Skoltech
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Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Saeed Osat

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Percolation on complex networks and its applications

Supervisor: Assistant Professor Vladimir Palyulin

Name of the Reviewer:

I confirm the absence of any conflict of interest	 **Date: 27-09-2021**

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

Saeed's thesis is devoted to the percolation on complex networks and its applications. In particular, he starts from studying different types of percolation for monoplex networks and then generalizes the results to the case of multiplex networks. Special attention is paid to community structure in networks and its relation to hyperbolic embeddings.

The thesis is well written and follows the conventional structure: introduction, series of chapters devoted to methodology accompanied with experimental results, and conclusions. The main content is concentrated in the following chapters with their titles well corresponding to the content: emergence of power laws in noncritical neuronal systems, generalization of core percolation on complex networks, observability transition in multiplex networks, optimal percolation on multiplex networks and k-core structure of real multiplex networks. Each of these five chapters is followed by a discussion on the presented results. From the complex networks perspective, relevant methods are used.

The results were published in the high-impact journals and do contribute to the state of the art. In fact, the quality of publications is extraordinary and well confirms the quality of the work. Developed theory of percolation may be used in a wide range of applications.

Saeed is a first author of the paper "Optimal percolation on multiplex networks", which was published in the Nature Communications, a Nature Index high-impact journal. He is second author in another Nature indexed paper "Characterizing the analogy between hyperbolic embedding and community structure of complex networks" published in PRL, which demonstrates the recognition on the international level.

I have positive opinion about the research contents of the thesis but I think that the text deserves some improvements (see issues below). To sum up, I think that the issues found do not decrease the scientific quality of the thesis and Saeed Osat deserves to be awarded with Skoltech PhD degree.

The list of minor issues:

1. [list of publications] List of publications should contain full bibliographic references including pages. Currently it sometimes contains strange numeric codes instead of pages.
2. [sub-subsections numbers] Currently the text contains (very) many sub-subsections. I think that numbering them will slightly improve the experience of interacting with the text.
3. [Notations] Please, make sure that all the notations are introduced. For example, one can guess that <> is for averaging but anyway it should be introduced as this notation is not uniformly used across sciences.

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*