Millepede II news (V3-00-00)

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Statistics group meeting 18.11.09

Overview

- Tracks based on 'broken lines': explore speed
  (V. Blobel, Nuclear Instruments and Methods A, 566 (2006), pp. 14-17)
  - Local fits with bordered band matrices ($\mathbf{M}\mathbf{x}_{loc}=\mathbf{y}$)
  - Auto detection of bordered band matrices
- Robustness
  - Check for NaNs in results
  - Check for rank deficit in local fits
- Inline toy MC
  - Simple Si strip detector added (different track models)

Local fit with b. b. matrix

- ★ Decomposition
  - Border part *A*: b·b, B: b·n
  - Band part *C*: n·n with width m

$$\mathbf{M} = \begin{pmatrix} A_{bb} & B_{bn} \\ B_{bn}^{t} & C_{nn} \end{pmatrix}$$

- ★ Solution

CPU cost ≈

  - *C* by root free Cholesky decomp. (**C=LDL**†) $n \cdot m^2$
  - *A* by inversion b^3
- ★ Inversion
  - Full for construction of large global matrix $n^2 \cdot m$
  - Band part for parameter errors, pulls $n \cdot m^2$

(Broken lines: b=1 (curvature), n~n_{hit}, m=5)

Detection of b. b. matrix

- Matrix construction
  - From derivatives of residuals r_k

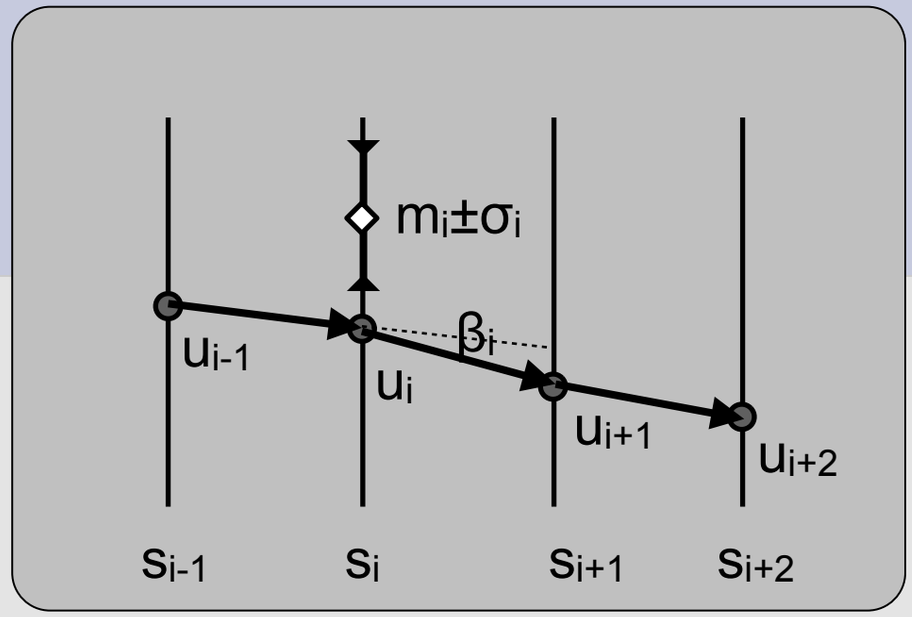
$$M_{ij} = \sum_k w_k \frac{\partial r_k}{\partial x_i} \frac{\partial r_k}{\partial x_j}$$

- Matrix structure
  - For each (i,j,k) with non zero $\partial r_k/\partial x_i \cdot \partial r_k/\partial x_j$
    - Band width $m(i,j)=|i-j|$, border size $b(i,j)=\min(i,j)$
  - For each hypothetical band width m determine maximal border size $b_{max}(m)$
  - Choose m with minimal cost $n(m+b_{max}(m)+1)^2+b_{max}(m)^3/3$
  - If (m,b) too large use inversion for local fit

Backup

Broken lines on one page

Broken Lines (refit)



- ★ Broken Lines trajectory
  - ▸ Defined by offsets $u_i(s_i)$
  - ▸ Connected by kinks β_i and curvature κ

$$\beta_i = \left[u_{i-1}\delta_{i-1} - u_i\left(\delta_{i-1}+\delta_i\right) + u_{i+1}\delta_{i+1} \right] - \tfrac{1}{2}\left(\Delta s_{i-1} + \Delta s_i\right)\kappa$$
$$\Delta s_i = s_{i+1} - s_i, \quad \delta_i = 1/\Delta s_i$$

- ★ Simple case: Si tracker
  - ▸ Material and measurement at same position
- ★ Solution by minimizing
  - ▸ σ_β from multiple scattering
  - ▸ Bordered band matrix
    - ✦ Curvature correlates all u_i, the kinks a few adjacent u_i

$$\chi^2(\mathbf{u},\kappa) = \sum_{i=1}^{n} \frac{\left(m_i - u_i\right)^2}{\sigma_i^2} + \sum_{i=2}^{n-1} \frac{\beta_i^2}{\sigma_{\beta,i}^2}$$