Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Mile Mitrovic

PhD Program: Engineering Systems

Title of Thesis: Data-driven stochastic AC-OPF using Gaussian processes

Supervisor: Assistant Professor Elena Gryazina
Co-supervisor: Assistant Professor Petr Vorobev

Name of the Reviewer:

I confirm the absence of any conflict of interest Alexander Nazin	**Date: 19-08-1951**

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 by Mile Mitrovic is dedicated to application of Gaussian process regression for solving a problem of chance-constraint optimal power flow problem (CC-OPF). Optimal power flow problem is a classical problem of power systems, and was historically solved using deterministic methods. Recent increase in the penetration of renewable energy sources brings a lot of uncertainty to the problem. Approaches, that are based on considering of different scenarios are both computationally challenging and not accurate enough. On the other hand, approaches based on chance-constraint optimization, are more systematic, but require development of new analytic tools. The thesis is dedicated to one of such approaches, that uses Gaussian process regression in order to approximate non-linear power flow equations, which allows to incorporate the probabilistic constraints in a natural way.

The thesis is well structured and easy to follow. It provides a comprehensive overview of optimal power flow problem, highlighting the difficulties associated with uncertainties. A brief review of the mathematical method of Gaussian process regression is then given, which makes the thesis self-contained. The main section then presents the application of Gaussian process regression to CC-OPF problem, which is supplemented by extensive numerical validations on a number of test-cases.

In my opinion, the problem formulation is well explained, methods of solution are appropriate and the results are practically relevant, so the work definitely corresponds to the standards of a PhD thesis. The level of the thesis results is confirmed by journal and conference publications.

I have some technical comments in the form of questions to the applicant, which are optional but could help to improve the thesis.

1. How big is the typical range of uncertainties in the CC-OPF problem?

2. How well is your assumption about log-normal distribution for power fluctuations justified?

3. Does your method suffer from the “curse of dimensionality” with the increase in the grid size?

4. Are there instances when scenario-based approach is better than your method?

5. How would you find the level of uncertainty for real-life power grids?

Alexander Nazin

Provisional Recommendation

☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*