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Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Nikita Klyuchnikov

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Multi-fidelity classification and active search

Supervisor: Associate Professor Evgeny Burnaev

Name of the Reviewer: Dmitry Yarotsky

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Signature:**  **Date: 23-01-2021**

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

The overarching topic of the thesis is predictive modeling with multi-fidelity data. The thesis contains three parts. The first part describes a new approach to classification, using low- and high-fidelity training data and a co-kriging model. The second part describes a new multi-fidelity active search algorithm. The third part describes several specific industrial problems (mostly geology- and drilling-related) that involve multi-fidelity data. Solutions of these problems use, in particular, the algorithms developed in the first two parts. The three parts are closely connected by the idea of multi-fidelity learning. The structure of the thesis is quite reasonable, and the topic perfectly matches the actual content.

The results described in the thesis are new and were published in 7 journal and conference papers co-authored by the author. Most of the content of the thesis was published in three papers that appeared at top international venues (A* conferences or Q1 journal) and listed N. Klyuchnikov as the first author. Accordingly, the results have a high scientific significance, and the personal contribution of N. Klyuchnikov to these results is presumably also quite high.

The thesis is sufficiently diverse in that it includes both theoretical and applications-oriented components. Analytic derivations and algorithms in chapters 2 and 3 are accompanied by many numerical experiments, and comparisons with multiple competitive state-of-the-art methods are provided. The analysis of the drilling problems in chapter 4 seems to be quite relevant to industrial needs.

On the whole, the thesis is well-written, though there are a few places where I found it hard to follow. In particular, I have found section 2.2.3 to be rather confusing (oddly enough, even some objects appearing in this section, e.g., the matrices W, A, D and the function \zeta, are discussed or used in computations one or two pages before they are actually defined). It appears that the compilation of the thesis from the research papers was a bit sloppy. This does not, however, prevent the reader from understanding the general logic and the key ideas.

It is stated in chapter 5 that “the method MF-ASC has recently been integrated into Vega (cite) library for Neural Architecture Search”, but I couldn't find this method among the algorithms of this library.

Summarizing, though the thesis has some small issues, I assess it on the whole as a good work reflecting a sufficiently significant scientific contribution of the author.

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*