Functional Modeling for Control Structure Design – With Applications to Future Power Systems

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Uncontrollable power generation, distributed energy resources, controllable demand, etc. are fundamental aspects of energy systems largely based on renewable energy supply. These technologies have in common that they contradict the conventional categories of electric power system operation. For a system with 100 percent renewable energy supply, it seen that today's system design cannot keep up by simply adapting in response to changes, but that also new strategies have to be designed in anticipation.

Approaches are required that support the design and evaluation of power system operation and control in context of future energy scenarios. The method presented in this talk adresses this challenge, not by providing a solution, but by introducing and adapting a basic modeling methodology. It enables better problem formulation and supports the re-design of system operation and control.

The methodology is a functional modeling approach called Multilevel Flow Modeling (MFM), which has been adapted to the power systems domain and extended to represent control-oriented challenges characteristic for power systems. A formalization of control as a service is introduced and a formal mapping of fluctuating and controllable resources to a multi-scale and multi-stage representation of control and operation structures is presented. Based on this methodology two case studies are discussed.