

**Workshop on Energy Flexibility in Smart Buildings and
Smart Grids**

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**Energy Flexibility
Smart Grid & Buildings**

**Optimal Expansion Planning of Smart Distribution Power Networks:
Deterministic vs Stochastic Approaches**

Bruno Canizes

Research Group on Intelligent Engineering and Computing for Advanced Innovation
and Development (GECAD)

Type of talk: Invited talk

Abstract:

The era of renewable distributed generators, such as wind and solar, dispersed across the distribution networks (DN), is helping to achieve environmental and political goals. However, this kind of generators present considerable variability and intermittency, adding significant complexities and obstacles to distribution network planning. Furthermore, the current DN design isn't quite ready to handle with a huge number of distributed renewable energy sources (RES) units [1, 2]. The high penetration of these types of generators can have a positive or negative impact on the DN's operation [3, 4]. In this way, adopting advanced models for distribution networks planning/reinforcement that consider uncertainty factors is very important for the successful implementation of smart grids (SG). A two-stage stochastic model can be used as an efficient model to incorporate the ability to handle uncertainty factors [5]. Thus, it is shown by this presentation a comparison between the stochastic model and the deterministic model to show how much improvement can be achieved by a stochastic solution. For this, it is used a realistic distribution network with 180 buses and high distributed generators penetration. The main features of the proposed models can be summarized by: 1) seasonal (spring, summer, fall, and winter) and daily periods (night, morning, peak, and afternoon) impact effect in the long-term of the smart distribution network planning; 2) optimal energy storage systems size and location as well as the optimal type and location of new lines or the replacement of the existent ones; 3) reliability improvement with optimal radial topology.

Related References:

- [1] Bruno Canizes, João Soares, Zita Vale, Juan M. Corchado, "Optimal Distribution Grid Operation Using DLMP-based Pricing for Electric Vehicle Charging Infrastructure in a Smart City", *Energies*. 686 (2019) 12(4).
- [2] Bruno Canizes, João Soares, Angelo Costa, Tiago Pinto, Fernando Lezama, Paulo Novais, Zita Vale, "Electric Vehicles User Charging Behaviour Simulator for a Smart City", *Energies*. 1470 (2019) 12(8).
- [3] M. Mejboul Haque, Peter Wolfs, A review of high PV penetrations in LV distribution networks: present status, impacts and mitigation measures, *Renewable & Sustainable Energy Reviews*, 62 (2016) 1195e1208, 9.
- [4] J.O. Petinrin, Mohamed Shaabanb, Impact of renewable generation on voltage control in distribution systems, *Renewable & Sustainable Energy Reviews*, 65 (2016) 770e783, 11.

[5] Bruno Canizes, João Soares, Fernando Lezama, Cátia Silva, Zita Vale, Juan M. Corchado, "Optimal expansion planning considering storage investment and seasonal effect of demand and renewable generation", *Renewable Energy*. 138 (2019) 937–954.