Real-time Image Denoising of Fluoroscopy Images for Dose Reduction

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Analysis of Shapes and High Dimensional Data

- X-ray fluoroscopy is the continuous “video” capture of X-ray radiography to image in vivo moving anatomy
- Modern fluoroscopes consist of an X-ray source, an X-ray intensifier, and a CCD camera to allow these videos to be displayed on monitors
- Because fluoroscopy emits X-rays continuously, patients receive a high level of ionizing radiation dose
- The reduction of the radiation intensity leads to noisy (and often unacceptable) images
- Minimizing the delivered dose would greatly enhance the utility of X-ray fluoroscopy and reduce risk in existing applications
- Using advanced image processing algorithms, we are able to reduce the noise of these low-dose images

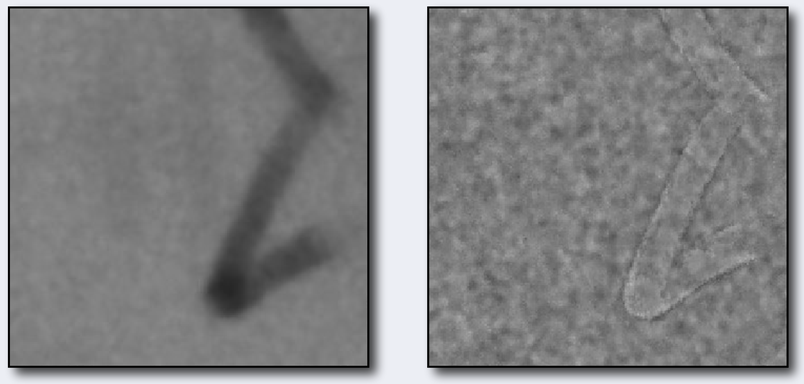
GE OEC 9900 Elite Carm Fluoroscope

Spatiotemporal UINTA

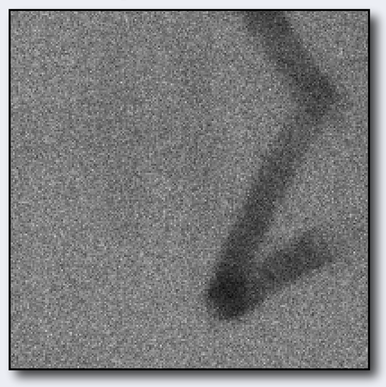
The proposed algorithm denoises the image by searching for similar patches in the image. At each pixel of the noisy image, the surrounding patch is compared to nearby patches in space and back in time. The denoised pixel is a weighted average based on similar surrounding patches.

Denoising Strategy Currently Used by GE Healthcare

- **Bilateral filtering** (denoised image and residual)

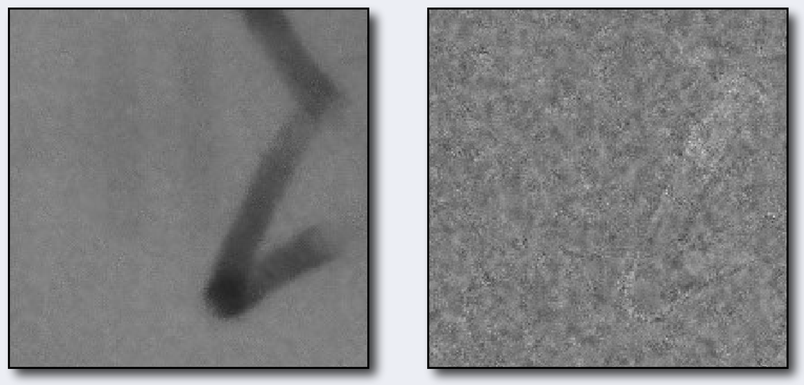


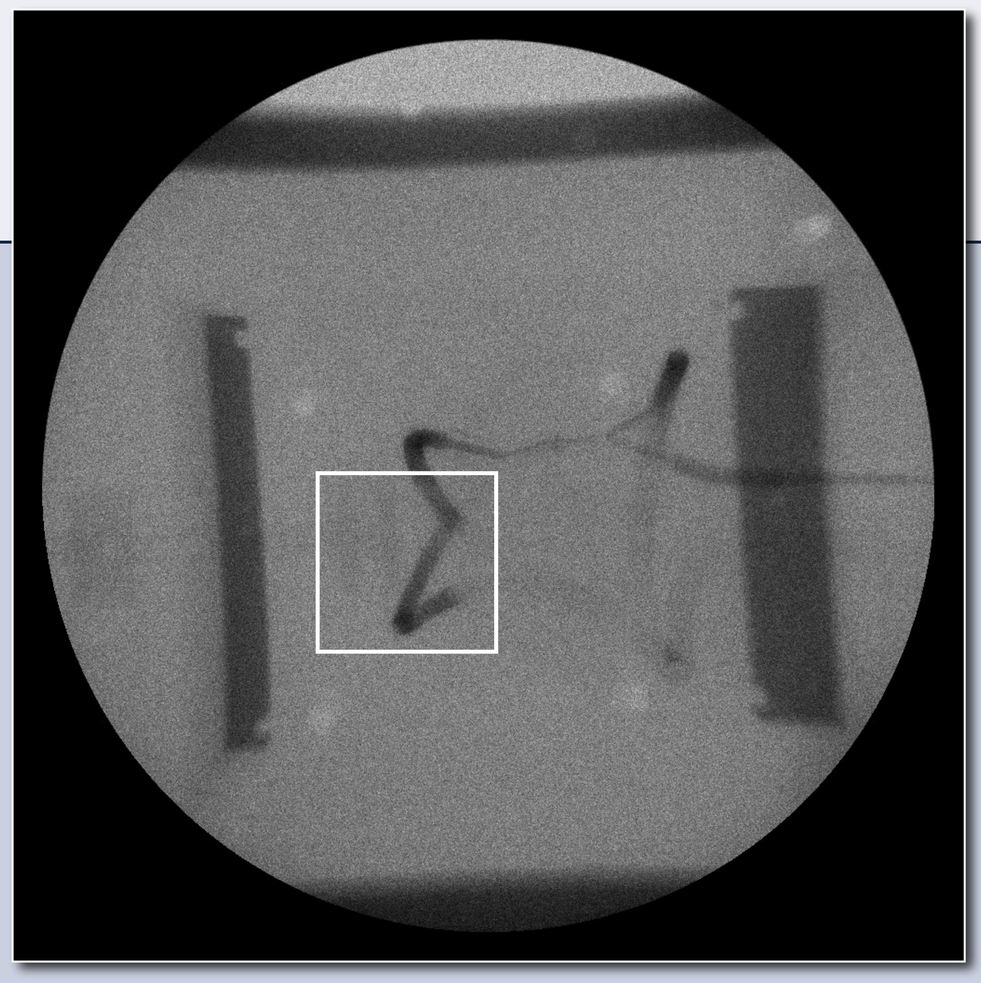
- **Noisy data**



Proposed Denoising Strategy

- **UINTA** (denoised image and residual)





Phantom Dataset with Poisson Noise

GPU Implementation

- Denoising algorithms are computationally intensive and are impractical to run in real-time on a CPU
- These algorithms are very parallelizable and are implemented much more efficiently on a GPU

Conclusion

- UINTA preserves edges and detail much better than bilateral filtering
- The UINTA algorithm is more complex than bilateral filtering and may not be immediately feasible on current hardware. However, as GPU performance keeps improving, this will be feasible in 2-3 years.

[1] Awate, S. P., and Whitaker, R. T. Unsupervised, information-theoretic, adaptive image filtering for image restoration. IEEE TRANS. PAMI 28, 3 (2006), 364-376.