

# Multi-Agent Control of Large-Scale Hybrid Systems

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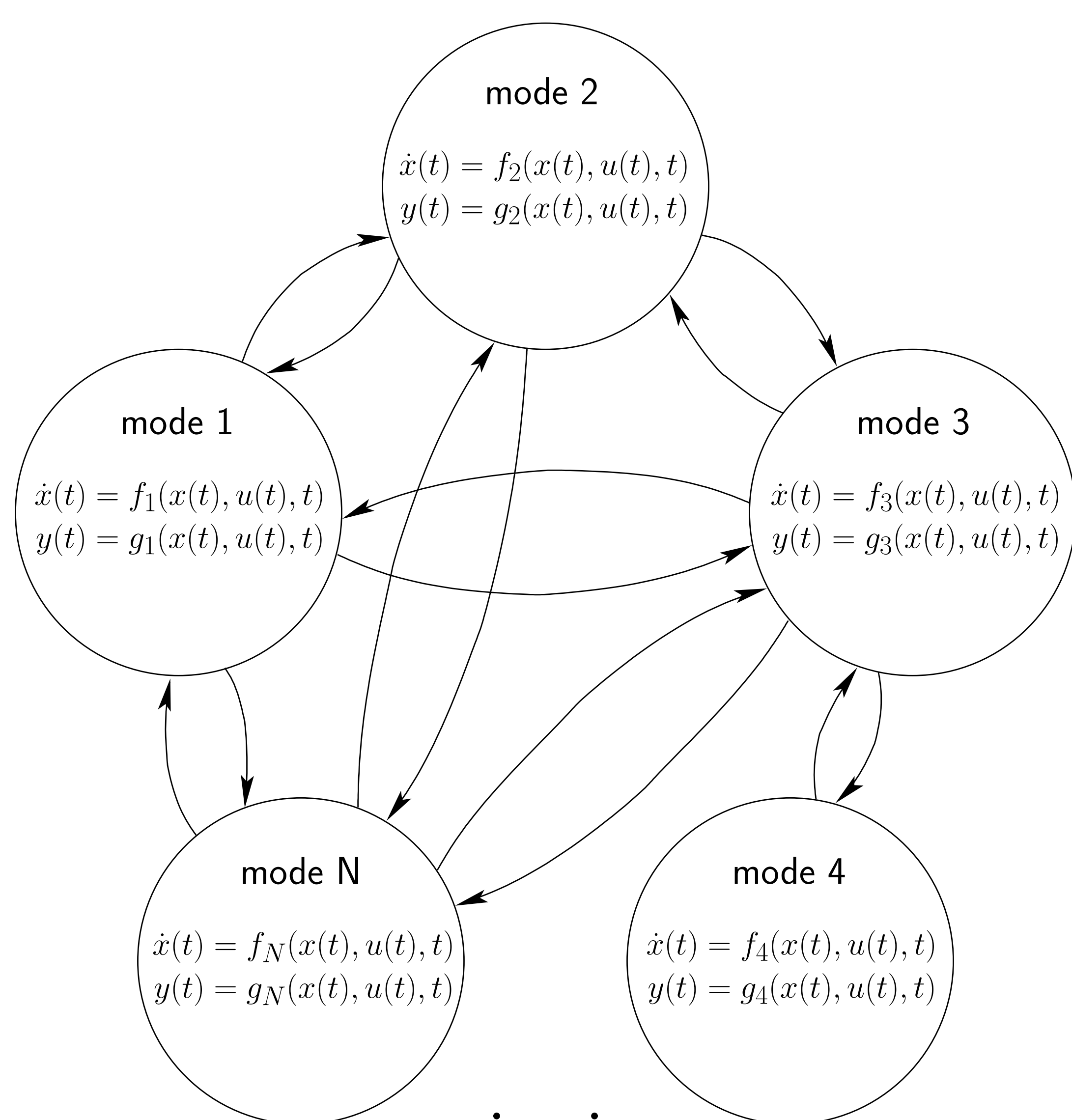
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## Motivation

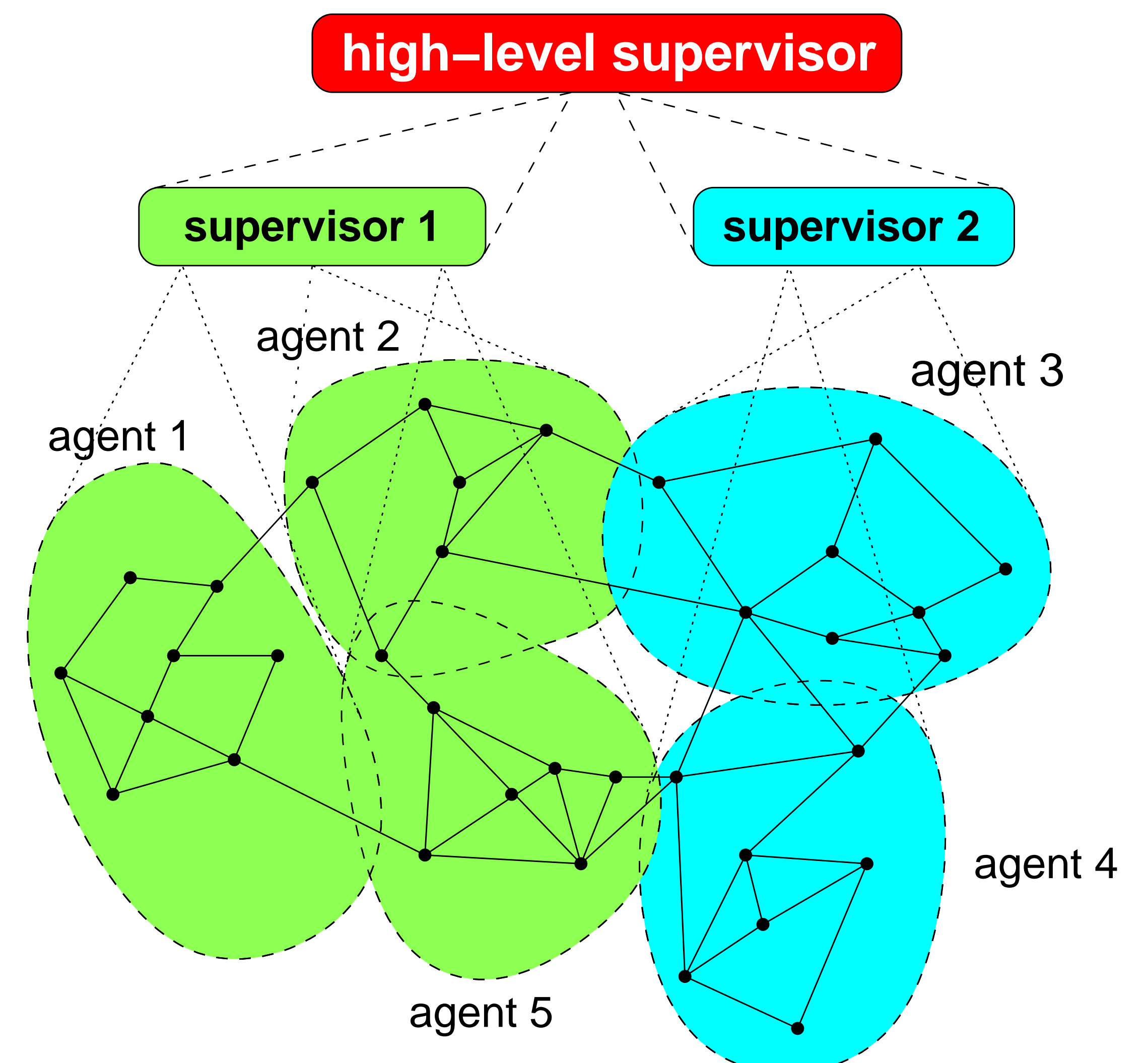
Reliable operation of traffic and transportation systems, electricity distribution networks, and other large-scale complex systems is of crucial importance for our modern society. The operation of these large-scale systems has a significant impact on amongst others economic growth, quality of life, and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

Many of these systems can be modeled as *hybrid systems*, systems with both continuous and discrete dynamics. E.g., in traffic systems the flow of cars through a network can be modeled as a continuous process, while actions such as ramp metering and route directions 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.



Schematic representation of a hybrid system.



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

## Overall Aim

The overall aim of this project is to find a structured and tractable design methodology for robust control of large-scale hybrid systems. 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.

In this project we concentrate on three specific application fields: traffic and transportation, electricity distribution, and logistics.

## References

- [1] R.R. Negenborn, B. De Schutter, and J. Hellendoorn. Multi-agent model predictive control: A survey. Technical report, Delft University of Technology, Delft, Netherlands, 2004.