

Millepede II MC Study: Iterations and Shrinkages

Gero Flucke

Hamburg Alignment Chat
June 29th, 2010

Outline

- MC Alignment Setup
- Remaining Misalignment: Iterations Help
- TEC z -Shrinkage and Iterations
- Barrel r -Shrinkage and Iterations
- Summary

Remarks:

- Not really knew - work done in February before I left.
- Main plots shown by e-mail to Julia and Claus end of March.
(Sorry, Frank - always thought you got it as well!)
- Necessity to iterate mentioned afterwards at other occasions,
now “common knowledge” (?).

CMSSW_3_1_X Cosmics MC

/TkCosmics38T/Summer09-STARTUP31X_V3_StreamTkAlCosmics0T-v1/ALCARECO

- Still using RecHit2D in TIB and TOB.
- $p > 5 \text{ GeV}/c$, $N_{hit} \geq 14$, $N_{2D-hit} \geq 3$, $N_{hit-pede} \geq 10$
- $S/N > 18$, $\phi_{sensor \rightarrow track} > 0.35$, pixel quality flags
- use only first 250 000 events per file: $\Rightarrow 2.26 \cdot 10^6$ tracks in pede

Alignment Parameters

- u, w, γ for strip units, in TIB also α, β
 - u, v, w, γ in Pixel, **except γ in FPIX**
- $\Rightarrow$ 55 980 parameters (about 1000 without hits: simulated dead modules [?])
- BPIX as reference
 - **Private misalignment of (and APE for) aligned parameters only!**
 - BPIX not misaligned - but APE > 0 .

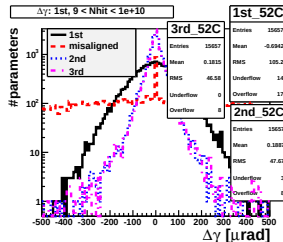
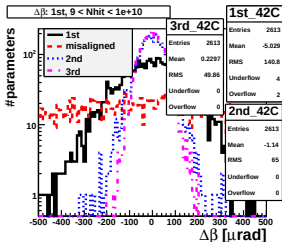
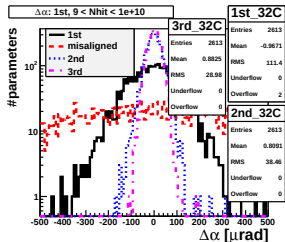
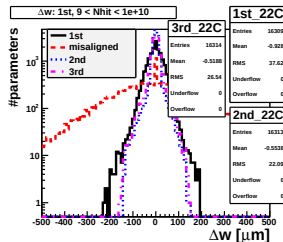
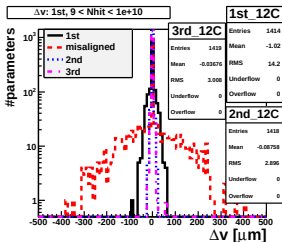
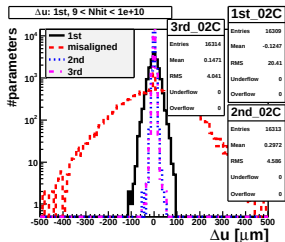
Millepede II

- V03-00-01
- 3 iterations “sparseMINRES”
- χ^2 -cut (“30.0 4.5”), no down-weighting
- regularisation to improve matrix condition against weak modes:
add $1 \cdot \sum_i \left(\frac{\text{param}_i}{\sigma_i^{\text{pre}}} \right)^2$ to χ^2
- Using soft $\sigma^{\text{pre}}(\alpha, \beta, \gamma) = 500 \text{ } \mu\text{rad}$, $\sigma^{\text{pre}}(u, v, w) = 500 \text{ } \mu\text{m}$
- ≥ 10 entries per parameter
Note: not per hit, i.e. pixel w + angles get 2 entries per hit!

Track Refitting etc.

- Pixel hits and errors:
TrackAngles (not templates) since TrackRefitterP5-default
- GlobalTag MC_3XY_V21.
- Trajectory: **BrokenLinesCoarse**.

Remaining Misalignment in Parameter Space



misaligned

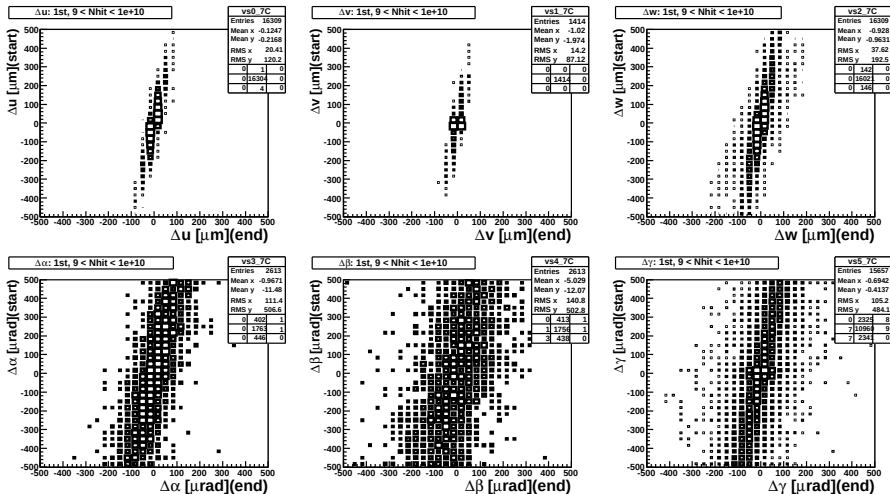
1st iteration

2nd iteration

3rd iteration

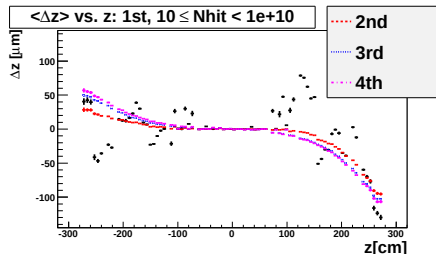
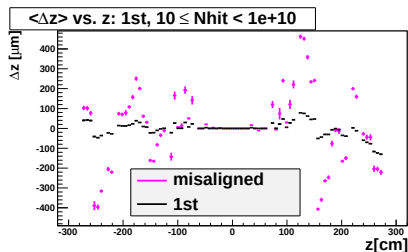
- Aligning pretty well.
- Few modules gain hits to survive 'entries 10' in iteration 2 and 3.
- 2nd iteration:
 - improves significantly.
- 3rd iteration:
 - improves mainly angles (not linear),
 - w in TEC gets worse: z-bias 'develops' with iterations ($\Rightarrow$).

Misalignment: Start Value vs. 1st Iteration



- Strong correlation, but slope $\neq 1 \Rightarrow$ Corrections too small!
- Why?

z-Bias and Iterations

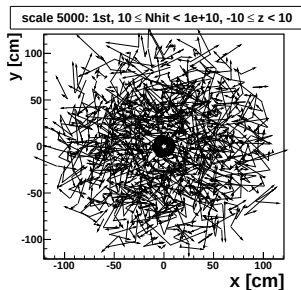


- 1st iteration biased (by regularisation) to start values.
- 2nd iteration develops typical shrinkage pattern.
- Shrinkage continues with further iterations (damped by regularisation).
- TEC+ almost converged after 4th iteration?

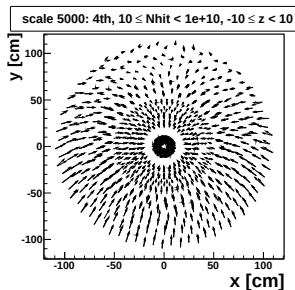
Radial Shrinkage in Barrel

Slice $|z| < 10$

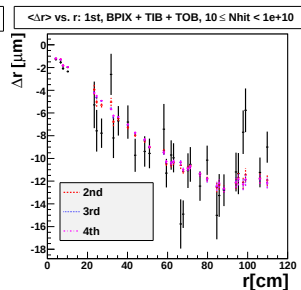
1st Iteration



4th Iteration



Barrel Profile



- Everything moves inwards (except upper TOB).
- Clear pattern arises after 2nd iterations.
- Further iterations are stable.

Summary

- Cosmics MC Setup with coarse broken lines.
- Iterating Millepede is necessary, even for shifts.
 - Correction from Millepede seems to be systematically too small?
- Drawback: z-shrinkage develops with iterations (otherwise tight by regularisation).
- Radial shrinkage in barrel stable.

Outlook

⇒ Urgent need to understand z-bias!

- I started to look into BLfine with residuals from Kalman fit.