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Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Ilias Giannakopoulos

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Memory compression of the Galerkin volume integral equations and coil modeling for the electrical property mapping of biological tissue

Supervisor: Prof. Maxim Fedorov

Date of Thesis Defense: 12 May 2020

Name of the Reviewer: Maxim Panov, Assistant Professor, CDISE, Skoltech

I confirm the absence of any conflict of interest.	**Signature:**  **Date: 22-04-2020**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

The considered thesis targets the important area of developing computationally efficient methods for solution of integral equations with applications to MRI. Overall the thesis is very well-written. However, I find that while the amazing work was done on covering the necessary basics on physics and computational math, the structure can be improved by explicitly highlighting parts which constitute author's personal contribution. Currently, it is relatively hard to distinguish between existing developments, own experiments with standard methods and actually novel results. It doesn't diminish the significance of the main results on speeding-up solving integral equations with tensor decompositions and modern computational architectures.

The thesis topic is very relevant as it targets the important area of biomedical engineering and the results are very practical. The content well corresponds to the title, in particular Chapter 4 summarizes some most important results on memory compression. I appreciate usage modern and efficient methods for the tensor decomposition such as Tucker and CP decompositions. They are very natural solution for the considered problem. Also, the usage of GPUs for speeding up the computations is an essential part of the developed approaches and highlights the nice interplay of this research between computational techniques and their parallelization on modern hardware.

Finally, the results of the thesis research are important both from the perspective of the computational science and for the considered applications in MRI diagnostics. The publications summarizing the results were published in the well-reputed journals and conference proceedings including 2 publications in Q1 journals. Thus, the quality of the publications well supports the overall good scientific quality of Ilias's thesis research.

While I have overall positive opinion about the research contents of the thesis I think that the text deserves some improvement. The list of suggestions which should be incorporated in the final version of the manuscript:

1. The Section 2.2.2 is slightly sloppy in terms of mathematics, confusing functions and distances, not defining the objects, …
2. Some of the figures have low resolution, for example figures 3.3? 3.7-3.10. It would be great if it is improved. The best way is to do vectorized pictures where possible.
3. [page 22] Equations 2.20 and 2.22 duplicate each other, only one should be left.
4. [Section 4.1.2] The accuracy epsilon depends on the rank r. From the text one may deduce that for any r arbitrary epsilon can be achieved.
5. Misprint in the title of Section 4.3.

To sum up, I think that the issues found do not decrease the scientific quality of the thesis and Ilias Giannakopoulos deserves to be awarded with Skoltech PhD degree.

Provisional Recommendation

[X] *I recommend that the candidate should defend the thesis by means of a formal thesis defense*

[ ] *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*

☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*