

## Review of Master's Thesis

**Student:** Nedeljković Sava, Bc.  
**Title:** Acceleration of Photoacoustic Imaging (id 21922)  
**Reviewer:** Bordovský Gabriel, Ing., DCSY FIT BUT

- 1. Assignment complexity** **average assignment**

The assignment requires an understanding of imaging techniques, primarily a back-projection, and familiarity with parallel computing on GPU accelerated supercomputers. The goal is to design and implement algorithms for imaging in 2 and 3 dimensions and a set of benchmarks to evaluate the quality of produced images as well as computational performance and memory consumption of provided solutions.
- 2. Completeness of assignment requirements** **assignment fulfilled only partially with serious reservations**

3. Design an algorithm for photoacoustic back projection in 2 and 3 dimensions aiming for high performance and efficiency.

The provided solution can produce only 2-dimensional image reconstruction. Three-dimensional reconstruction is missing.

5. Create a set of benchmark tasks to evaluate the quality of reconstructed images, computational performance and memory consumption.

No benchmarks have been provided.
- 3. Length of technical report** **shorter than minimum requirements**

The length of the technical report is less than a half of the required minimum.
- 4. Presentation level of technical report** **5 p. (F)**

The report is not finished. The proposed structure is adequate, but chapters are half-empty at their best. The chapters concerning the implementation and the results that are expected to cover majority of the technical report are just about a page long.

Two possible approaches to the back-projection are proposed in the Section 3.3; from the sensors' and the pixels' perspective respectively. It is not clear further in the text (for example in the Chapter 6) which of those versions was examined.
- 5. Formal aspects of technical report** **45 p. (F)**

The text of the technical report is written in English, and even though it is short, it's well written and comprehensive. The extended Czech abstract on the other hand uses cumbersome sentences and should've been revised by someone with a better knowledge of the Czech language.

The typographical side of the technical report could've been improved. The report contains pages with nothing than centered images and short descriptions resulting in large areas of unused space. Those images should've been better composed into the text. The descriptions of the produced images lack necessary details (e. g. in the Figure 6.3 and 6.4).
- 6. Literature usage** **90 p. (A)**

The referenced work is well cited and the amount of referenced literature is sufficient.
- 7. Implementation results** **10 p. (F)**

Documentation of the implemented solutions is practically missing from the report. The source code is reasonably formatted and well commented. Provided README.txt file covers pieces of information necessary to build and run the provided implementation.

The author has presented some test results regarding three code versions (CPU vector parallel, CPU thread & vector parallel and GPU vectorized), but information about the setup including the used hardware, algorithm and its parameters (i.e. number of CPU/GPU threads) is not present. A study looking for a suitable configuration is missing (strong scaling analysis).

**8. Utilizability of results**

Since the results are not documented properly they are of no value.

**9. Questions for defence**

- Which version of the proposed back-projection approaches has been used for the testing and what hardware was used for the testing?

- Images in the technical report are reconstructed using a grid of a size of  $1024^2$  grid points. What are the memory requirements for such reconstruction? Can you approximate the requirements for a 3D version of the used algorithm with a similar spatial resolution ( $1024^3$ )?

**10. Total assessment**

**25 p. failed (F)**

Both the technical report and the provided implementation seem to be unfinished. The length and content of the technical report do not match expectations for a master thesis. The solution does not cover back-projection of three-dimensional pictures and the set of benchmarks given in the assignment. The performance of the provided two-dimensional implementation is not properly examined.

Due to these shortcomings, I can not recommend a passing grade.

In Brno 26 June 2020

Bordovský Gabriel, Ing.  
reviewer