TomoGAN: Low-Dose X-Ray Tomography with Generative Adversarial Networks
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Summary: Synchrotron-based X-ray tomography is a noninvasive imaging technique that allows for reconstructing the internal structure of materials at high spatial resolutions. Only limited X-ray is allowed for in situ or dose-sensitive experiments to avoid sample damage or capture relevant dynamic phenomena. These low X-ray dose imaging conditions yield noisy measurements that significantly impact the quality of the resulting reconstructions. We present TomoGAN, a denoising technique based on GAN, for low-dose imaging conditions. TomoGAN has been evaluated in two photon-budget-limited experimental conditions: (1) sufficient number of low-dose projections (based on Nyquist sampling), and (2) insufficient number of high-dose projections. Evaluation with both simulated and experimental datasets shows that TomoGAN can reduce noise in reconstructed images significantly. Furthermore, the quality of the reconstructed images with filtered back projection followed by TomoGAN exceeds that of reconstructions with the simultaneous iterative reconstruction technique, showing the computational superiority of our approach.

1. The problem

2. The proposed solution

3. Experiment results

4. One more successful case

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