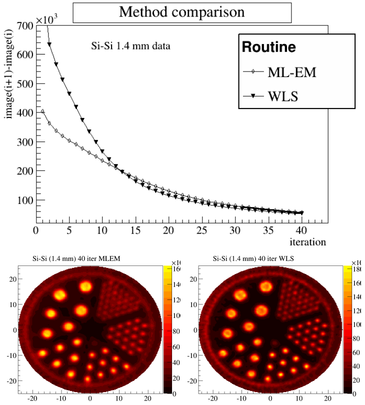
Trade-off

A. Studen[1]

[1] IJS, Ljubljana

November 20, 2013

Alternative reconstruction methods: WLS



WLS:

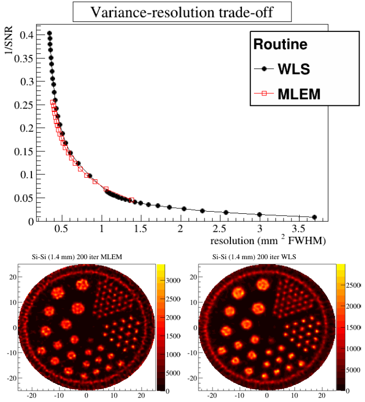
$$\chi^2 = (\mathbf{y} - A\boldsymbol{\lambda})^T C(\mathbf{y} - A\boldsymbol{\lambda})$$
$$C = diag^{-1}(A\boldsymbol{\lambda})$$

Benefits:

- PDF is defined for x$\in \Re$.
- Negligibly more complex:

$$\lambda_i^+ = \frac{\lambda_i}{S_i} \sum_j A_{ji} \frac{y_j^2}{(A\boldsymbol{\lambda})_j^2} \qquad (1)$$

WLS and MLEM comparison



WLS:

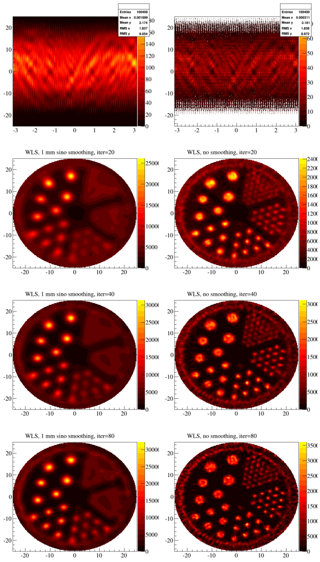
- Require equal projected and measured sinogram count:

$$\sum_k (A\lambda)_k = \sum_k y_k$$

- Iteration step modified to:

$$\lambda_i^+ = \frac{\sum_k y_k}{\sum_k \frac{y_k^2}{(A\lambda)_k}} \frac{\lambda_i}{S_i} \sum_j A_{ji} \frac{y_j^2}{(A\lambda)_j^2} \qquad (2)$$

Sinogram smoothing



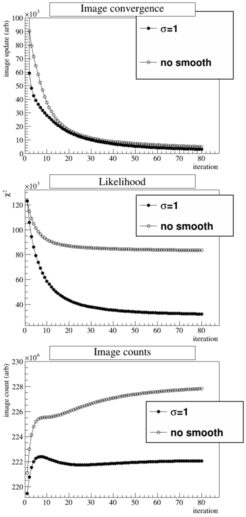
Sinogram smoothing:

$$\mathbf{y}' = W\mathbf{y}$$
$$A' = WA$$

W is a square matrix in sinogram space

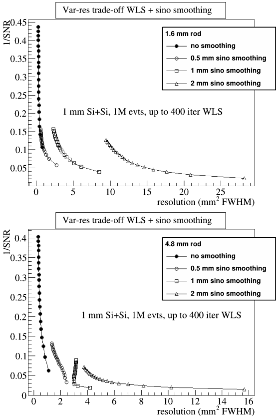
- In our case, smooting is a Gaussian σ wide along p

Convergence parameters



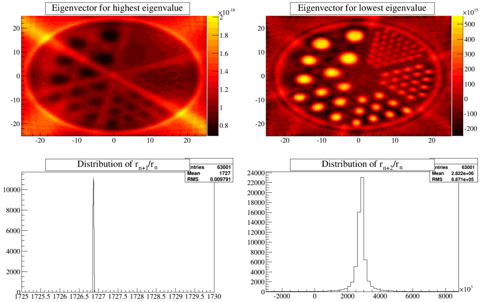
- Similar properties
- Better convergence of smoothed images, if anything

Smoothing sinograms



- Smoothing of 1.6 and 4.8 mm rods

Exploring Fischer matrix and CR bound



Eigenvalues of F through power method

$$A^n\mathbf{r} \sim \lambda^n_{max}\mathbf{r} \qquad (3)$$

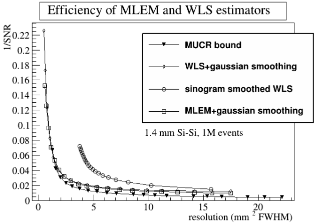
and

$$\left(\left(A - \lambda_{max} I\right)^2\right)^n \mathbf{r} \sim \left(\left(\lambda_{min} - \lambda_{max}\right)^2\right)^n \mathbf{r}$$

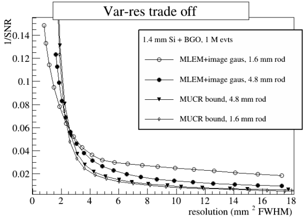
- Smoothing of 1.6 and 4.8 mm rods

Comparison of estimates to MUCR

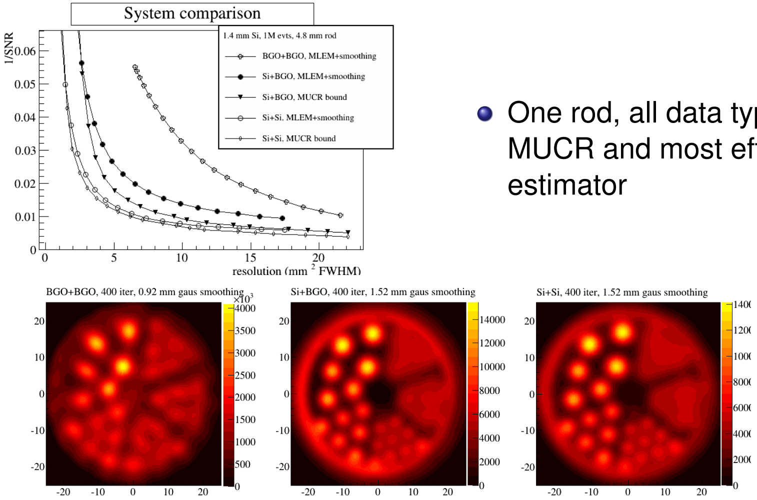
- For a fixed rod and varying reconstruction algorithm



- For both rods and most efficient algorithm



Putting it all together



- One rod, all data types, MUCR and most efficient estimator