Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Oleg Khamisov

PhD Program: Engineering systems

Title of Thesis: Optimization of Frequency Control in Power Systems

Supervisor: Assistant prof. Anatoly Dymarsky

Co-advisor: Prof. Janusz Bialek

Date of Thesis Defense:

Name of the Reviewer: Antonio Cammi

I confirm the absence of any conflict of interest	**Signature:**  **Date: 02-03-2020**

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

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 thesis work focuses on the following control aspects of power systems: frequency control and congestion management. These problems are analyzed by means of two different approaches: theoretical and numerical.

The thesis includes sixteen chapters. Chapters 1-3 give an introduction to the problems of frequency control and congestion management in power systems and a discussion on currently implemented solutions, the possibilities of improvement, the goals of the work, the research methodology and the scientific novelty. In addition, a detailed comparison with literature and the novelties of the present work are pointed out. Chapter 4 includes a general description of the thesis structure while chapter 5 introduces notations. Chapters 6-7 include a detailed description of the frequency control and congestion management. Chapter 8 on "Preliminaries of stability theory" describes the concepts, theorems and main results provided by stability theory and used in this work. In Chapter 9, the development of a power system network model is presented (the limits of this model for analytical predictions and numerical simulations are correctly underlined). Chapters 10-14 focus on the control problem. Here, seven problems are discussed and analyzed (three of them are dedicated to the centralized control and are dedicated on the derivation of the control approach; the last four problems are more related to the control properties, in particular on distributed communication, congestion management and inter-area flows control. Finally, several simulations are presented and benchmarks using classical and developed approaches are discussed.

The last part of the work gives the “Conclusion & Perpectives" with an overview of the findings of the project and with a clear strategy for the continuation of the research activities.

The thesis is logically constructed and reflects the ability of the candidate to properly use analytical models, numerical models and to perform numerical simulations. The methodological approach described is very interesting and promising. The description of results is appropriate, with a very good degree of investigation on the physical mechanism and constraints affecting them. The conclusions, easy to follow and understandable, confirm that the objective of the work was successfully reached and future developments have been highlighted. Last but not the least, the candidate is author/coauthor of six papers published in international journals and seven works presented in international conferences.

There are no fundamental weaknesses which may need further attention.

Summarizing:

This thesis is well written in a clear and concise manner and is very well documented.

The necessary introductions are given to make the thesis self-contained.

The explanations are suitable and focus on the relevant parts.

The figures, schemes, results and tables are shown properly as well.

The hypothesis and arguments are well formulated and with interesting conclusions.

The numbers and quality of publications are is excellent for a PhD candidate.

In conclusion, the author of this dissertation thesis has produced a very good quality results, demonstrating a strong ability in analyzing problems and proposing solutions.

The thesis meets the standard requirements for a dissertation and the reviewer authorizes the thesis defense.

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*