SCHOLARLY PUBLICATIONS
School of Electrical Engineering
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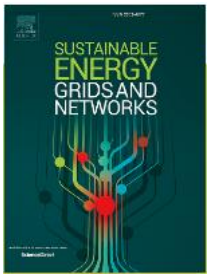
Journal Name: Sustainable Energy, Grids and Networks **IF: 5.4**

Title: Evaluation of power grid vulnerability indices accounting for wind power uncertainty

Author: Pani S.R., Samal R.K**.**

Details: Volume 38, June 2024, Article number 101354

Abstract: As power systems undergo transformative changes driven by the integration of renewable energy sources, smart grids, and advanced control systems, evaluating vulnerabilities becomes paramount for ensuring resilience. This article introduces a robust framework for computing vulnerability indices, encompassing both cascading indices and spectral graph metrics. Cascading indices are initially computed. Then these indices are compared with pure and extended spectral graph metrics to rank the lines under N−1 contingency conditions. The research also delves into N−k contingency scenarios, examining the system's vulnerability across various degrees of damage size. The influence of uncertainties related to wind power generation and load demand on line vulnerability is addressed. The Point Estimate Method (PEM) is employed to effectively accommodate these uncertainties offering a reduction in computational time. To validate the proposed framework and analysis methodologies, two case studies are employed—the IEEE 30-bus and 57-bus systems. It is found that the inclusion of wind power and load uncertainty affects the vulnerability of the system. While the impact on cascading indices is negligible for small networks, it becomes notable in the case of larger networks.



URL: https://www.sciencedirect.com/science/article/pii/S2352467724000833

SCHOLARLY PUBLICATIONS
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Journal Name: IEEE Transactions on Power Delivery **IF: 4.4**

Title: Autoregressive Coefficients Based Intelligent Protection of Transmission Lines Connected to Type-3 Wind Farms

Author: Bera P.K., Kumar V., Pani S.R., Malik O.P.

Details: Volume 39, Issue 1, Pages 71 – 82, 1 February 2024

Abstract: Protective relays can mal-operate for transmission lines connected to doubly fed induction generator (DFIG) based large capacity wind farms (WFs). The performance of distance relays protecting such lines is investigated and a statistical model based intelligent protection of the area between the grid and the WF is proposed in this article. The suggested method employs an adaptive fuzzy inference system to detect faults based on autoregressive (AR) coefficients of the 3-phase currents selected using minimum redundancy maximum relevance algorithm. Deep learning networks are used to supervise the detection of faults, their subsequent localization, and classification. The effectiveness of the scheme is evaluated on IEEE 9-bus and IEEE 39-bus systems with varying fault resistances, fault inception times, locations, fault types, wind speeds, and transformer connections. Further, the impact of factors like the presence of type-4 WFs, double circuit lines, WF capacity, grid strength, FACTs devices, reclosing on permanent faults, power swings, fault during power swings, voltage instability, load encroachment, high impedance faults, evolving and cross-country faults, close-in and remote-end faults, CT saturation, sampling rate, data window size, synchronization error, noise, and semi-supervised learning are considered while validating the proposed scheme. The results show the efficacy of the suggested method in dealing with various system conditions and configurations while protecting the transmission lines that are connected to WFs.

URL: https://ieeexplore.ieee.org/document/10271697