Optimization and Control Group | Institute for Applied Computer Science (IAI)

Master Thesis: Stochastic Optimal Power Flow using Polynomial Chaos Expansion

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Duration:	6 months
Start:	Immediate start possible, or whatever is suitable

Activity Description

The increasing amount of distributed generation from renewable energy sources, the availability of always cheaper technologies to store and convert electric energy, and the growth of efficient electric devices opens up new possibilities in the design and operation of electric power systems. This increased number of control options has the potential to greatly improve the efficiency of the system. However, it also requires non-trivial automatic decisions on the best inputs that should be applied; decisions that should account for the uncertainty affecting uncontrolled generation and demand. Appropriate optimization algorithms are thus required for an effective operation of future power systems.

The purpose of the proposed thesis is to develop such an algorithm for radial power grids. Objectives of the thesis include:

- review and compare different formulations of the stochastic optimal power flow problem;
- familiarize with polynomial chaos expansion and how it is used in optimization;
- develop a method to solve stochastic optimal power flow applying polynomial chaos expansion to the forward backward sweep optimal power flow method [1–3];
- simulate and analyze the effects of the developed algorithm.

Personal Qualification

We are looking for motivated students interested in control of power systems, and numerical optimization. Basic knowledge in power systems is required; basic knowledge in optimization is desirable but not necessary. The simulations can be realized in Matlab or Julia.

Selected Publications

[1] R. R. Appino, T. Mühlpfordt, T. Faulwasser, and V. Hagenmeyer. "On solving probabilistic load flow for radial grids using polynomial chaos". In: *PowerTech, 2017*. IEEE. 2017, pp. 1–6.

[2] P. Fortenbacher, M. Zellner, and G. Andersson. "Optimal sizing and placement of distributed storage in low voltage networks". In: *Power Systems Computation Conference (PSCC), 2016*. IEEE. 2016, pp. 1–7.

[3] S. Karagiannopoulos, L. Roald, P. Aristidou, and G. Hug. "Operational Planning of Active Distribution Grids under Uncertainty". In: *10th Bulk Power Systems Dynamics and Control Symposium (IREP) 2017*. 2017, In press.