TUTORIAL N°4

Optimization in distribution systems operation: how to leverage flexibility and efficiently assess grid impact? New tools and methods

Background

The integration of **flexible distributed energy resources** in distribution grids, for instance EVs and battery storage, opens the door to new **tools for supporting the network operational and long-term planning and in increasing its sustainability**, especially in the presence of large penetration of distributed generation units such as photovoltaics (PVs).

In this context, this tutorial will firstly present an AC-OPF tool for the optimal operational planning at different time scales (from week-ahead to day-ahead) of modern distribution networks in a deterministic fashion. Then, the different existing mathematical methods to account for uncertainties (in load behavior, generation and market-related variables) will be introduced, along with their pros and cons and guidelines on their practical applicability. Finally, a focus on the end-user perspective with possible interactions to improve the energy management of communities is provided with the necessary game theoretical aspects.

Aim of the tutorial

The purpose of the tutorial is to present state-of-the art tools and methods to tackle issues arising in modern distribution networks, while providing the necessary mathematical background to efficiently exploit these advanced optimization techniques. In this way, AC OPF for the combined optimization of operational planning of distribution network is presented. The focus is then given to methodologies to handle uncertainty at different time horizons (from long-term to near to real-time) with different risk-aversion policies. A general description of different optimization techniques, which are illustrated with relevant power systems-based examples. The final part is devoted to the introduction to game theory with a particular focus on the cooperative aspects between end-users.

Content

1. Multi-period OPF to leverage flexibility in distribution systems: tool features and mathematical aspects
2. Hands-on demo and further tool development roadmap
3. Overview of mathematical methods to handle the different sources of uncertainty
4. Game theory: interactions between active prosumers

Expected benefits

Participants will gain an improved understanding of:

- How innovative tools are designed that optimize the operation of the distribution system so as to foster the optimal integration of flexible resources such as electric vehicles.
- Which are the different techniques to accommodate uncertainty in optimization problems: how and when to apply them?
- How can end-users with flexible resources improve the network operation (and their electricity bill) by taking advantage of game theory.

Who should attend

Distribution system operators, companies aiming to valorize their flexibility resources, end-users interested in smart cooperation in modern distribution systems, research scholars/students? …

Support material

A copy of all the presentation material used in the tutorial will be supplied to delegates (electronic version).

About the presenter(s)

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