Karlsruhe Institute of Technology

Institute of Theoretical Informatics
Institute for Control Systems
http://i11www.iti.kit.edu
http://www.irs.kit.edu

Contacts:

Franziska Wegner
ITI (50.34), Room 316
franziska.wegner@kit.edu
Phone: 0721/608-44322

Martin Pfeifer
IRS (11.20), Room 107
martin.pfeifer@kit.edu
Phone: 0721/608-43236

Start: upon consultation **Duration:** 6 months

Direction: theoretical

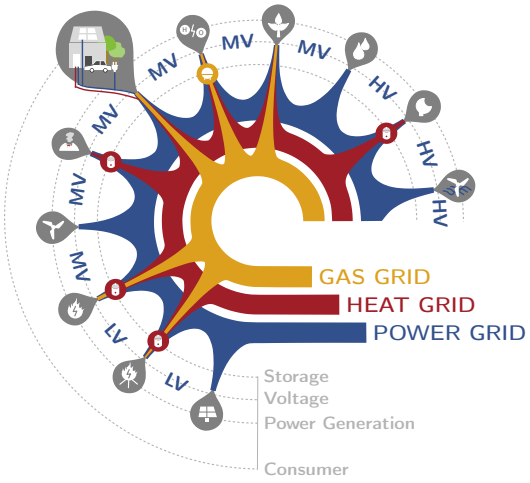
Emphasis: graph theory, power engineering and systems theory

Master's Thesis

Observability of Multi-domain Energy Distribution Networks

Motivation

Due to fundamental changes in the current power supply systems, the existing central power supply with separated physical domains transforms to a decentralized cross-domain supply structure. Important components of this development are renewable energies, combined heat and power (CHP), energy storages and power-to-X technologies. The corresponding systems operate mostly on the distribution network level and cause time-varying power flows, which are not detectable for the network operator because of an insufficient sensor equipment and experienced-based—but not optimal—placement. As a result, there are impermissible limit violations, e.g., the voltage or pressure in the electrical or gas network, respectively. The placement of sensors to obtain an observable multi-domain energy distribution network is just one arising question in this research field.



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Task Definition

In a theoretical thesis the student clarifies at which points in a multi-domain energy distribution network a monitoring is necessary to observe all states in the whole network. First of all, the student gets familiar with graph theoretical aspects, fundamentals of the different physical principles in the various power domains and the domain-interconnection. The graph-theoretical modeling will be first done based on static systems and by using that the observability will be analyzed. From this findings an observation criteria has to be derived, which is applicable on common network structures. In a second step, additional dynamic states will be considered, which extend the static to a system-theoretical observability. The work is completed by a presentation of the results and a thesis.

Karlsruhe Institute of Technology (KIT)
Kaiserstraße 12
76131 Karlsruhe

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