Faster X-ray computed tomography in real-world dynamic applications

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Stellingen

Behorende bij het proefschrift

Faster X-Ray Computed Tomography in Real-world Dynamic Applications

1. A triple X-ray source-detector set-up, combined with the constrained Simultaneous Iterative Reconstruction Technique, allows for a unique time-resolved fully-3D reconstruction of dynamics inside gas-solids fluidized beds (Chapter 2).
2. Small neural networks can be trained concurrently with dynamic tomographic experiments, allowing real-time image analysis of on-the-fly quasi-3D reconstructed images (Chapter 3).
3. Flexibility in GPU-accelerated implementations of X-ray forward and backprojectors enables algorithms with reduced memory consumption and improved computational efficiency (Chapter 4).
4. The performance of blind-spot denoisers on X-ray radiographs with correlated noise can—under additional assumptions—be recovered via a deconvolution with an empirically-estimated point-response function (Chapter 5).
5. Self-supervised denoising of radiographs, applied as a preprocessing step before algebraic reconstruction, can outperform denoising in reconstruction space, for example in sparse-view cone-beam CT imaging.
6. State-of-the-art deep-learning-based CT reconstruction methods that rely on both forward and backprojector operators are still computationally infeasible for practical 3D cone-beam and spatio-temporal imaging contexts.
7. Advancing research in real-time tomographic reconstruction, either requires dedicated scientific software developers or greater scientific recognition for software development.
8. In practice, the accuracy of reconstructions obtained from scientific X-ray set-ups depends critically on the preprocessing steps taken, as well as the calibrations of the geometry and detector model.
9. Training a neural network on four RTX A4000s, for the duration of one week, emits roughly 40 kilograms of carbondioxide (source: *ML CO_2 Impact*), comparable to burning 18 liters of E10 gasoline. Our environmental impact should be more carefully considered in our computational workflows.

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