generator to check the performance at different phase space regions.
For instance :

at 0.1 GeV/c 1 track, 5 tracks, 10 tracks
at 0.3 GeV/c 1 track, 5 tracks, 10 tracks
at 1. GeV/c 1 track, 5 tracks, 10 tracks
at 5. GeV/c 1 track, 5 tracks
at 10. GeV/c 1 track, 2 tracks

b) Exclusion from analysis of montecarlo tracks producing
less than a predefined number (for instance : 3) hits in the Panda central detector. Also exclusion of those MC tracks not originating from the interaction vertex.

c) Assignment of each track found by the global Pattern Recognition to one (if possible) MC track.

(Naturally and unfortunately there is no unique way of assigning a track found by PR to the corresponding MC track. See below the method I suggest to use).

d) COMPUTATION OF A TABLE WITH THE % OF TRUE HITS FOUND,
THE NUMBER OF HITS NOT BELONGING (SPURIOUS); IF A TRACK IS NOT ASSIGNED TO ANY MC TRACK, increase the counter of spurious tracks. IF A MC TRACK HAS NO PR TRACK ASSIGNED, increase the counter of unmatched tracks.
This numbers are the Benchmark Table.

2- Benchmark Plots, concerning momentum resolutions and physics

channels performance.

For these plots PR + momentum fitting (Kalman with Genfit) is needed.

a) Plot of the residual of total momentum for all momenta and track topologies generated as said before.

In other words : plot of
[(Total Reconstructed Momentum) - (MC truth Momentum)]/
(Error on Total Reconstructed Momentum)

b) Plot of the residual of Pper (Momentum in XY plane) for each momentum and all topologies.

c) Plot of some typical physical EXCLUSIVE channel, with all charged particles. An examples could be :

At lower energy :
- f_2(2000) --> fi fi --> K+K-K+K-

Intermediate energy, only 2 tracks :
- J/Psi --> mu+ mu- ;
- J/Psi --> pi+ pi- ;

Higher energy, 6 tracks, more complicated topology :
Y(4320) --> psi_2S(3686) pi+pi-
|
|--> J/Psi (mu+mu-) pi+pi-
so actually this is Y(4320) --> pi+pi+pi-pi-mu+mu-

OF THESE CHANNEL THE BENCHMARK NUMBERS COULD BE :

- # OF EVENTS WITH MASS 'CLOSE' TO THE NOMINAL ONE, I.E. # EVENTS RECONSTRUCTED;
- THE RESOLUTION of the primary generated particle mass.

Appendix

SCHEME TO ASSIGN PATTERN RECOGNITION FOUND TRACKS TO MC TRACKS.

There is no unique way of assigning a track found by PR to the corresponding MC track. Here I propose a simple scheme that works in the general case in which tracks are found by PR, with hits belonging to different MC tracks :

a) first calculate a 2-dimensional Matrix ; the number of rows are equal to the # of tracks found by PR, the # of columns is equal to the # of MC tracks having at least 1 hit in any of the tracks found by PR;
each cell of this Matrix is filled with the corresponding number of hits.

For instance, suppose that the track # 2 found by PR has 7 hits belonging to MC track # 5, that the cell (2,5) is filled with 7.

Do the filling looping over all tracks found by PR.

b) Find the cell in the Matrix with the largest number. Assign the corresponding track found to PR to the MC track.
For instance, suppose the cell (5 , 8) contains 25, and that is the maximum value in the whole Matrix. The the track found # 5 is assigned to the MC track #8.
Erase the row and column just matched (row 5, column 8 in the example)
c) Consider the remaining Matrix; iterate the procedure in b) and assign another track found by PR to a MC track. Iterate untill ALL MC TRACKS or ALL TRACK FOUND BY PR have been exhausted.

Gianluigi
