Analysis and Synthesis of Robustly Controlled Smart-Grid-Systems (ROCS-Grid)

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- Conventional power systems
  - Transmission and distribution lines owned by the same company
  - No uncertainty arising from renewable-based power-producing units

![Figure: Overview of the conventional power grid operation.](image)

**Figure:** Overview of the conventional power grid operation.
Smart grid systems

- Management of bidirectional energy flow in a competitive market
- Less predictable operation of the overall system

Figure: Overview of the smart grid.
Topic 1: Assessment of Power Systems

Current techniques
- Deterministic simulations using (N-1) security assessment
- Lyapunov direct method
- Set-based reachability analysis

Task:
- Literature review about Lyapunov stability in power system
- State-of-the-art with regards to the estimation of the domain of attraction
- Implementation on a simple example in power systems (e.g. SMIB)
Topic 2: Impact of Renewable Resources on Power Systems

- **Background**
  - Variable nature of renewable resources (wind, solar) introduces uncertainty
  - The effect on the generation side is not known due to forecast errors

- **Task:**
  - Literature review about impact of renewable resources
  - Implementation on a simple example in power systems (e.g. SMIB)

**Figure:** Overview of a single-machine-infinite-bus (SMIB)
Topic 3: Identification of Cyber Attacks in the Smart-Grid

**Background**
- Several challenges in the grid due to the interaction between the IT systems and the power transmission and distribution system
- The Automatic Generation Control (AGC) is one of the few control loops that are closed over the SCADA system without human operator intervention

**Task:**
- Literature review about application of reachability methods in the case of a cyber attack
- Implementation on a simple example in power systems (e.g. SMIB)