Image Reconstruction and Motion Correction using STIR

MIC 2009
STIR Workshop

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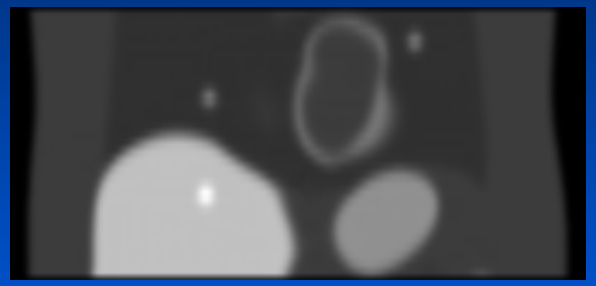
Why STIR?

- Well evaluated reconstruction algorithms
- User friendly
- Useful utilities
- Easy to develop

Image Reconstruction
NCAT (GE Advance)

Sinogram

OSEM (8 iterations, 12 subsets)

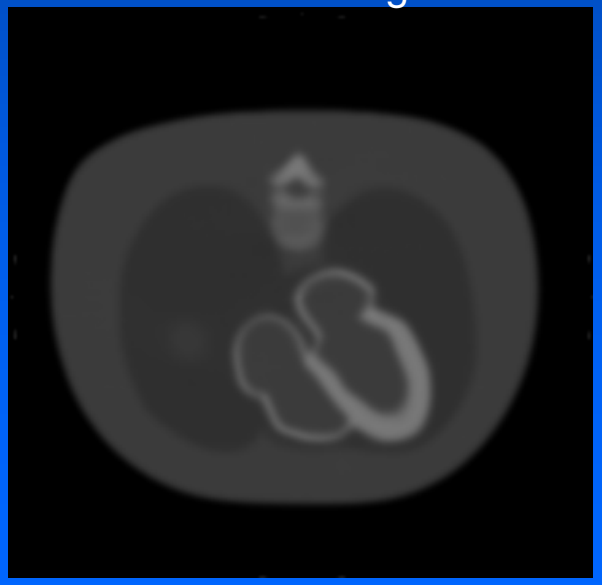


Motion Correction using STIR

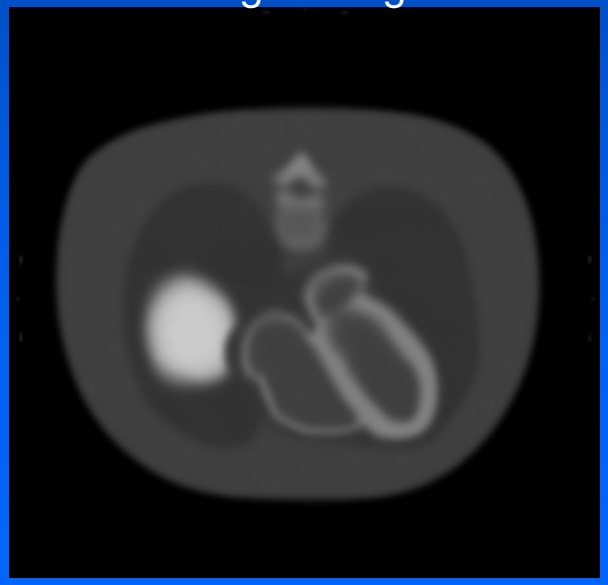
- Calculate motion parameters from registration (ITK library)
- Motion correction methods
  - post-reconstruction registration
  - motion compensated 4D image reconstruction

Motion Parameters

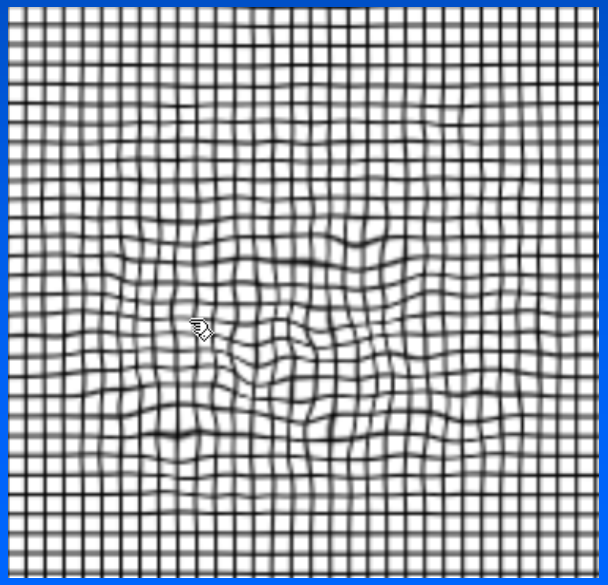
Source Image



Target Image



Deformation Field



Evaluate Registration

Target - Source

Target - Registered

	SSD	CC	NMI
Before registration	64.4	0.962	1.439
After registration	34.9	0.989	1.645

Motion Correction (I)

Post-Reconstruction Registration (PRR)

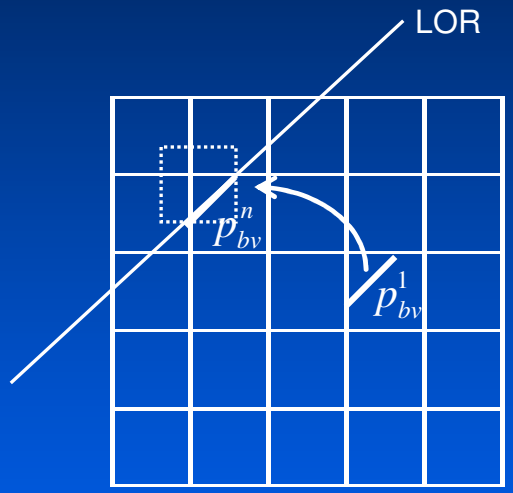
$$\tilde{f} = \frac{\tilde{f}^1 + \sum_{n=2}^{N} W^{n\to 1}\tilde{f}^n}{N}$$

Motion Correction (II)

Motion Compensated 4D Image Reconstruction (MCIR)

$$\tilde{f} = \frac{f}{\sum_{n=1}^{N} P_n^T} \sum_{n=1}^{N} P_n^T \frac{g_n}{P_n f}$$

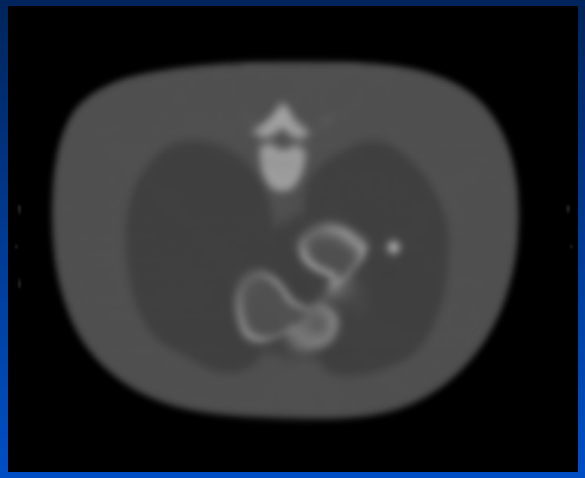
where $P_n = W^{1 \to n} P_1$



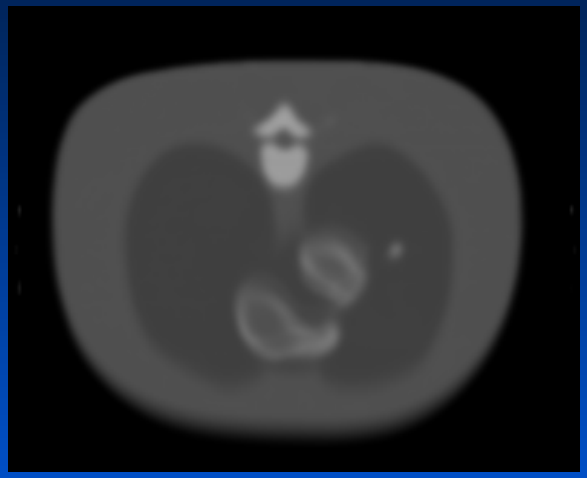
Features

- Unlike PRR all acquired data are taken into account when updating the estimate
- Computationally expensive

Evaluation Using NCAT



Target Frame



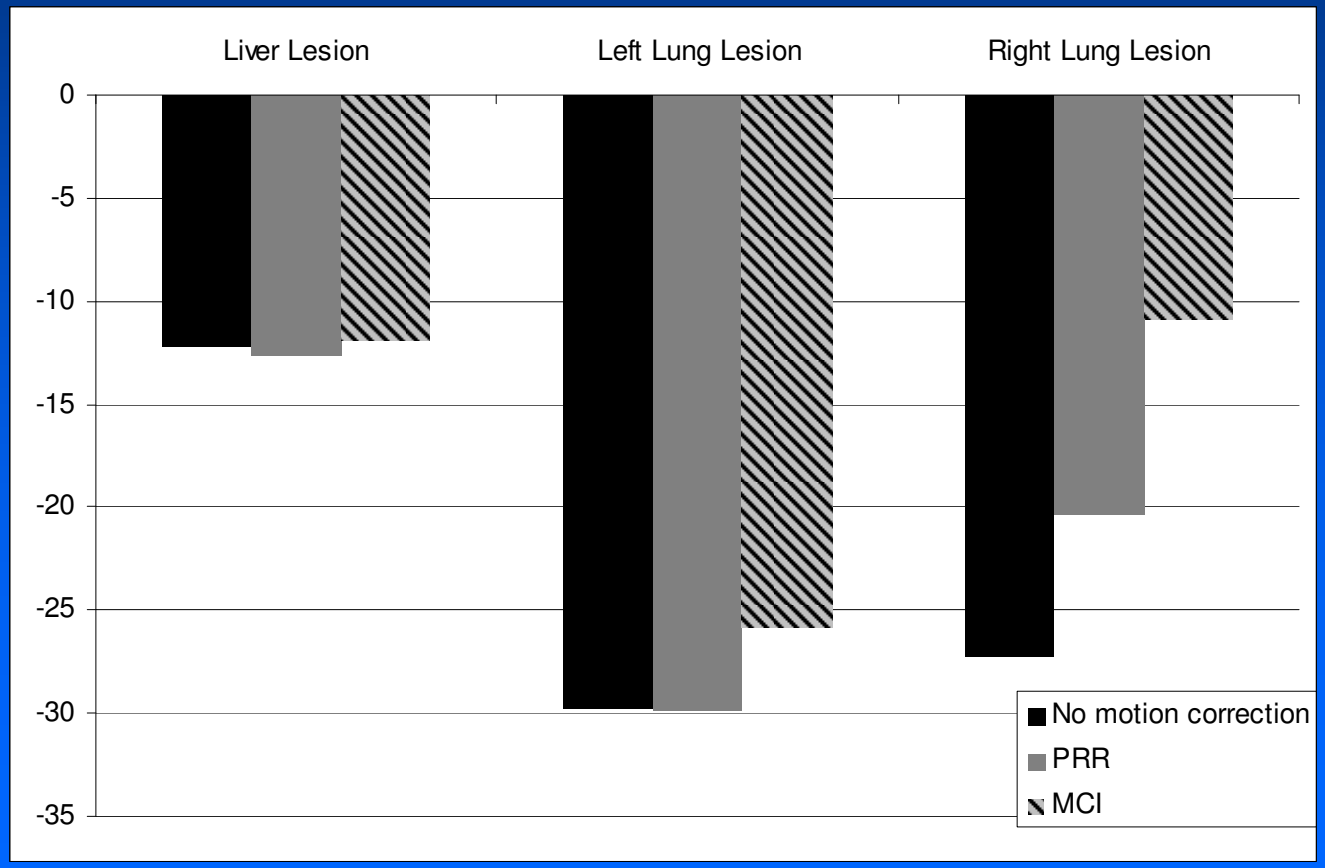
PRR

No Motion Correction

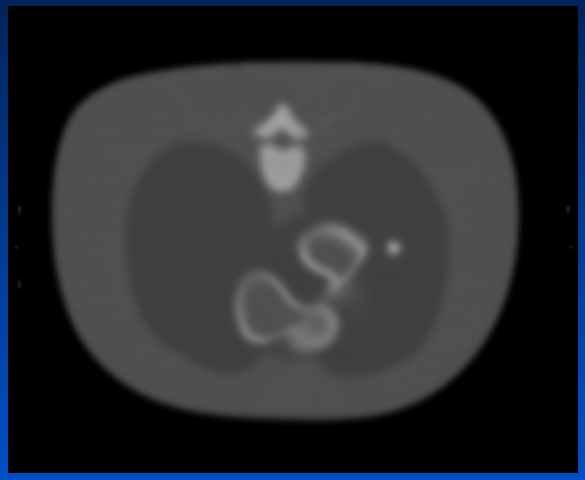
MCIR

Lesion Quantification

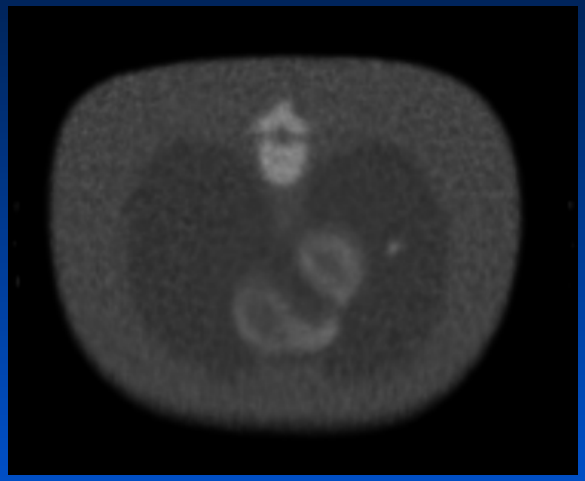
$$Percentage\ bias = 100 \cdot \left(\frac{All\ \ frames - Target}{Target} \right)$$



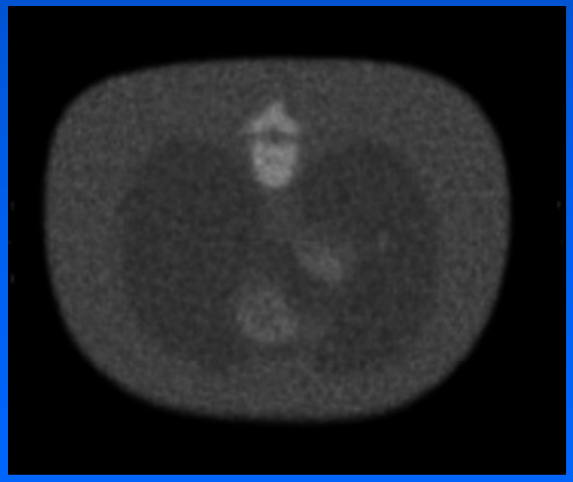
Add Poisson Noise



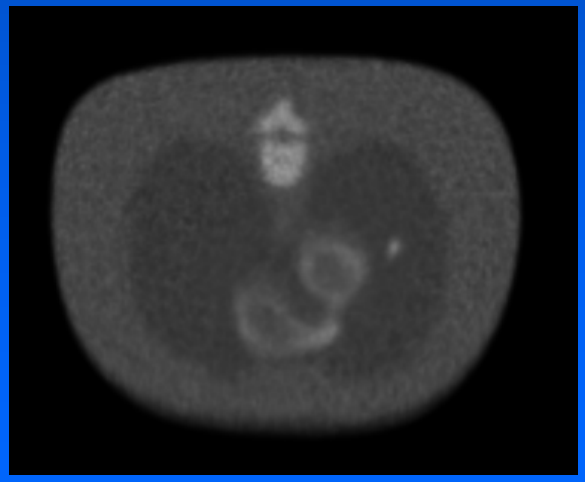
Target Frame



PRR



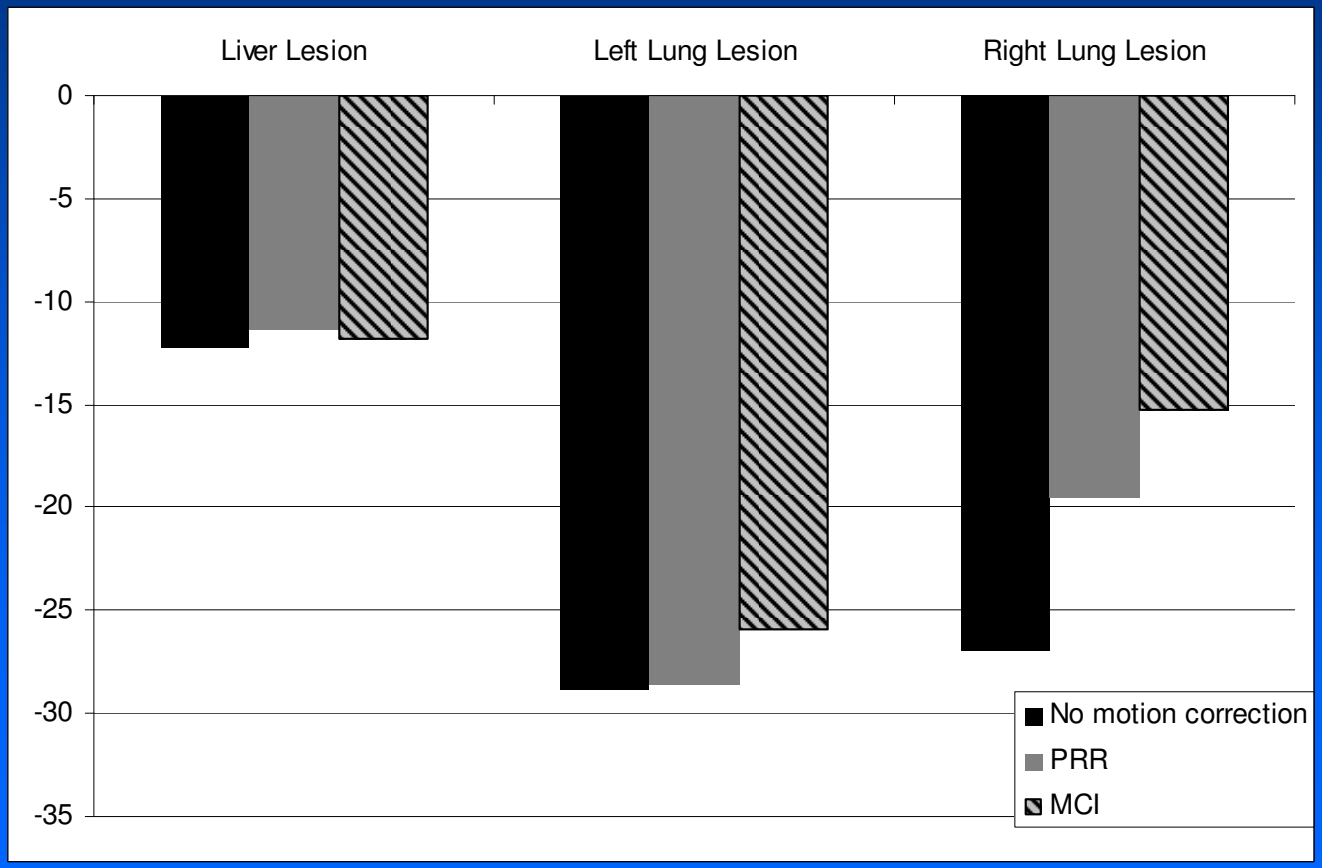
No Motion Correction



MCIR

Lesion Quantification

$$Percentage\ bias = 100 \cdot \left(\frac{All\ \ frames - Target}{Target} \right)$$



PET+MR: Cambridge Scanner

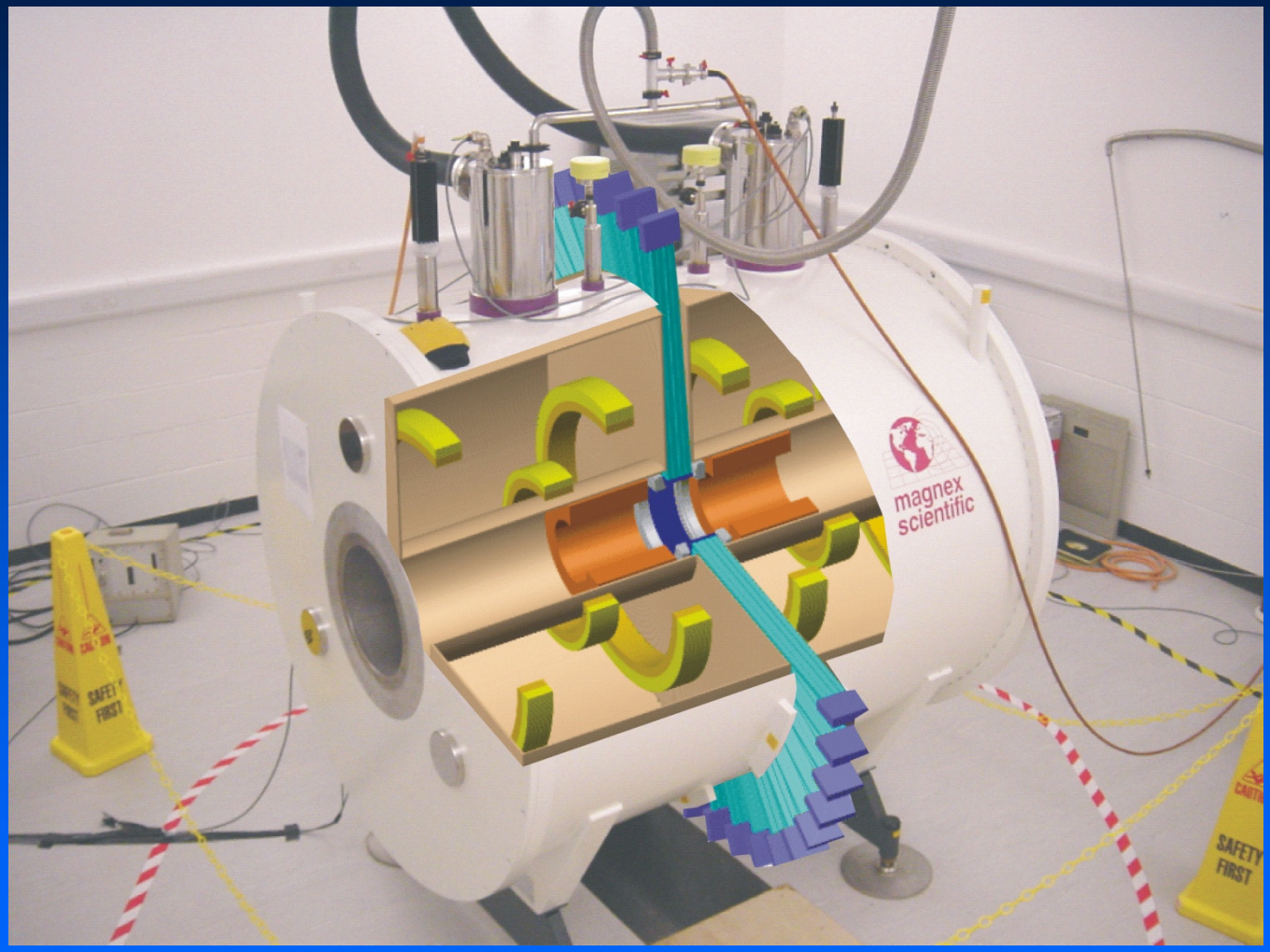


Image Reconstruction
MOBY (Focus 120)

OSEM (8 iterations, 12 subsets)

Summary

- We have implemented motion correction in STIR
  - PRR
  - MCIR
- Motion correction improved lesion quantification in NCAT
- STIR-based motion correction has also been applied to real MR/pseudo-PET (poster M05-253)