Fast Enhanced CT Metal Artifact Reduction using Data Domain Deep Learning
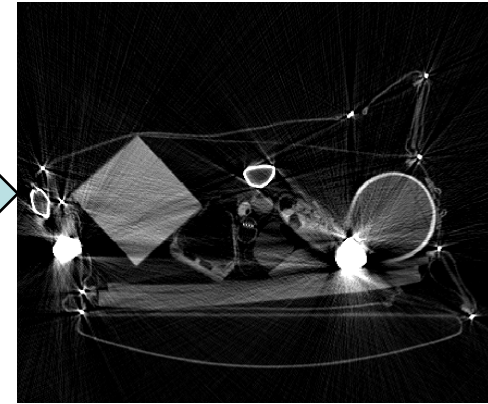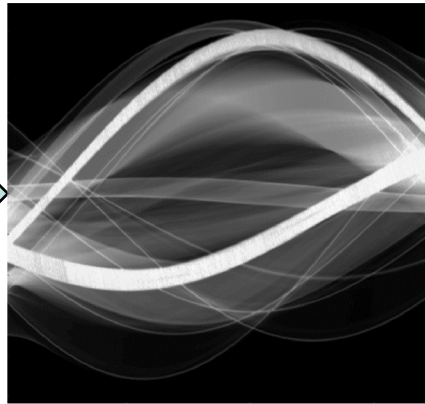
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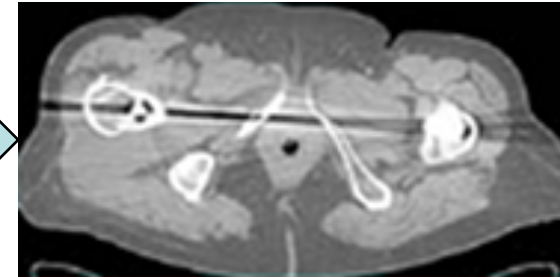Boston University

W. Clem Karl
Boston University

BOSTON
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Applications with Metal Artifacts
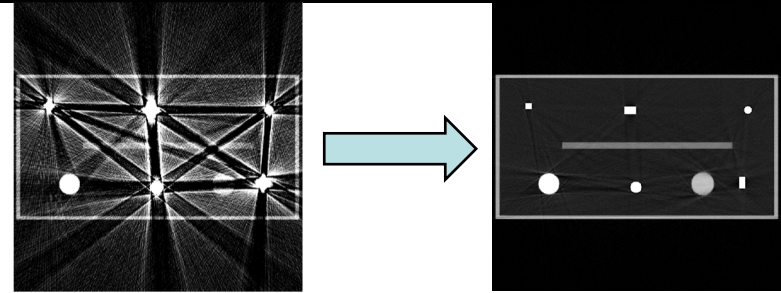
- ■ **Security**

Sinogram

- ■ **Medical Imaging**

Sinogram
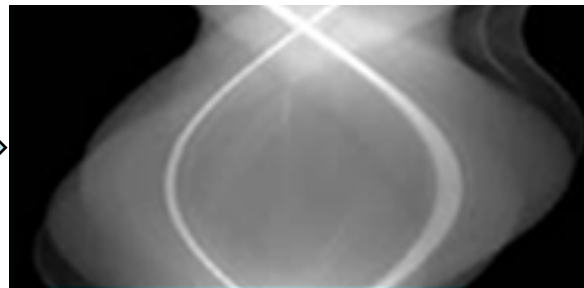
Esther Meyer, Rainer Raupach, Michael Lell, Bernhard Schmidt, and Marc Kachelrieß. Normalized metal artifact reduction (nmar) in computed tomography. Medical physics, 37(10):5482–5493, 2010.

CT Metal Artifact Reduction

- **Motivation**
  - Improve detection in X-ray CT-based scanners by reducing metal artifacts
  - Iterative reconstruction can reduce artifacts and improve detection
    - Problem: iterative reconstruction is slow, priors can be generic, brittle

- **Solution**
  - Use Deep Learning for CT reconstruction
  - Focus on **pre-reconstruction** correction of metal artifacts in X-ray CT data
  - Focus on a fast method within a standard workflow
  - Explore use of synthetic training data

New Approach: *Deep*-MAR

- ## Key points:

  - ### **Sinogram-focus**

  - Learn **complete** sinogram behavior

  - Use <u>fully convolutional network</u> (FCN) for efficiency

  - Use <u>cGAN</u> for good performance

  - ### **Synthetic data training**, coupled with real data tuning

- ## Remove problems rather than post-hoc correction

FBP

Original Sinogram

Metal Segmentation

Metal Image

Forward Project

Metal Sinogram

Incomplete Data (x)

Data Deletion

Trained Generator Network (G)

Metal Insertion

Final Corrected Image

Reconstruction without Metals

FBP

Completed Sinogram $G(x)$