How to: Module Alignment with Millepede II

Encouragement to use Millepede II to do alignment

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Analysis meeting
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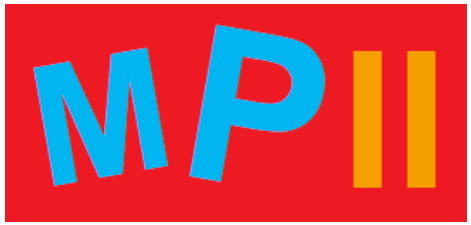

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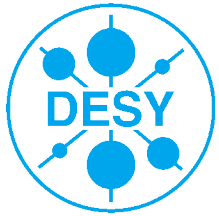
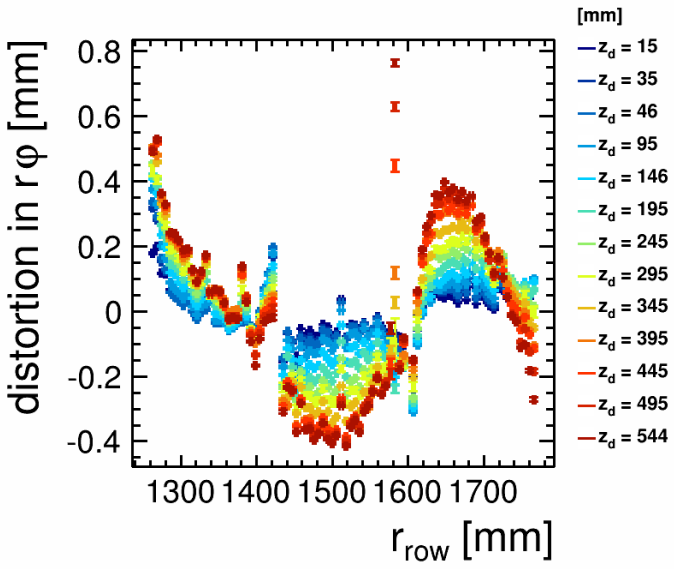


Why Alignment with Millepede II ?

- Every group sees slopes/offsets in their distortion plots
  - Field distortions?
  - Alignment?
- Using the distance between the hits and the track as en estimator for distortions or alignment gives biased results
- Millepede II uses a global fit of all input tracks at a time-> minimal biased
- Might look difficult to use at first glance, but with our tools it becomes rather simple



Get Millepede Input from Marlin

- Use the SimpleHelixGeneralBrokenLinesInterfaceProcessor
  - Refits the input tracks
  - Equivalent to a Kalman filter
  - Interface to Millepede II
- Switch on Millepede output:
  - <parameter name="WriteMillepedeBinary" type="bool">true </parameter>
  - <parameter name="MillepedeFilename" type="string"> FILENAME </parameter>
- Chose the problem to solve with Millepede (here: module alignment)
  - <parameter name="MillePedeCalcMethod" type="int" value="0"/>

DESY

Perform Module Alignment

- Download and install Millepede II
  - http://www.desy.de/~kleinwrt/MP2/doc/html/index.html
  - svn checkout http://svnsrv.desy.de/public/MillepedeII/tags/V04-02-00 target
  - make pede
- Create a steering file for Millepede II
  - Depends on the problem under investigation

Steering File for Module Alignment

```
Cfiles
PathToFile/FirstInputFile
PathToFile/SecondInputFile

Parameter
4 0. -1. ! fix rotation around x of module 5
5 0. -1 ! fix rotation around y of module 5
31 0. -1. ! offset in x of module 3
32 0. -1. ! offset in y of module 3
33 0. -1. ! offset in z of module 3
34 0. -1. ! rotation around x of module 3
35 0. -1. ! rotation around y of module 3
36 0. -1. ! rotation around z of module 3
54 0. -1. ! fix rotation around x of module 5
55 0. -1. ! fix rotation around y of module 5



outlierdownweighting 3
method inversion 3 0.10

end
```

->Define input files

->Fix global parameters to have a constrained problem

Alignment parameters:
1-3 offsets in x,y,z
4-6 rotations around x,y,z

labels are defined as:
module ID*10+alignment parameter

-> Set parameters for calculation algorithm

DESY

Running Millepede

- ./pede MillepedeSteeringFile.txt
- Produces output “millepede.res”

! label	final value	initial error	correction and	error from MP2
1	0.85422	0.0000	0.85422	0.14696
2	5.0177	0.0000	5.0177	0.11682
3	0.34625	0.0000	0.34625	0.74496E-02
4	0.0000	-1.0000		
5	0.0000	-1.0000		
6	-0.30487E-02	0.0000	-0.30487E-02	0.72996E-04
31	0.0000	-1.0000		
32	0.0000	-1.0000		
33	0.0000	-1.0000		
34	0.0000	-1.0000		
35	0.0000	-1.0000		
36	0.0000	-1.0000		
51	-0.80873	0.0000	-0.80873	0.16429
52	0.80207	0.0000	0.80207	0.10402
53	0.12050	0.0000	0.12050	0.74539E-02
54	0.0000	-1.0000		
55	0.0000	-1.0000		
56	-0.43124E-03	0.0000	-0.43124E-03	0.72607E-04

Applying the Corrections

- Take your gearfile and change:

```
<module>

<angle value="-0.02083" />

<offset x_r="-172.5" y_phi="0" />

</module>
```

```
<module>

<angle value="-0.02083 -  zRotation" />

<offset x_r="-172.5 – xOffset"
 y_phi="0 - yOffset" />

</module>
```

Some Advice/Comments

- Fix all parameters of module 3 (relative alignment)
- Fix z offset and x,y rotations as they cannot be inserted into the gearfile
- Use as much different input as possible
  - Z scans, x scans, phi scans, theta scans
- Check the difference between 0/1T data
  - 1T data might create problems due to distortions
  - If problems occur, use 0T data only
- Your track finder and fitter might have problems with a y offset in the gearfile, but there are tools which can handle this
- You might need to iterate this procedure (I had to do this twice)

- If help is needed, don't hesitate to ask Claus Kleinwort or me
- LC-TOOL-2014-008 LC note of Claus Kleinwort