Pede χ^2 cut

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Overview

- ★ Basics
- ★ Large initial misalignment
- ★ Fixed global parameters
- ★ Case study
- ★ Summary

Basics

- Pede rejects bad local fits (tracks)
  - Prob(χ^2/min(f,50), ndf) < Prob(3^2, 1) = 0.27%
  - Scaling factor f starts large (f_0), reduced during pede iterations to 1 ($f_{i+1}=f_i^{0.5}$)

`'chisqcut f0 f1'`

- Proper rejection requires proper χ^2 distribution
  - Forward/backward helix trajectories: $\langle\chi^2/ndf\rangle \ll 1$
  - Break points, Broken Lines traj.: $\langle\chi^2/ndf\rangle \approx 1$
- Pede aborts if rejection fraction > 1/3

Large initial misalignment (I)

- Misalignment is significant contribution to χ^2
- First Pede iteration
  - $\langle\chi^2/ndf\rangle \gg 1$, very many tracks rejected as 'bad'
  - But tracks are 'good', track finding and fitting are using APE (alignment position errors) for proper χ^2
  - Information about detector parts with large(st) misalignment lost
  - Pede global matrix and solution won't be optimal
  - No cut on χ^2 at all may be the better choice

`'chisqcut 0. f1'` (available in next Pede release)

Large initial misalignment (II)

- Further Pede iterations
  - Usually small remaining misalignment
  - χ^2 cut unaffected
  - Global matrix can be recalculated

`'matiter 2'`

Fixed global parameters

- Too little statistics: parameter fixed `'entries $n_{min}$'`
- Initial misalignment
  - Adds to χ^2, more local fits rejected
  - Significant rejection: misalignment is in the order of or larger than the error of single residuals
  - Therefore alignment with few measurements better than keeping misalignment
  - Reduce entries cut (default CMSSW: 50, Pede: 10)

Case study (I)

- MC minimum bias events
  - CMSSW_2_2_6
  - TrackerSurveyLASCosmicsScenario
  - Broken Lines
  - 10k events, 18k tracks selected, 45k global par.
- Good result ($\langle \chi^2/ndf \rangle \approx 1$) requires
  - no cut on statistics of global parameters
  - no χ^2 cut in first iteration or recalculation of global matrix

Case study (II)

matiter	entries	chisqcut f_1	frac. fixed par	frac. hits fixed par	frac. trks fixed par	frac. rej. first iter.	frac. rej. last iter.	$\langle\chi^2/ndf\rangle$ last iter.
1	30	30	68%	37%	100%	17%	>1/3	aborted
1	30	0	68%	37%	100%	-	>1/3	aborted
1	10	30	25%	6.5%	66%	17%	15%	1.25
1	10	0	25%	6.5%	66%	-	9.0%	1.15
1	1	30	1%	0	0	17%	12%	1.11
1	1	0	1%	0	0	-	3.4%	0.98
2	10	30	25%	6.5%	66%	17%	9.5%	1.16
2	1	30	1%	0	0	17%	3.8%	0.98
3	10	30	25%	6.5%	66%	17%	9.2%	1.15
3	1	30	1%	0	0	17%	3.5%	0.98

Summary (I)

- Bad χ^2 caused by
  - Misalignment
  - Tracking problems (outliers etc)
- Suggestions
  - Initial misalignment dominating
    (expect large decrease of χ^2 with first iteration)
    - Don't waste information
    - Avoid fixed parameters and χ^2 cut in first iteration
    - Recalculation of global matrix may help

Summary (II)

- ★ Suggestions
  - Tracking problems dominating
    (expect only moderate decrease of χ^2)
    - ✦ Improve tracks by down weighting of bad hits
    - ✦ Use (decreasing) χ^2 cut to reject bad tracks
    - ✦ Recalculation of global matrix may help
  - Both comparable
    - ✦ Be careful