Two-Pass Track Fitting Method

Mark M. Ito

Jefferson Lab

October 1, 2008

M. Ito (JLab)

Two-Pass Track Fitting Method

October 1, 2008 1 / 15

3. 3

Least-Squares Fitter

- Uses Levenberg-Marquardt algorithm from GNU Scientific Library
- Works with FDC hits, CDC hits, or any combination
- Current status: Unweighted fit (assume equal measurement errors)
- Track parameters:
 - Total inverse momentum: 1/p
 - Polar angle: θ
 - Azimuthal angle: ϕ
 - Transverse distance of point of closest approach to beamline: x'_0
 - Z of point of closest approach to beamline: z₀

Problem: local minima

- rough starting position:
 - ▶ 1/p = 0
 - ► *z*₀ = 0
 - ϕ and $\mathbf{x}_{\mathbf{0}}'$ set by line going through first and last cdc wires
 - $\blacktriangleright\,$ theta set to be 45, 90, or 135 degrees whichever is closest to the true $\theta\,$
- Many fits with poor chi-squrared (few tens of %)

New approach: flat in the middle



Residual vs. position for a 1 mm radius cell and a drift distance of 300 microns.



Squared residuals for 300 micron drift distance, red: nominal, green: flattened

3

(日) (周) (三) (三)



Squared residuals for 800 micron drift.

3

(人間) トイヨト イヨト

Two-Pass Approach

- It with modified, flattened residual function
- Ose results as starting point for second fit with standard residual function



Event 3, one-pass method, chi-squared = 0.600

M. Ito (JLab)

3

イロト イヨト イヨト イヨト



Event 3, two-pass method, chi-squared = 0.030

M. Ito (JLab)

3

イロト イヨト イヨト イヨト

Monte Carlo Data Sample

- Positive pions
- p = 2.0 GeV/c
- Uniform in theta and phi
- Fixed starting point:
 - ► x'_0 = 0
 - ▶ z0 = 65 cm
- 100,000 events generated

3



Total momentum, one-pass and two-pass methods, linear scale

M. Ito (JLab)

October 1, 2008 11 / 15

3

伺下 イヨト イヨト



Total momentum, one-pass and two-pass methods, log scale

M. Ito (JLab)



Chi-squared, one-pass and two-pass methods, linear scale

M. Ito (JLab)

October 1, 2008 13 / 15

3

- 4 目 ト - 4 日 ト - 4 日 ト



Chi-squared, one-pass and two-pass methods, log scale

M. Ito (JLab)

Things to do

- get the covariance matrix
- put in position smearing
- try without multiple scattering, energy loss
- look at events that still have bad chi-squared
- look at residual distributions and scale terms in chi-squared appropriately
- try fitting using transverse momentum rather than total momentum
- fix events that have bad minimum brackets