On the optimization of imaging pipelines

Schoonhoven, R.A.

Stellingen

Stellingen behorend bij het proefschrift *On the optimization of imaging pipelines*.

1. Achieving real-time tomographic imaging requires concerted efforts across conceptual design, software development, and hardware usage (Chapter 2).

2. By leveraging modern auto-differentiation software, it is possible to enhance the quality of images produced by existing imaging pipelines (Chapter 3).

3. In practice, neural network pruning is a strong tool for reducing memory consumption and computation time during inference (Chapter 4).

4. Auto-tuners coupled with a diverse range of optimization algorithms can greatly increase the computational efficiency of GPU applications, and their adoption could be more widespread (Chapter 5).

5. Most scientific software running on GPUs can run with increased energy efficiency with an acceptable increase in runtime (Chapter 6).

6. Integrating classical algorithms with modern auto-differentiation software offers a potentially powerful alternative to exclusively deep learning-based methods. This integration particularly excels in interpretability, and typically imposes more constraints than deep learning methods, reducing the probability of generating implausible solutions, often referred to as "hallucinations".

7. Reformulating scientific problems in a different mathematical domain, such as graph theory, can be a powerful approach and exposes the use of existing knowledge in that field.

8. Neural network pruning is insufficiently supported by popular auto-differentiation packages when it comes to offering practical improvements in computation time and memory footprint.

9. By default computer hardware operates at maximum computational performance, which is excessive for most applications.

10. Similar to the "eco-mode" found in modern cars, manufactures of computer hardware should be required to offer an easily accessible energy efficient mode, which should be enabled by default.

Richard A. Schoonhoven,
Leiden, 11 juni, 2024.