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Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Sajjad Asefi

PhD Program: Engineering Systems

Title of Thesis: Advancements in power system state estimation: innovative algorithms and solutions for enhanced reliability and efficiency

Supervisor: Assistant Professor Elena Gryazina

Name of the Reviewer: Prof. Ramesh Bansal

I confirm the absence of any conflict of interest Yes (Alternatively, Reviewer can formulate a possible conflict)	**Date: 18-11-2023**

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 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

Evaluation report for Doctor of Philosophy Thesis of Mr. Sajjad Asef on the topic, "Advancements in Power System State Estimation: Innovative Algorithms and Solutions for Enhanced Reliability and Efficiency"

The goal of this thesis is to increase the dependability and effectiveness of contemporary power grids by exploring and introducing key developments in power system state estimation. A unique technique has first been developed for the detection and classification of single/multi-bus rapid load changes and single/multi-state false data injection attacks. For precise categorization, this approach makes use of supervised machine learning techniques and an anomaly detection index. Additionally, the suggested approach uses the best feature selection technique, "maximum relevance - minimum redundancy," to speed up the training of machine learning algorithms and provide more effective state estimation procedures.

A modified convergence criterion and IEEE standard test systems are also used in the study to evaluate several distributed state estimation techniques. Based on parameters like data transmission needs, computation time, solution correctness, and convergence rates, the most efficient approach is chosen due to this evaluation. To ensure the integrity of crucial data, the research also investigates the integration of blockchain technology to improve the security of data transfers within the distributed power system state estimation framework. The work also considers the difficulties given by asynchronous and delayed data transfer inside distributed state estimation, aiding in the creation of strong algorithms equipped to deal with actual communication restrictions. This thesis offers practical solutions to improve the dependability and efficiency of power grid operations, ultimately enhancing the resilience and sustainability of contemporary power systems. It presents a thorough and innovative approach to power system state estimation.

Suggested Changes

Although the thesis is quite well written, there are formatting and grammatical issues. When submitting their thesis for the last time, the student is recommended to carefully review and amend their work for formatting issues and typos., e.g.

1.   Chapter 2: Elaborate chapter 2 by adding more recent references from the literature. Include a comparative table showing key points and challenges from the state of the art.
2.   Include a summary at the end of each chapter.
3.   Describe all terms in the equations in the text.

4.   How does the proposed method prove viable for the case of single bad data in larger networks? Discuss the analysis of both the weighted and normalized residuals in the presence of gross errors when compared to $\chi 2$ testing.

5.   How can grid operating procedures be taken into consideration to achieve better data detection?

6.   Considering the expansion of the future grid, what are the other types of anomalies that can be considered as future directions for the development of ADCIT? Discuss in brief.

7.   Hyperparameters are tuned using sequential optimization in the ADCIT tool, how does it benefit from other optimization techniques?

8.   Chapter 6: Explain the feasibility of conducting an economic analysis of blockchain implementation.

9.   Check the line indent on all pages.

10.   Check the grammar and tense of the text throughout the thesis. Check line spacing.

It is clear from the candidate's publication (3 in high quality journal papers, and 3 conf. papers) that the work presented in the thesis is of top quality in recent years. For secure data transmission and boosting system reliability, the candidate has presented a combination of distributed state estimation and a communication platform built on the blockchain. Utilizing the idea of smart contracts would result in enhancing the system's overall security. Additionally, the resilience has been examined in relation to the data transmission latency. Of the more than 50 Ph.D. theses I have reviewed, this one ranks in the top 5%. The candidate deserves praise for superior research. I am happy to recommend the award of a PhD degree.

Prof. Ramesh Bansal
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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*