Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Evgenii Baraboshkin

PhD Program: Petroleum Engineering

Title of Thesis: Automated core description based on computer analysis

Supervisor: Professor Dmitry Koroteev
Co-supervisor: Dr. Denis Orlov

Name of the Reviewer: Mohammad Ebadi

I confirm the absence of any conflict of interest ~~(Alternatively, Reviewer can formulate a possible conflict)~~	**Date: 14-12-2022**

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

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

I reviewed with interest the thesis by Mr Baraboshkin on use of computer vision and deep learning to develop an automated core description paradigm for consideration of a doctoral degree at Skoltech. Core descriptions and analyses based on imaging technologies and artificial intelligence are among areas of my research interests. The candidate has indicated the robustness of computer vision methods for carefully formulation of a time-consuming problem related to hydrocarbon reservoir engineering and fluid flow in porous media.

Overall, I was impressed with the work, and I appreciate that several outstanding papers published in high impact journals. Reviewing this thesis was also an opportunity for me to learn more about the exciting research in the field of employing deep learning methods in core analyses.

Below, I outline my minor comments. Considering them might be useful to improve the quality of the thesis. I believe the thesis is an original contribution to the field, and it would meet the requirements for the degree of Doctor of Philosophy.

Chapter 1:

The problem statement has been made by the applicant very clearly. The core description is one of the vital steps in building a representative static model for the next simulation steps. Regarding the literature review, the Ph.D. applicant has focused on image-based rock texture classification. He has provided an enriched literature review. I believe that the quality of the undertaken research can be improved to even higher levels if the author presents a high-level figure showing the current state of using computer vision in his favorite field of research. The diagram can be inserted in section 1.2 and before going to part 1.2.1. The supposed diagram can immediately deliver a broad overview of the topic the interested readers.

Chapter 2:

The PCA which is normally used for dimensionality reduction has been used for the feature extraction. Has the applicant used other transformers like Fourier's series?

Chapter 3:

I believe that it would be better to add more descriptions to Figure 8.

Section 3.4.2: Does the proposed framework apply the changes randomly? or it needs a pattern (template). It might be useful to show how it works in terms of a diagram.

Chapter 4:

Figure 22: What is the main difference between PCA+SVM vs. SVM

Figure 28: I could not understand what you mean. It might be better to add more description.

Chapter 5:

Figure 49: I could not figure out which CNN structure has been used.

Chapter 6:

Does "Deep Core" provide as a real-time service? Install a camera and and have a stream of images and have the feedback instantaneously.

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Provisional Recommendation

☒ *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*