Contribution ID: **209**   Type: **Oral**

Vertex finding by sparse model-based clustering

Thursday 21 January 2016 14:25 (25 minutes)

Vertex finding in the presence of high-pile up is an important step for reconstructing events at the LHC. In this study we propose a novel approach based on the model-based clustering paradigm. Using the prior distribution of the number of vertices and the prior distribution of the cluster size, i.e. the number of tracks emerging from a vertex, the posterior distribution of the number of vertices can be computed, given the actual number of reconstructed tracks in an event. Utilizing this posterior distribution, a sparse model-based clustering algorithm [1] is employed to compute the optimal association of tracks to vertices. It starts with a deliberately too large number of clusters and implicitly estimates the correct number during iterative application of Markov chain Monte Carlo sampling with a shrinkage prior.

We present results from a simplified simulation of vertices and tracks, obtained from a Pythia [2] simulation of proton-proton collisions, under various assumptions about the average pile-up. In addition, the sensitivity of the resulting clustering to the assumptions about the prior distributions is studied.

[1] G. Malsiner-Walli, S. Frühwirth-Schnatter, B. Grün, Statistics and Computing (2014)
[http://dx.doi.org/10.1007/s11222-014-9500-2]
[2] T. Sjöstrand, S. Mrenna and P. Skands, JHEP05 (2006) 026, Comput. Phys. Comm. 178 (2008) 852
[http://dx.doi.org/10.1016/j.cpc.2008.01.036]

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Session Classification: Track 2

Track Classification: Data Analysis - Algorithms and Tools