Multi-Agent Control of Large-Scale Power Systems

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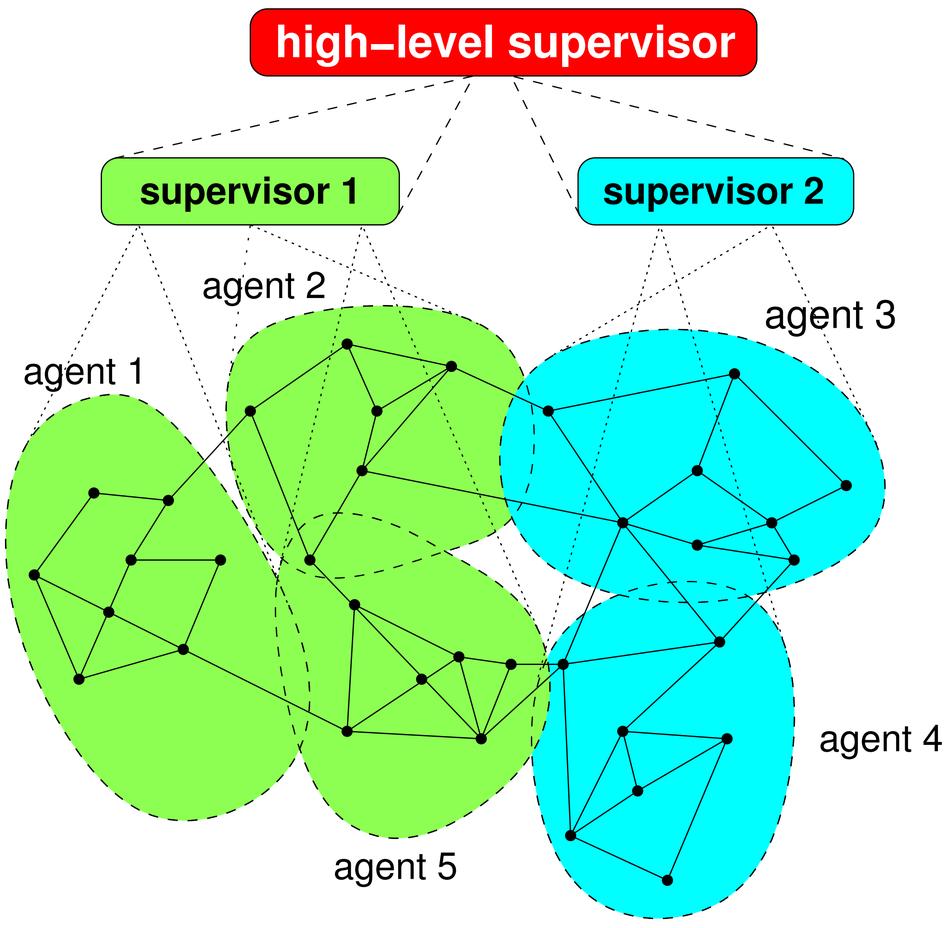
Motivation

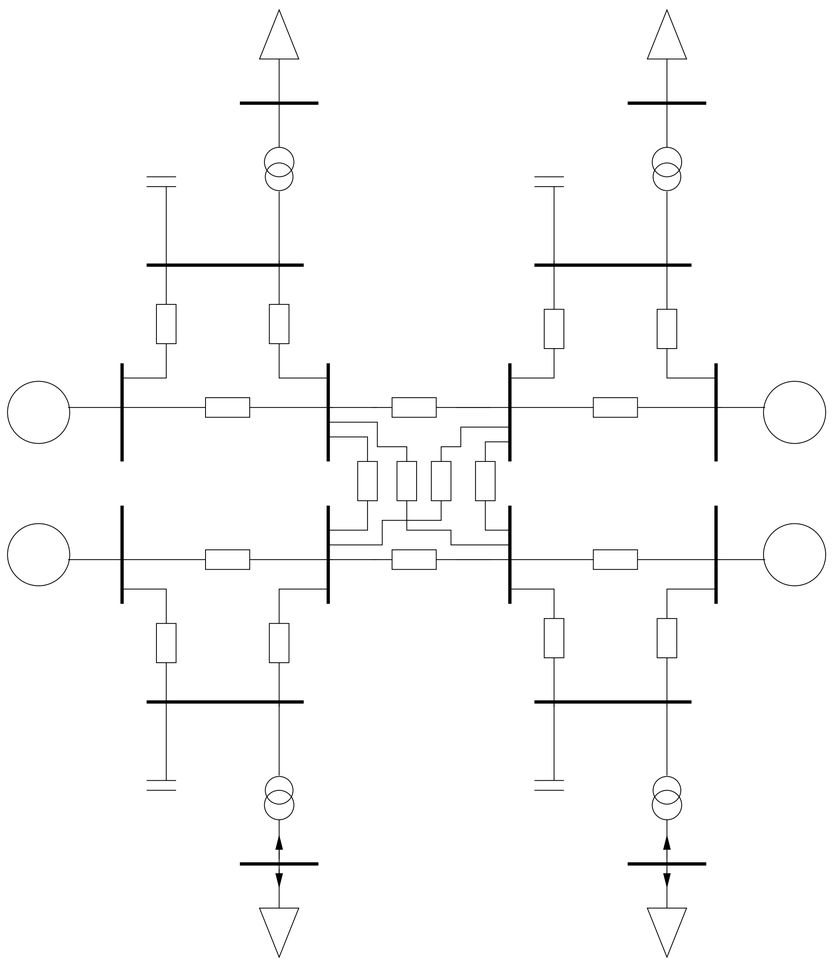
Reliable operation of large-scale power networks and other transportation systems, like traffic, logistic, and water systems, is of crucial importance for our modern society. The operation of these large-scale systems has a significant impact on amongst others economic growth, quality of life, and the environment.

Many of these systems can be modeled as *hybrid systems*, systems with both continuous and discrete dynamics. E.g., in power systems the flow of power through a network can be modeled as a continuous process, while actions such as switching of transformer taps provide discrete actions on the system.

So far, most control methods for hybrid systems are based on a *centralized* control paradigm or on *ad-hoc* techniques. However, centralized control is often not feasible in practice due to computational complexity, communication overhead, and lack of scalability. Furthermore, structured control design methods for large-scale hybrid systems are lacking.



Multi-level control structure with coordination at and across all levels.



Representation of a power network.

Overall Aim

The overall aim of this project is to find a structured and tractable design methodology for control of large-scale networks. We will develop a design framework using an approach based on:

- a *multi-level* control structure with *local control agents* at the lowest level, and one or more *supervisory agents* at the higher levels,
- the combination and integration of techniques from *computer science*, and *control engineering* in order to obtain coordination *at* and *across* all control levels.

To assess the performance and potential of the framework we will use examples from the field of power distribution systems. Due to the deregulation in power generation and distribution, the power system has changed from a hierarchical structure into a decentralized structure. This new structure requires new control designs which our framework will provide.

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