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Advancing learned algorithms for 2D X-ray computed tomography

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Citation

Kiss, M. B. (2025, November 7). *Advancing learned algorithms for 2D X-ray computed tomography*. Retrieved from <https://hdl.handle.net/1887/4282439>

Version: Publisher's Version

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Note: To cite this publication please use the final published version (if applicable).

Stellingen

Stellingen behorend bij het proefschrift getiteld **Advancing learned algorithms for 2D X-ray computed tomography**, door Maximilian B. Kiss.

1. To obtain significant information and useful insights from CT scans it is important to tailor the CT acquisition to the characteristics of the samples being scanned (Chapter 3).
2. Matching 2D CT scans with different acquisition settings of a diverse mix of samples enables the application of a variety of deep learning methods (Chapter 4).
3. Learned denoisers trained on pairs of simulated noisy projection data and clean reconstructions perform worse than the ones trained on experimental noisy projection data when reconstructing real-world noisy data of the 2DeteCT dataset (Chapter 5).
4. Setting up standardized CT experiments is essential for benchmarking machine learning methods reproducibly (Chapter 6).
5. The challenges imposed by the key characteristics of cultural heritage objects, i.e. multi-scale features, varying sizes and shapes of objects, and their multi-material nature can be overcome through object-tailored CT scans.
6. Realistic experimental imaging datasets and corresponding reconstruction challenges facilitate the development and training of state-of-the-art machine learning algorithms.
7. Despite decades of research on the statistical phenomena and simulation in X-ray CT measurements accurate noise models of low-dose CT scans remain an open challenge and require further validation using real-world experimental measurements.
8. Beam hardening correction algorithms based on e.g. single-material or multi-material linearization, a dual-energy approach, or iterative reconstruction, are usually developed and tested on simulated datasets. This can now be expanded to deep learning methods based on real-world experimental data (2DeteCT) and physical beam-hardening correction.
9. Data and code sharing as well as interdisciplinary collaborations are the hallmarks for outstanding academic research.
10. PhD students should be encouraged to develop agency and a hands-on mentality for their PhD project, to learn practical project management skills, as well as to receive coaching for effective (science) communication.
11. The Pareto Principle and a thorough understanding of the Circle of Concern, the Circle of Influence, and the Circle of Control, are important concepts to develop serenity, courage, and maybe even wisdom throughout your PhD studies.

Maximilian B. Kiss,
Leiden, 7 November 2025.