Joint transmission and distribution generation expansion planning

Supervisor  Xuejiao Han, xuhan@eeh.ee.ethz.ch
Type        Master

Background  Generation expansion planning (GEP) is defined as an optimization problem that entails answering the following four basic questions over a long range planning horizon, to satisfy the expected energy demand: i. WHAT - the types of generation technologies that will be added to the grid; ii. HOW MUCH - the size of each new generation plant; iii. WHERE - the location of these plants; iv. WHEN - the stage of the planning horizon when the new units must be implemented. This is subject to various economic and technical constraints and usually involves solving a large-scale, non-linear and dynamic optimization problem in a highly uncertain environment.

Nowadays, as a result of the increasing penetration of variable and uncertain energy resources (renewables, electric vehicles, flexible loads, etc.) at the distribution level of the power system, the expansion planning of distribution systems has an important impact on the overall planning of the power system. Under these new conditions, a need for joint optimization of transmission and distribution generation expansion planning so as to suitably exploit the available energy resources, has been raised.

Description  The main goal of this project is to develop simulation tools that can be used to study the joint optimization of transmission and distribution GEP models in order to minimize the costs and ensure the safe operation of power systems. In this framework, constraints regarding investments, operations and network for both TSOs and DSOs must be developed. Tasks are to

1. Literature review on GEP models for both transmission and distribution systems.
2. Set up the general mathematical formulation of a GEP model.
3. Define and set up the interfaces between transmission and distribution GEP model.
4. Develop the joint optimization model for the transmission and distribution GEP model.
5. Validate the proposed framework on test systems.

Prerequisites  The student should be familiar with MATLAB and mathematical optimization techniques.