Frequency-Combined Extended 3D Reconstruction for Multiple Circular Cone-Beam CT Scans

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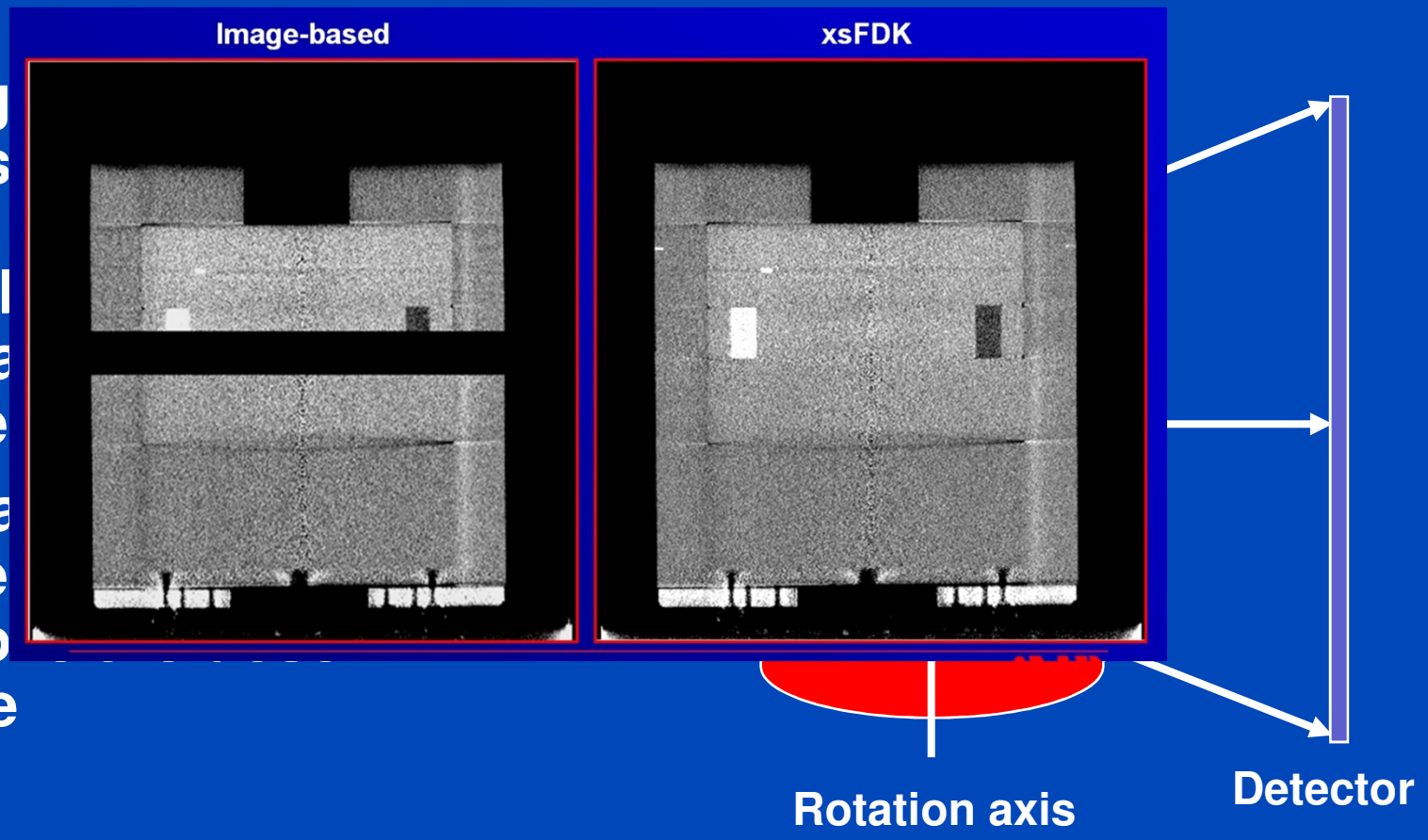
Aim

- To provide a reconstruction method for cone-beam sequence scans with reduced noise and reduced cone-beam artifacts

Method A: Extended Sequence Reconstruction[1,2]

- Slices farther from the midplane receive less than 360°
- Using slices voxel least I increa range
- Increa range impro usage



[1]Grimmer, Oelhafen, Elstrøm, Kachelrieß. Med. Phys. 36(7):3363-3370, July 2009
[2]Grimmer, Berkus, Oelhafen, Kunz, Kachelrieß. IEEE MIC Record M13-207:3759-3763, October 2009

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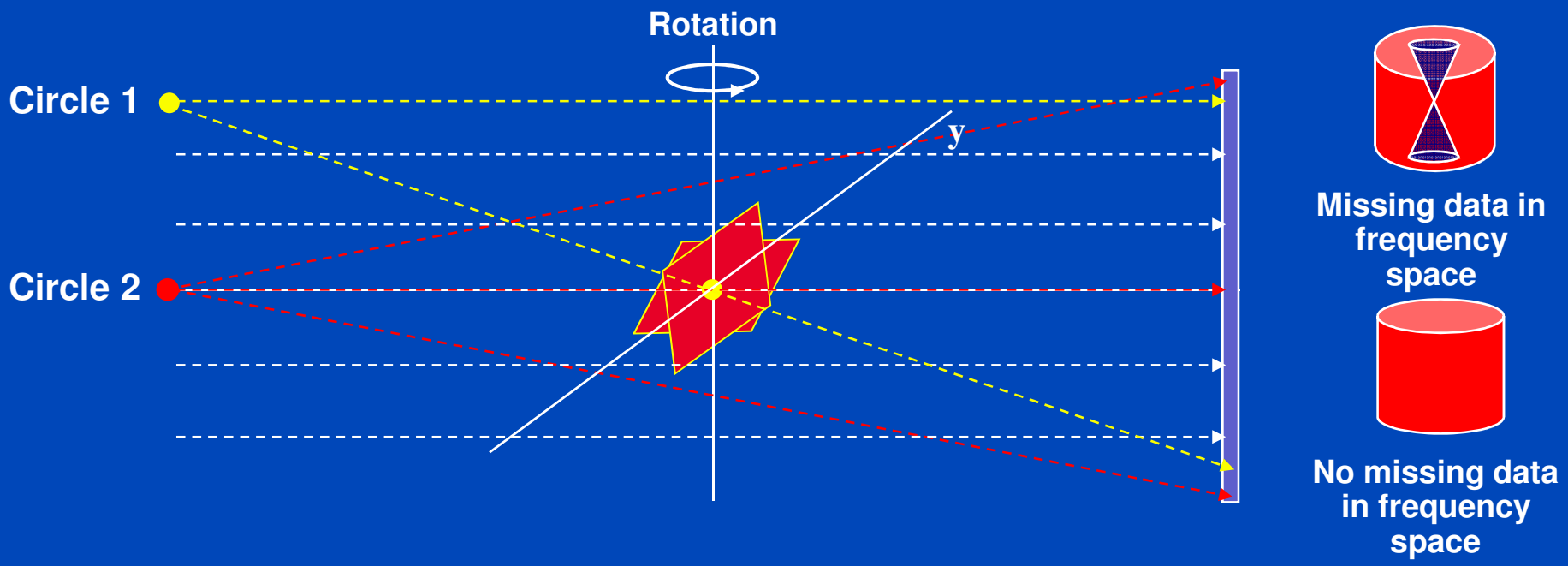
Method B: Combination in Frequency Domain[3]



[3]Baek, Pelc. Med. Phys. 37(10):5351-5360, October 2010

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xsfFDK

- Extended sequence scan frequency-combined Feldkamp (xsfFDK) reconstruction is a combination of
  - Method A and
  - Method B

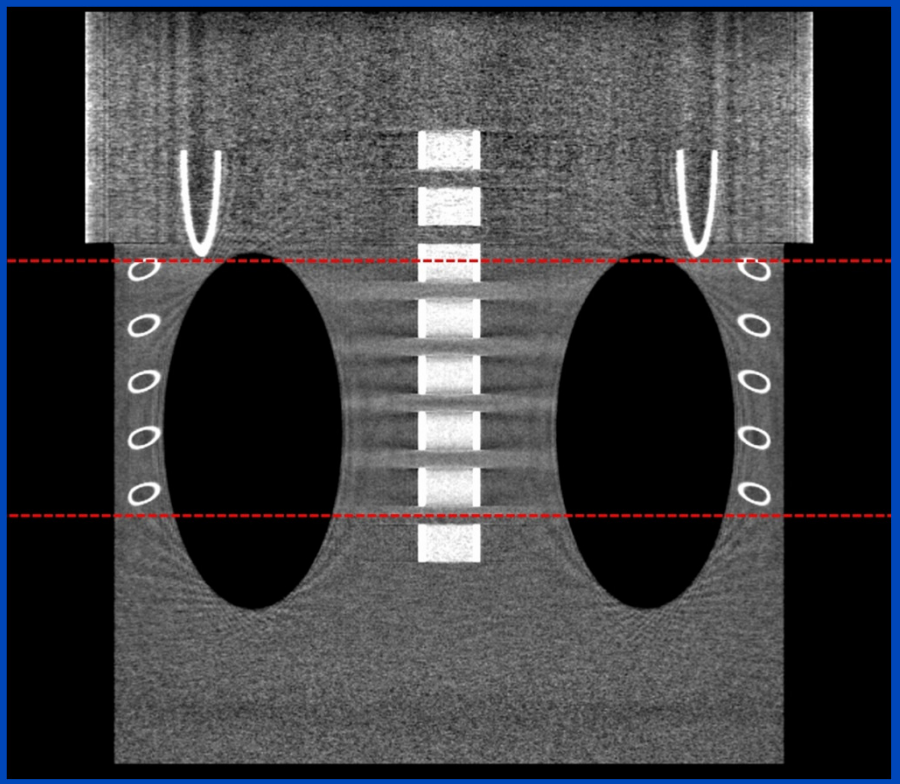
Materials

- **Simulation:**
  - 1080 x 1080 detector with 0.5 mm square pixels
  - Cone angle 15°
  - FOM radius is 130 mm
- **Varian OBI flat detector CT:**
  - 1008 x 752 detector with 0.388 mm square pixels
  - Cone angle 11°
  - FOM radius is 130 mm
- **VAMP TomoScope micro-CT:**
  - 517 x 476 detector with 0.1 mm square pixels (reduced detector size)
  - Cone angle 6.5°
  - FOM radius is 20 mm

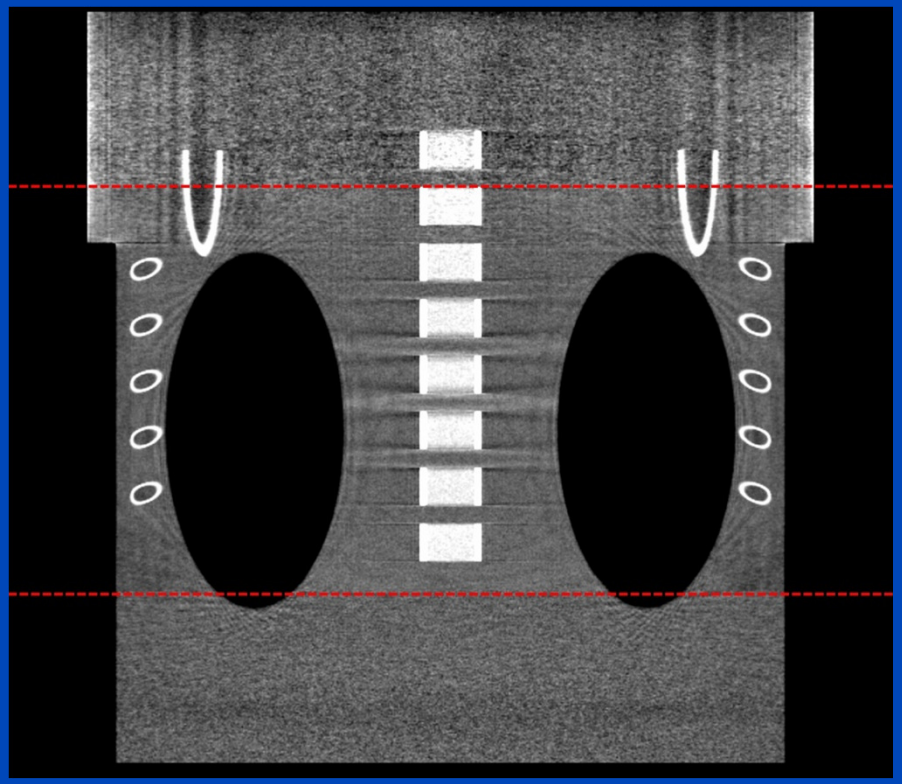
Simulation Study: Increased Overlap

Thorax Coronal

Averaged FDK



Proposed Method

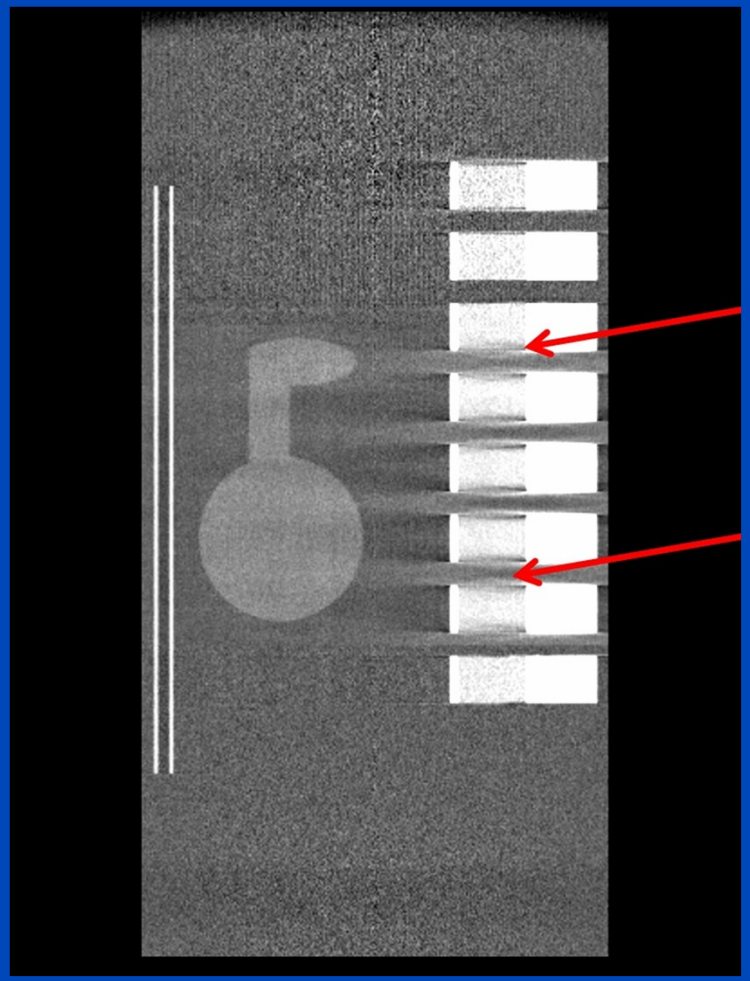


C = 0; W = 300 HU

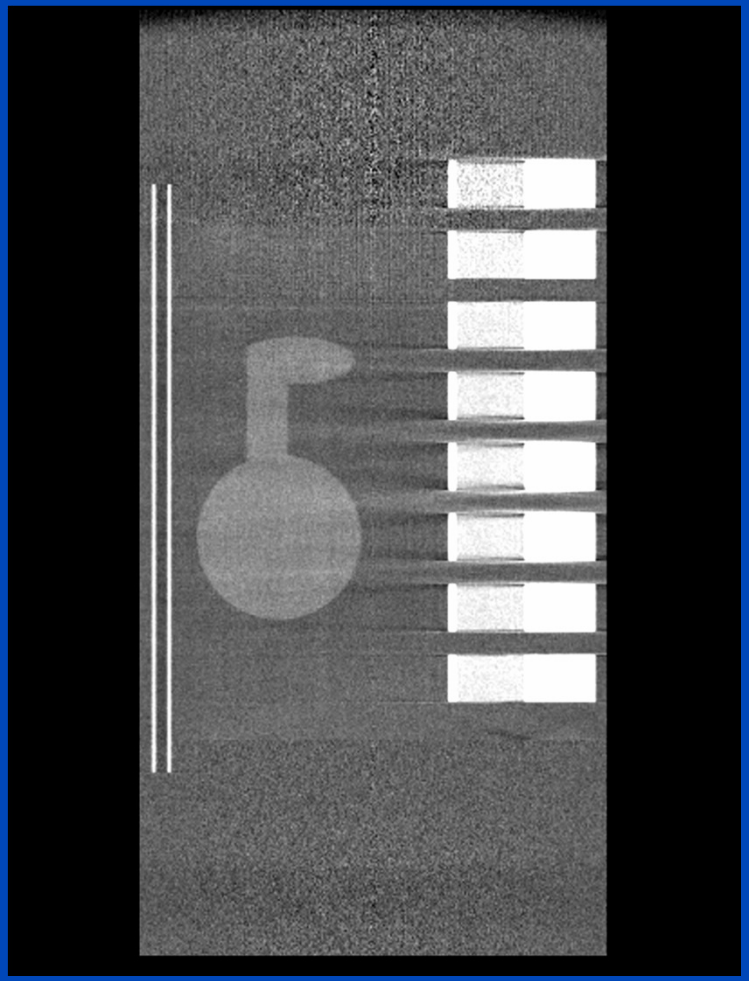
Simulation: Lower Cone-Beam Artifacts

Thorax sagittal

Averaged FDK



Proposed Method



C = 0; W = 300 HU

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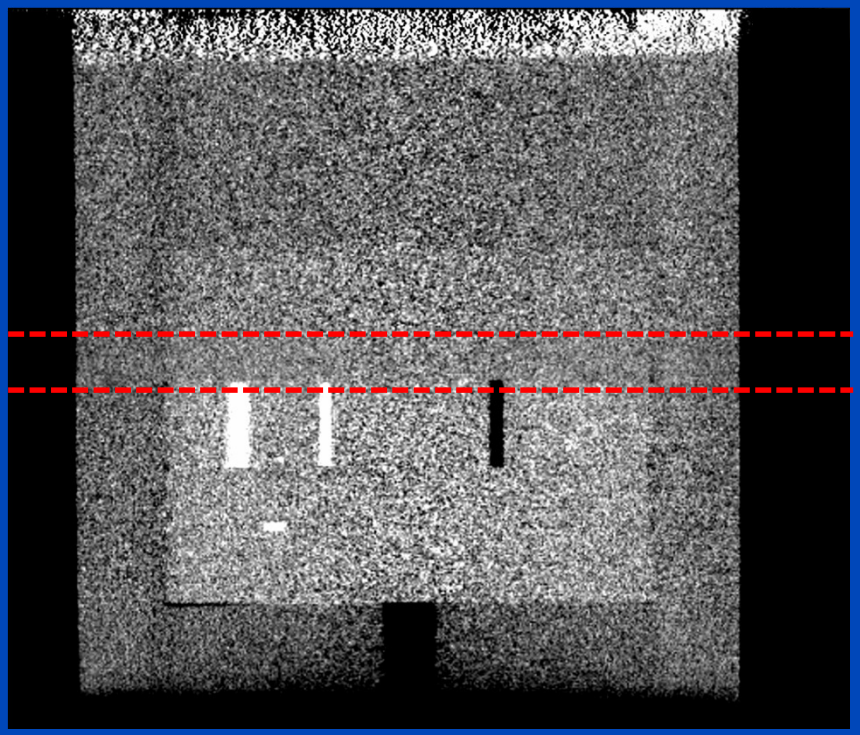
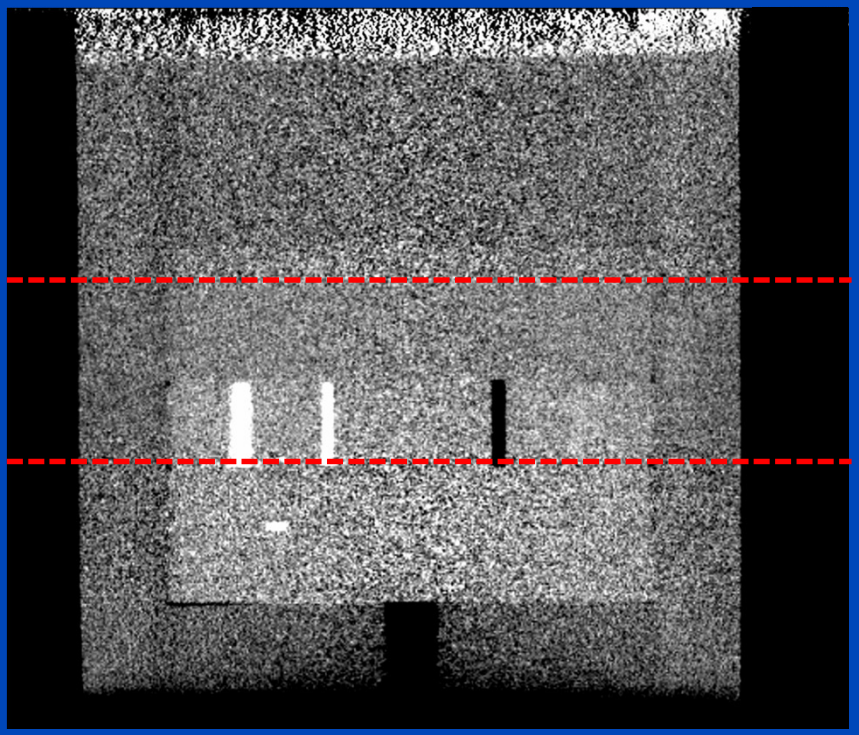
Measurement Study: Increased Overlap

Varian OBI Scanner

Averaged FDK



Proposed Method



C = 0; W = 500 HU

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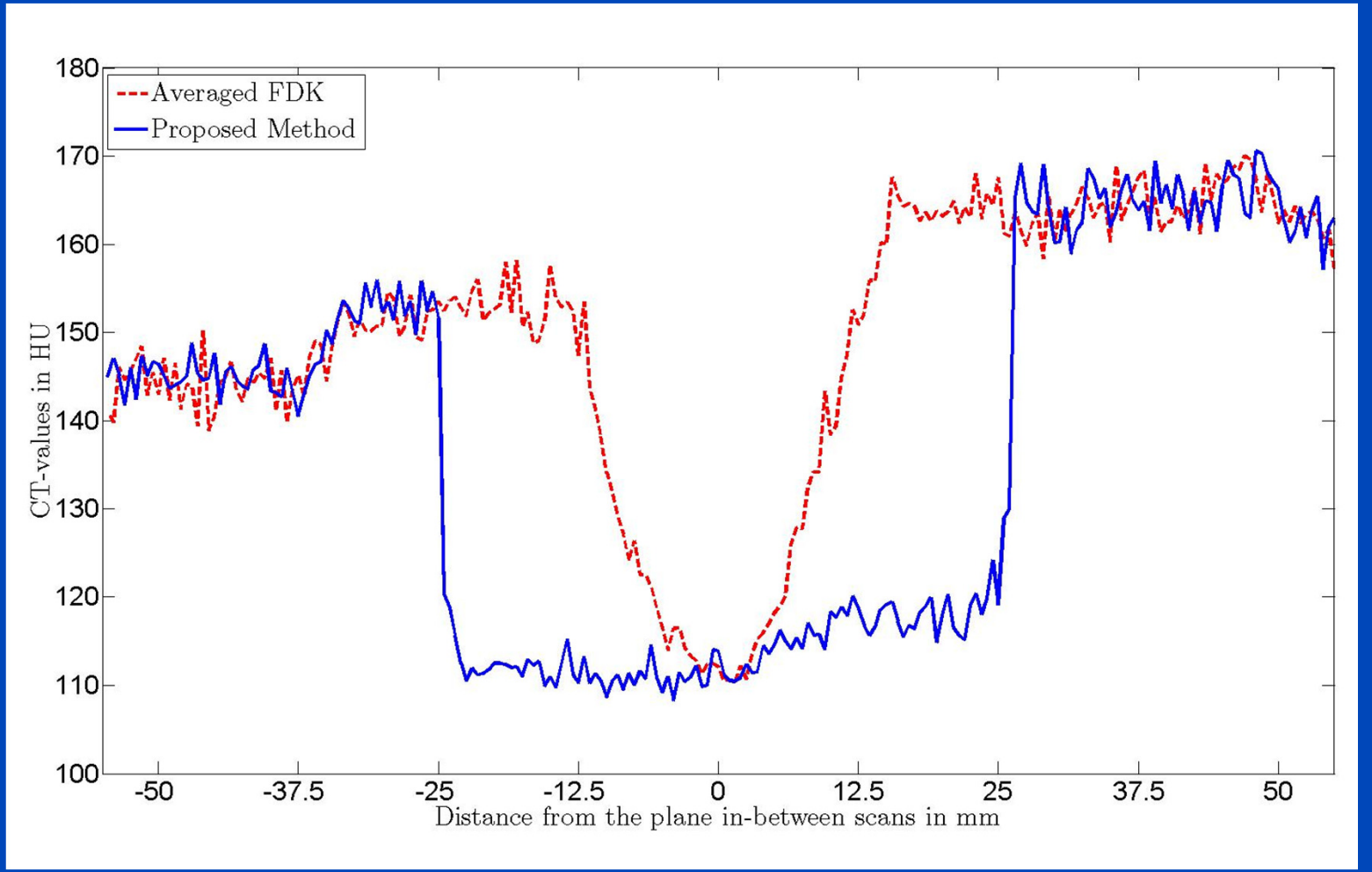
Image Noise in the Overlap Region

Varian OBI Scanner



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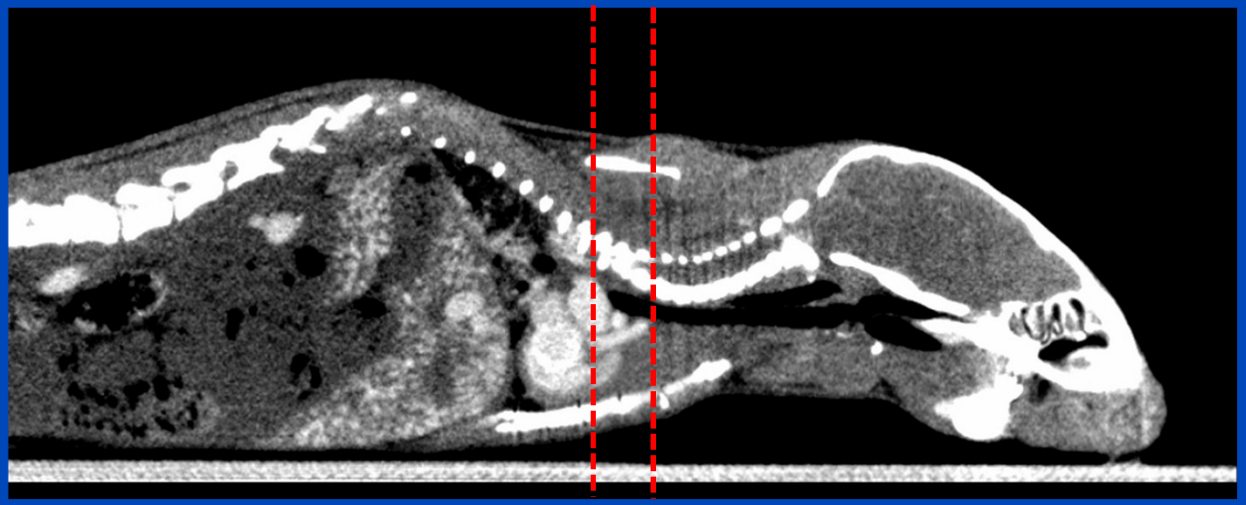
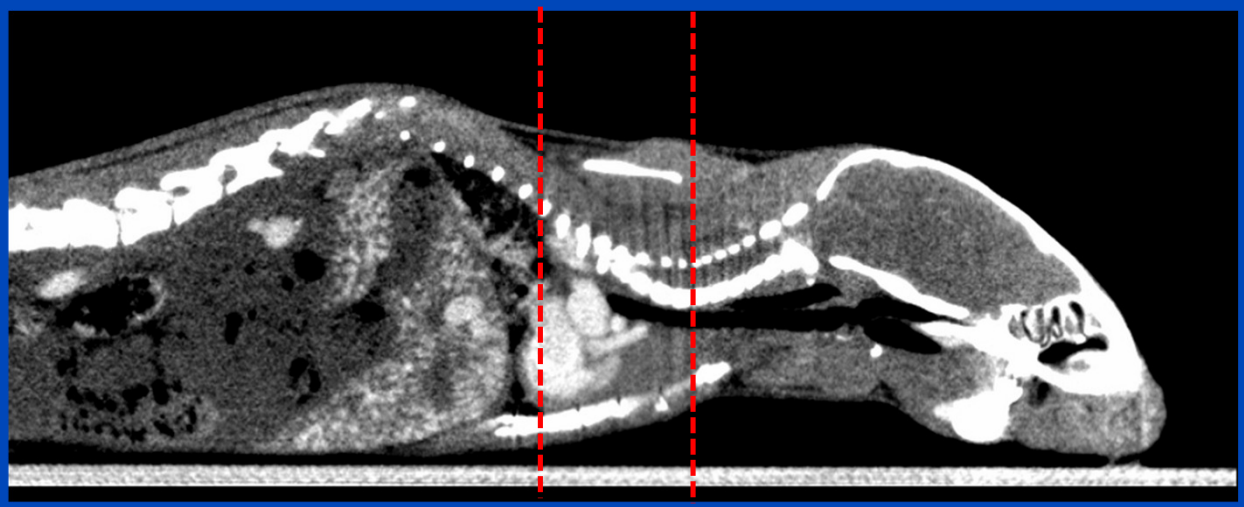
Measurement Study

CTI TomoScope Scanner

Averaged FDK:



Proposed Method:



C = 0; W = 500 HU

dkfz.

Conclusions on xsfFDK

- The extended sequence frequency-combined FDK algorithm provides
  - improved image quality in overlap regions
    - » reduced cone-beam artifacts
    - » reduced noise/dose
  - maintained image quality in non-overlapping regions
- The xsfFDK technique can be used to increase the scan length in sequential CT without increasing the dose.

Thank You!

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