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Power systems research – why we should cooperate

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Political goals, technological progress and economic pressure challenge existing concepts for power systems. The trends to operate with narrower stability margins under increased decentralization and uncontrolled power injections, e.g. through power market activities or renewables, are drivers in the restructuring process of the existing operation scheme.

While today's architecture of operation is separated in terms of spatial and temporal scales, we expect that the future architecture requires the combination of static load flow planning and dynamic control as depicted in Fig. 1. A massive increase of interacting components necessitates the development of novel control and planning methods supporting a safe and highly automated system.

We observe the need for coordinated research from many fields, including business development, infrastructure planning, design of components, operations research, software and communications engineering, cyber security, and control theory. A first approach for bringing together various disciplines at TUM was the Workshop on Smart Grids held in 2011 in Benediktbeuern. The participating researchers conducted a survey of ongoing and planned research efforts in order to identify overlap and potential cooperation, which resulted in [1]. Amongst others we identified the following current research topics at several TUM institutes:

- Electricity markets: economic dispatch / unit commitment
- Flexibility of components: power plants, storage, loads
- Static load-flow simulation
- Novel approaches to design and verify local controller mechanisms integrated in a global electricity infrastructure
- Scalable approaches to aggregate, optimize and control thousands of components on different levels of abstraction
- Development of a new information and communication infrastructure on top of the physical system
- Cyber attacks and IT security
- Decentralized, robust control of the grid, i.e. a dynamical system of (very) high order modeled by differential-algebraic equations

In [1] we collected and documented individual research goals, interests, and expertise. We shared methods, datasets, related lectures, tools, research articles in order to create a common knowledge base.

We concluded that existing separation of research disciplines is not adequate to explore solutions to the above mentioned problem. To foster constructive exchange between the disciplines we observed the need to express criteria and relationships between problems at different levels in power systems research in a unified way. A first step could be to provide a list of requirements for an efficient, stable and safe system.

To emphasize the importance of cooperation, we highlight two specific results of our coordinated research:
- Application of methods from communication engineering to power system planning.
- Combination of static optimal dispatch with dynamic control.

These promising results motivate further joint research efforts at TUM. With this contribution we want to initiate a discussion:
- How to intensify and coordinate research cooperations at TUM?
- What is the adequate form of funding (SFB) ?
- Which role does TUM want to play in designing this new architecture?

References:
[1] Smart Grid Workshop, Benediktbeuern, 2012 (Avalable at FGC-EI)

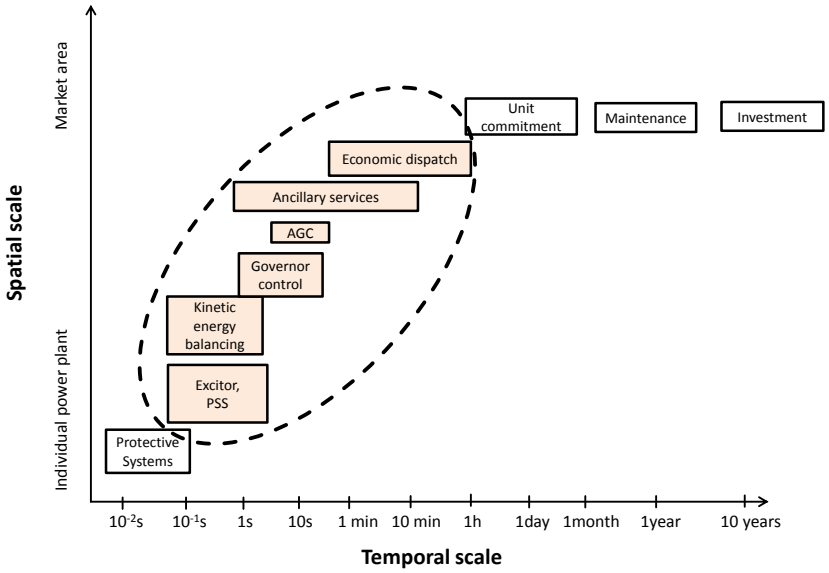

Fig.1: Temporal and spatial scales of control mechanism

Participants of Smart Grid Workshop, Benediktbeuern 2011
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