

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: Henni Ouerdane, Associate Professor

I confirm the absence of any conflict of interest

(Alternatively, Reviewer can formulate a possible conflict)

Date: 06-10-2023

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 doctoral thesis manuscript is composed of 7 chapters, including the Introduction and the Conclusion. Interestingly, for clarity, the candidate has split the manuscript from Chapter 2 to Chapter 6 into two main parts: Part I – Background theory and state of the art over Chapters 2 and 3; and Part II – Contributions over Chapter 4, 5, and 6, the last one being dedicated to the software developed and used as part of the research works.

While overall the thesis manuscript is well-balanced, the Conclusion is quite short and rather looks like an abstract or a simple recap. In fact, while some limitations and challenges with the methods routinely used for optimal power flow calculations, are mentioned in the Introduction, I see no research question(s) properly formulated there, which of course has consequences in the way the Conclusion chapter is written.

- The relevance of the topic of dissertation work to its actual content

Optimal power flow calculations represent a quite difficult technical problem, yet critical for cost-effective power grid operation; and while various methods and approximations are used to solve constrained optimization problem, real-life situations require more realistic approaches that can account not only for the nonlinear and nonconvex character of the problem, but also for the increasing penetration of renewable energy sources in the power grid and the uncertainty this generates.

In his thesis, the candidate tackles the challenging problem of solving the stochastic AC chance-constrained optimal power flow problem, and the develop a data-driven algorithm for that purpose. This research work is both timely and relevant.

- The relevance of the methods used in the dissertation

The proposed method is based on the use of Gaussian process regression, which can be used for learning non-convex data-driven approximations to the AC power flow equations. To manage the trade-off between complexity and accuracy, a sparse and hybrid Gaussian processes framework is used. This original method has proved to be relevant given the obtained results.

- The scientific significance of the results obtained and their compliance with the international level and current state of the art

The significance of the results is high, as the method developed successfully combines machine learning techniques and chance-constrained approaches to solve stochastic optimal power flow problem. The work is on par with international standards in the candidate's field of research as shown by the publications in international journals and presentations at international conferences.

- The relevance of the obtained results to applications (if applicable)

The candidate has not only managed a proof of principle but also to develop an open source software that could reveal itself very useful for the computation of solutions of real-life stochastic optimal power flow problems. As of yet, the candidate could only work with synthetic data, but the software could confidently be tested using data provided by transmission system operators.

- The quality of publications

The results of the doctoral work have been published in good peer-review international journals and presented at reputable conferences, which indicates good quality.

The summary of issues to be addressed before/during the thesis defense

Apart from polishing the text, sharpening the formulation of the research problem and writing a more satisfactory Conclusion that is not a mere recap of the thesis, I see no particular technical/scientific issue that should be addressed.

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