Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Aleksei Shcherbak

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Diagnosis of the human neurological movement disorders based on the analysis of heterogeneous data using ML methods

Supervisor: Associate Professor Andrey Somov

Name of the Reviewer: Pavel Osinenko

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	 **Date: 03-11-2024**

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 PhD thesis by Aleksei Shcherbak explores the application of machine learning (ML) for diagnosing neurological disorders such as Parkinson's disease and essential tremor. The study focuses on differential diagnosis, which is challenging due to symptom overlap and the absence of definitive biomarkers. The research develops a comprehensive ML-based framework to address this problem, employing a unique experimental setup with synchronized wearable sensors and video data. The thesis includes the design of 11 exercises in collaboration with neurologists. Using the developed Wait-n-Sync method for Bluetooth-based synchronization, the study collected data from over 100 patients. The work introduced innovative data fusion techniques, such as the STFT-based analysis for tremor detection, achieving good diagnostic metrics, including an F1 score of 0.96 for PD detection. The thesis is well structured and is convenient for the reader. The content of the work and its topic are well synchronized. The methods are appropriate for the studied problem. I should stress that detecting Parkinson's disease and essential tremors is a task worth highest appreciation in my subjective view. The results of thesis work are backed by a solid publication track record, as highlighted in the manuscript. Whereas full medical approval of the methodologies developed by Aleksei is challenging, I do believe that they bear a great potential of integration into medical practices in future.

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*