Alignment progress
Millepede simple example

Millepede

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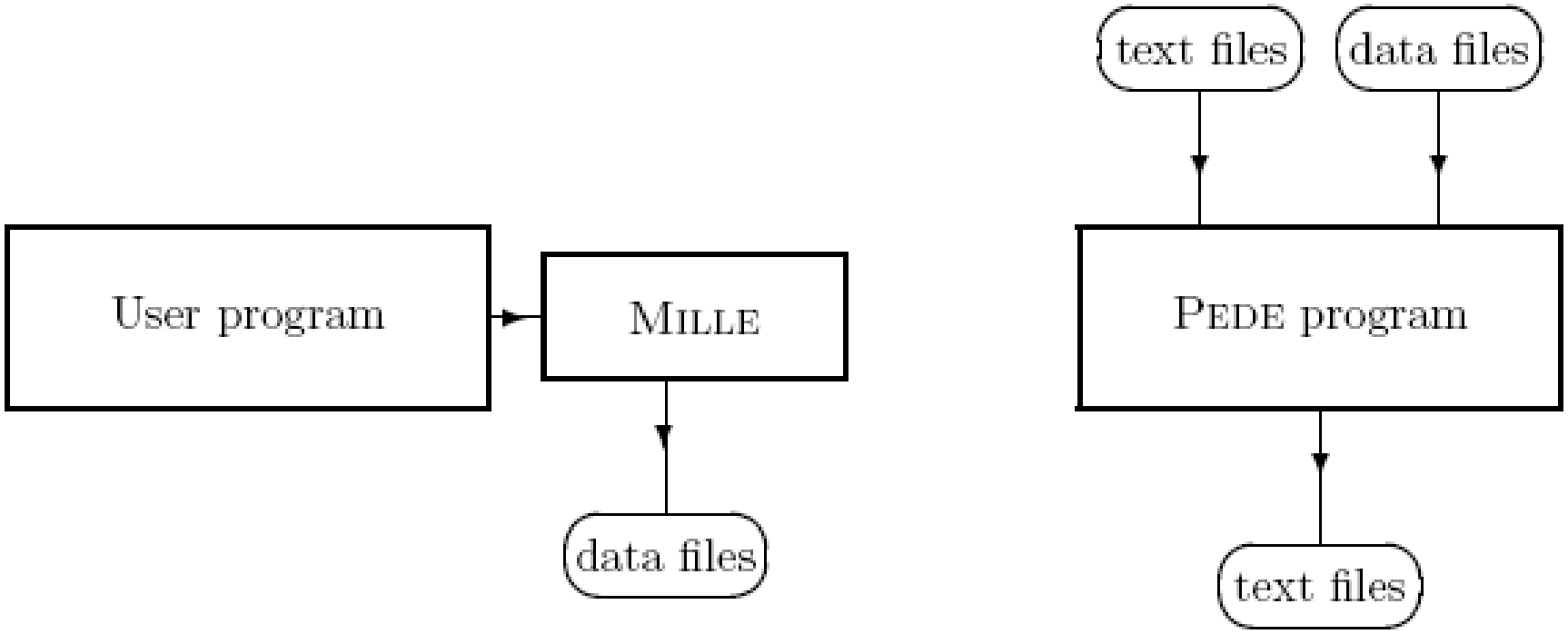
DESY

Optimization

- The optimization problem is complicated by the fact, that often not all global parameters are defined by the ansatz. In the alignment example the degrees of freedom describing a translation and rotation of the whole detector are not fixed.
- Global parameters - vector p and local parameters for the data set j – vector qj .
- The objective function to be minimized in the global parameter optimization is the sum of the local objective Function, depending on the global parameters p and the vectors qj :

$$F(p, q) = \Sigma F_j(p, q_j)$$

MillePede == Mille + Pede



- TelAna-> Root file -> C_script with help of Mille
- Mille -> Binary file for Pede

Global Parameters

- Global parameters to be determined in a track-based alignment are mostly geometrical corrections:
  - translation shifts and rotation angles. the assumption of constant first derivatives is sufficient (otherwise an iteration with creation of new data files would be necessary).
- In general an alignment should be done simultaneously of all relevant detectors, perhaps using structural constraints (see below).
- In addition to the geometrical corrections there are several additional parameters, which determine
  - trak-hit positions like Lorentz-angle and T0-values, drift-velocities etc.

Global Parameters

- X and Y strip detectors information fit independently by:

X = A + B*Z

Y = C + D*Z

X_fit = A + B*Z + Xshift + Z shift + 3 rotations

Y_fit = ……..

- Derivatives calculations:

d(X_fit – X_hit)/dA = 1

d(X_fit – X_hit)/dB = Z

d(X_fit – X_hit)/dP1 = 1

……

d(X_fit – X_hit)/dP5 = 1

- P1….P5 – global parameters

$$R = \begin{pmatrix} \cos\psi\,\cos\varphi - \cos\vartheta\,\sin\psi\,\sin\varphi & -\cos\psi\,\sin\varphi - \cos\vartheta\,\sin\psi\,\cos\varphi & \sin\vartheta\,\sin\psi \\ \sin\psi\,\cos\varphi + \cos\vartheta\,\cos\psi\,\sin\varphi & -\sin\psi\,\sin\varphi + \cos\vartheta\,\cos\psi\,\cos\varphi & -\sin\vartheta\,\cos\psi \\ \sin\vartheta\,\sin\varphi & \sin\vartheta\,\cos\varphi & \cos\vartheta \end{pmatrix}$$

Algorithm to get binary file

1. Write a script for reading a root file from TelAna
2. Include Mille.h and Mille.cc
3. Analyze only straight tracks with 3 hits per telescope and one hit per telescope plane
4. Creat an object of the class Mille as provided in files Mille.h and Mille.cc:

```
Mille myMille("fileName.dat");
```

5. Loop over the events to make track fits with A+B*X
6. After each track fit, loop on the hits and write out the hit information with

```
mille.myMille(numTrackPar, ptrToTrkVarDerivs, nAliParOfHitSensor,
              ptrToAliParDerivs, ptrToAliParLabels,
              residualHitPosTrkFit, hitSigma)
```

7. After the loop on the hits of the track is finished call

```
mille.end()
```

Pede

- Two input files:

>pede [options] [main steering text file name]

- mp2str.txt – test steering file
- mp2con.txt – test constraints file
- mp2tst.bin – test datafile
- Now with Mille.cc and .h new binary file can be created

Parameters Identification

Parameter

Label initial value presigma

……

Label initial value presigma

If 3 planes with X and Y independently then 30 parameters with label should be declared

If to test MillePede for work with only X fitting then only 3 X_planes * 5 parameters = 15 Global Parameters

Presigma

- The pre-sigma sl defines the status of the global parameter:
- sl > 0 - The parameter is variable with the given initial value. A term 1/s2` is added to the diagonal matrix element of the global parameter to stabilize a perhaps poorly defined parameter. This addition should not bias the fitted parameter value, if a sufficient number of iterations is performed;

  it may however bias the calculated error of the parameter (this is available only for the matrix inversion method).
- sl = 0 - The pre-sigma is zero; the parameter is variable with the given initial value.
- sl < 0 - The pre-sigma is negative.

Steering files

- Ongoing understanding
- Check that Root file has values in mkm
- Labels for all global parameters
- Derivatives of 3 Euler angles calculations for every hit???
- But still something is missing

- In contact with Gero Flucke