Today’s power systems are operated and controlled in a centralized way, under which monitoring and control tasks are handled at different hierarchical levels. However, emerging technologies, such as distributed energy sources, electric vehicles, and energy storage devices, pose new challenges to the operation and control of legacy power systems due to the increased scale and complexity. To overcome these challenges, it is envisioned that future, smart grids will be populated with multiple hybrid producer-consumer agents. These economically motivated agents are called prosumers, which can make strategic decisions empowered by a cyber-layer superposed on top of the physical grid. Under the prosumer-based framework, smart grids will be operated and controlled in a distributed way. The challenges are thus how to gracefully extend the current control and management paradigm to power grids comprised of thousands of prosumers. In this seminar, I will discuss my recent efforts to address one particular, technical aspect of the multi-agent smart grids, namely the frequency regulation problem. I will present a distributed architecture for frequency regulation and address the problem of how thousands of sparsely located prosumers can regulate frequency in a distributed and robust manner.

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