Automatic and efficient tomographic reconstruction algorithms

Lagerwerf, M.J.

Stellingen

Stellingen behorend bij het proefschrift: "Efficient and Automatic Tomographic Reconstruction Algorithms".

1. Without a proper strategy for picking the parameters of a tomographic reconstruction method any reconstruction method becomes a trial-and-error method.
   Hoofdstukken 2 en 3 van dit proefschrift.

2. Incorporating knowledge of tomographic reconstruction into machine learning methods results in improved data- and running time efficiency compared to standard machine learning methods.
   Hoofdstukken 4 en 5 van dit proefschrift.

3. Computational efficiency and scalability should be a major consideration when developing developing new methods in CT imaging, even for offline computations.
   Hoofdstukken 4 en 5 van dit proefschrift.

4. Developing data-driven methods that do not rely on high-quality reference data is crucial for the development of new tomographic techniques and applications.
   Hoofdstuk 5 van dit proefschrift.

5. Even though metrics such as the peak-signal-to-noise-ratio, or the structural similarity index proposed by Wang et al. are commonly used to describe the quality of a reconstruction, they will never fully replace visual inspection of a reconstruction.
   'Image quality assessment: from error visibility to structural similarity', IEEE transactions on image processing, **13**, 600, (2004).

6. Network architectures that require a limited number of trainable parameters and architecture choices to be effective, such as such as the mixed-scale dense networks proposed by Pelt et al., are easier to use and understand and will therefore be more useful in the long run.
   'Improving tomographic reconstruction from limited data using mixed-scale dense convolutional neural networks', Journal of Imaging, **4**, 128, (2018)

7. Theoretical frameworks that do not fully describe the deep neural networks used in practice, such as the one proposed by Ye et al, can still be highly useful for understanding the full potential of machine learning methods. *'Deep convolutional framelets: A general deep learning framework for inverse problems.'*, SIAM Journal on Imaging Sciences, **11**, 991, (2018).

8. Although work such as Wu et al. shows that the memory requirements for 3D network architectures can be circumvented by 3D patch learning, it also shows us that such strategies are far from applicable to high resolution problems.

   'Computationally efficient deep neural network for computed tomography image reconstruction', Medical Physics, **46**, 4763, (2019).

9. Implementing existing models for new applications is a key part of transferring cutting edge research into daily life and therefore deserves more recognition as scientific output.

10. Mathematics can be applied in many casual situations, ranging from board game nights to your daily workout.

Marinus Jan Lagerwerf,
Leiden, DD-MM-YY.