

Some tests on aligning the tracker using CRAFT09 data and Millepede with broken line fit

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Introduction

After a first failed attempt to align the tracker using cosmic tracks from CRAFT09 I wanted to investigate this a little bit further...

Results

First I tried to check the influence of varying track model, *entries* and *matiter*. Parameters common to all alignments:

- ▶ Run range 118598-119407 (= november data, CRAFT09)
- ▶ chisqcut 30. 6.
- ▶ NREC = 1176266
- ▶ Start geometry: GR09_P_V4
- ▶ Overall an alignment that works well without broken lines

Results: First results ... and the problem observed

no.	BL ¹	RK ²	entries	matiter	rejects 1st it.		rejects last it.		χ^2/ndf	remark
					huge	large	huge	large		
mp0001	X		100	def.	1217	2338	1217	502386	N/A	pede stopped
mp0002			100	def.	100	253	63	23531	0.34	
mp0010			1	3	100	253	51	21265	0.34	
mp0011		X	1	3	100	254	50	21272	0.34	
mp0012	X		1	3	1217	2338	511	343654	1.62	mp0011 geom.
mp0013	X	X	1	3	1218	2346	508	342601	1.62	
mp0016	X		1	3	509	524	525	344742	1.62	

The large reject rate using *broken lines* is strange. I tried to investigate this further...

¹broken lines

²Runge-Kutta propagator

Results: Adjusting pede-parameter χ^2_{cut}

I then tried to play around with the new pede rev43 and its capabilities³

no.	entries	matiter	χ^2_{cut}		rejects 1st it.		rejects last it.		χ^2/ndf	remark
					huge	large	huge	large		
mp0012	1	3	30.	6.	1217	2338	511	343654	1.61707687	old rev
mp0012-1	1	3	30.	6.	1217	2338	511	343654	1.61707687	rev43
mp0012-2	1	3	0	6.	0	0	511	343722	1.61708677	rev43
mp0012-3	1	3	0	30.	0	0	509	343522	1.6174736	rev43
mp0012-4	1	1	0	30.	0	0	505	343643	1.61754966	rev43

I would not claim any reasonable difference visible here. So the problem does not seem to be related to the χ^2 cut at first glance. Remember: We need to distinguish large χ^2 from misalignment and bad tracks. And both need their own care.

³See Claus Kleinwort's talks on

Results: Influence of momentum

Influenced by a chat with Markus Stoye I tried to investigate a little bit on what the cut on p does

no.	p -cut GeV/c	NREC	rejects 1st it.			rejects last it.			χ^2 /ndf	remark
			huge	large	total	huge	large	total		
mp0012	4	1176266	1217	2338	0.30%	511	343654	29.3%	1.61707687	old rev
mp0022	6	1066524	1204	2326	0.33%	498	317702	29.8%	1.62550771	
mp0023	12	835427	1164	2235	0.41%	469	260400	31.2%	1.64406466	
mp0024	20	644511	1089	2056	0.49%	426	208328	32.4%	1.65803111	
mp0025	100	145044	424	794	0.84%	141	48386	33.5%	N/A	stopped ⁴

It seems as we have a problem with high momentum tracks.

⁴pede stops if more than 1/3 of tracks are rejected

Results: Other small adjustments

In a reply to the previous slides, Gero suggested some adjustments:

no.	NREC	rejects 1st it.		rejects last it.		χ^2 /ndf	remark
		huge	large	huge	large		
mp0012	1176266	1217	2338	511	343654	1.61707687	magnetic field from data other Geometry sequence CRAFT09_R2_V2 as start geometry chi2nMax=10 instead of 9999 TrackAngleCut=0.10 instead of 0.35 without presigmias and regularisation fine broken lines instead of coarse set TOB as reference
mp0031	1176266	1217	2338	511	343654	1.61707687	
mp0032	1176266	1217	2338	511	343654	1.61707687	
mp0033		job exited with error (version problem)					
mp0034	1176260	1217	2338	511	343670	1.61707616	
mp0035	1259243	1244	2420	534	397250	1.64782822	
mp0036	1176266	1217	2338	513	342158	1.61057162	
mp0037	1176265	killed by LSF (unreasonable memory consumption) ⁵					
mp0038	1176266	1217	2338	508	343638	1.61725175	

No real improvement visible, though some valuable conclusions can be drawn:

- ▶ magnetic field was stable
- ▶ other geometry sequence gives no changes
- ▶ cut on χ^2 /ndof not needed as managed by pede (or still too high)
- ▶ TrackAngleCut may lead to accept worse hit information

⁵may also be a race condition on the machine as I loaded that node and used a wrong memory specification, so be careful to interpret this now

Results: Scaling the error

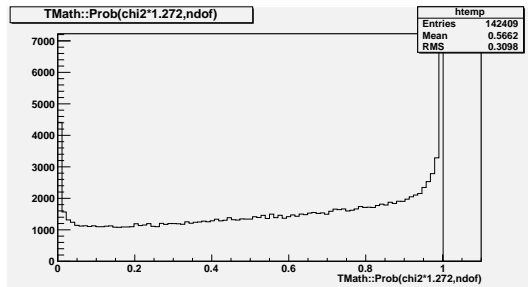
I then modified `MillePedeAlignmentAlgorithm.cc` to scale all errors passed to pede by a globally constant factor, assuming something is wrong with the errors.

no.	error scaling	rejects 1st it.		rejects last it.		rej. fraction	χ^2/ndf	remark
		huge	large	huge	large			
mp0012	1.00	1217	2338	511	343654	29.2%	1.61707687	
mp0040	1.27	368	1188	242	177495	15.1%	1.27814496	
mp0042	1.62	84	372	66	79261	6.74%	0.953903854	
mp0043	2.00	29	110	25	38143	3.24%	0.720448196	

Some remarks:

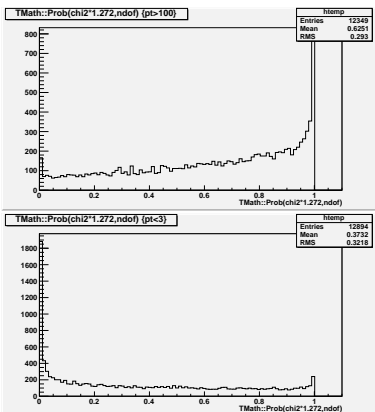
- ▶ Though the variable I scale has *error* in its name, it looks like it is the *variance*. Recall that $\sqrt{1.62} \approx 1.27$. Reading the code in `DataFormats/GeometrySurface` proves that this is the case.
- ▶ Nevertheless the hit error seems to be a bit too small
- ▶ Obviously the hit error plays an important role for the χ^2 -cut mechanism
- ▶ Rejection rate still high

A glimpse on p_T dependence of χ^2



I took the data files from the alignment and plotted χ^2 vs. p_T . The scaling factor 1.272 comes from Millepede. The last digit was used to flatten the histo as good as possible.

A glimpse on p_T dependence of χ^2



The low p_T tracks show a tendency to low probabilities (matching high χ^2). High p_T tracks show better χ^2 .

Conclusions

- ▶ Alignment using cosmic tracks and broken line fit shows large number of rejects. The same strategy without broken lines has lower reject rate (but overestimated errors from the helix track model as well)
- ▶ Cut studies on p suggest a problem with high momentum tracks
- ▶ The results suggest that the correctness of the hit error is important
- ▶ Currently investigating the geometries created
- ▶ More to come after the holidays