Computer Networks & Communications
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Title (WIP): Fault Identification for a Community-driven Blackout Recovery

Description:

Power grids are the most important critical infrastructure build by humans as other critical infrastructure, such as communication systems, heavily depend on it. With the transition from central fossil power plants to distributed renewable power plants, new concepts such as Renewable Energy Communities (REC) that foster regional self-consumption and self-sufficiency optimization emerge. Some of such RECs are located in remote areas with poor connection to the power grid, which increases the risks of blackouts and required blackout recovery strategies to enable the accelerated reaction on major disturbances.

In order to coordinate available power resources within a REC, first, a method is required to identify the origin of the power system disturbance (i.e. disconnected power line). Therefore, in this thesis the student should evaluate the applicability of existing fault identification and localization strategies, such as given in the references below. Together with the supervisor, the best suitable method is chosen and the student will apply it for evaluation to a realistic REC grid topology and advanced simulation environment.

[1] Y. Zhao, J. Chen, and H. V. Poor, "A Learning-to-Infer Method for Real-Time Power Grid Multi-Line Outage Identification," *IEEE Trans. Smart Grid*, vol. 11, no. 1, pp. 555–564, 2020.
[2] J.-C. Chen, W.-T. Li, C.-K. Wen, J.-H. Teng, and P. Ting, "Efficient Identification Method for Power Line Outages in the Smart Power Grid," *IEEE Trans. Power Syst.*, vol. 29, no. 4, pp. 1788–1800, Jul. 2014.
[3] Y. Liao, Y. Weng, C. W. Tan, and R. Rajagopal, "Urban distribution grid line outage identification," *2016 Int. Conf. Probabilistic Methods Appl. to Power Syst. PMAPS 2016 - Proc.*, pp. 1–8, 2016.
[4] Sapountzoglou, Nikolaos, Jesus Lago, Bart De Schutter, and Bertrand Raison. "A generalizable and sensor-independent deep learning method for fault detection and location in low-voltage distribution grids." *Applied Energy 276 (2020): 115299*.
[5] J. He, M. X. Cheng, Y. Fang, and M. L. Crow, "A Machine Learning Approach for Line Outage Identification in Power Systems," 2019, pp. 482–493.
[6] H. A. Tokel, R. Al Halaseh, G. Alirezaei, and R. Mathar, "A new approach for machine learning-based fault detection and classification in power systems," *2018 IEEE Power Energy Soc. Innov. Smart Grid Technol. Conf. ISGT 2018*, pp. 1–5, 2018.
[7] D. Madurasinghe, P. Arunagirinathan, and G. K. Venayagamoorthy, "Online Identification of Power System Network Branch Events," *Proc. 2019 IEEE PES Innov. Smart Grid Technol. Eur. ISGT-Europe 2019*, pp. 1–5, 2019.
[8] A. Ahmed *et al.*, "Multiple Power Line Outage Detection in Smart Grids: Probabilistic Bayesian Approach," *IEEE Access*, vol. 6, pp. 10650–10661, 2018.
[9] Z. S. Hosseini, M. Mahoor, and A. Khodaei, "AMI-Enabled Distribution Network Line Outage Identification via Multi-Label SVM," *IEEE Trans. Smart Grid*, vol. 9, no. 5, pp. 5470–5472, 2018.
[10] F. Yang, J. Tan, J. Song, and Z. Han, "Block-Wise Compressive Sensing Based Multiple Line Outage Detection for Smart Grid," *IEEE Access*, vol. 6, pp. 50984–50993, 2018.

Goals:

1. Provide a solid literature review of the fault identification and localization methodologies

2. Identify fault identification and localization methodologies which satisfy the requirements and resources of a REC in the low voltage grids
3. Create a simulation environment and use-cases while having a REC grid topology as an input
4. Based on the created use-cases, implement the selected methodology and evaluate the effectiveness and limitations of the fault identification and localization

Language:
English

Requirements:
Good knowledge in power systems
Research skills: reading the literature and understanding the methods, power system simulation, validation of the methodology

Supervisor: Hermann de Meer
Co-supervisor: Philipp Danner, Anna Volkova
Type: Master
Timeframe: ASAP