Implementation of a GUI for the MPS

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CMS tracker

The tracker is the device responsible for reconstructing the trajectories merging from the pp collisions.

- CMS tracker is the largest silicon detector ever built.
- A major requirement has been to achieve at least a 10% accuracy in the determination of the transversal momentum.



Tracker layout

- The tracker system consists of a series of concentric cylindrical detectors located inside a solenoid magnet that create an axial magnetic field.
- The detectors form a cylinder by assembling a set of rectangular sub-assemblies with the right orientation.
 - The layout comprise 25,000 silicon sensors having a composite surface of 210 m². The diameter is 2.4 m and the length is 5.4 m.

Layout for the silicon strip detector which is composed by several subdetectors, namely the tracker inner barrel, tracker outer barrel, tracker inner disks and tracker endcaps.





The pixel detector is composed by two barrel layers, it is located surrounding the immediate vicinity of the interaction region.

Why a silicon detector?

- Gas detectors are intrinsically limited in position reconstruction due to diffusion.
- Heavy flavor hadrons will be produced in QCD processes in LHC. High resolution required.
- [This can be achieved by a silicon detector.

Tracker must be aligned!

- We need to know with high precision the position of every single element of the tracker.
- This is impossible to achieve at this level of precision by mechanical (or optical) means.
 - Track based alignment has been used successfully in the past.

Track based alignment

- Track based alignment is based on the chi squared minimization principle of residuals.
- For CMS this is a complicated issue as it implies around O(100, 000) parameters.
 - In the CMS tracker one usual track consists of 20 measurements, a helix track can be determined from only five parameters .



Algorithms

The first one is the Hits and Impact method which minimizes a chi squared function constructed from the track hit-residuals on the sensor, it is an iterative and computationally light method.

The Kalman filter algorithm is another iterative method that avoids large matrix inversion and can use prior information, in this method the speed of convergence depends on the layer.

The Millepede algorithm

- Millepede is a linear least-squares algorithm.
- Designed for certain problems where parameters can be separated into global and local.

Data sample sources

High pt muons from W,Z decays.
Cosmic muons.
Beam halo muons.
Muons from J/Psi and b hadron decays.
Isolated tracks from QCD events.

Millipede Production System

- The Millepede production system (MPS) is a set of Perl scripts.
- It can be used to run a large number of Mille jobs, to fetch the output.
 - Output can be feed it into the pede program.

MPS Workflow



GUI Development First GUI implement for mps_setup.



GUI GUI skeleton produced by ZooZ

| ✓ Project 1 | | | | - 0 × | | | | |
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GUI Development

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GUI elopment



GUI Development

Output read-only window. The output of all commands is displayed to the user as soon as the command is executed.

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Conclusions

We have a functional GUI for the basic MPS workflow control.
Further development required to add the remaining scripts.
The GUI still needs some "beautification".