CoSES State Estimation

The TUM Center for Combined Smart Energy Systems (CoSES) is a laboratory focused on analysis of multi-energy systems. The laboratory has a capability to emulate a small microgrid with Low Voltage Electric Distribution Grid and Three Temperature Level Bidirectional Heat Grid. These energy grids supply 4 Single-family houses and 1 Multi-family house with different distributed energy sources and loads.

One of the main functions of the control and monitoring software in any system is to provide good situational awareness to the system operators. The basic situational awareness can be accomplished through manual monitoring of measured signals; however, this approach is prone to mistakes that are caused by inaccurate or erroneous measurements. In addition, this approach does not exploit measurement redundancy that is often available in modern systems.

In order to improve situational awareness a state estimation algorithms have been employed. They interfere available measurements and physical model of the system in order to produce the most likely state of the system. In addition, this approach enables identification of erroneous measurements or issues in the system model.

This project will investigate available open source state estimation software such as “pandapower” and implement the adopted software in the real-time system of the CoSES lab. The state estimation software will interface with existing real-time monitoring and control system that is based on National Instruments technology (LabVIEW and VeriStand), which will provide measured signals. Within a project a meaningful user interface has to be developed.

Project Tasks

1) Develop a model of CoSES electric grid suitable for state estimation.
2) Simulate the electric grid of the CoSES laboratory in order to test state estimation algorithm.
3) Create a suitable User interface for visualization of the state estimation results.
4) Integrate the developed software in the real-time system of CoSES laboratory and demonstrate the functionality of the system

Requirements

1) Background in Electrical Engineering or Software Engineering.
2) Solid background in data management, control systems and mathematical optimization.
3) Previous experience in with SCADA systems, IoT or LabVIEW is preferable.
4) Affinity to programming and structural thinking.
5) Good team-player and an attitude to learn and explore new approaches.

References

[1] L. Thurner *et al.*, “Pandapower - An Open-Source Python Tool for Convenient Modeling, Analysis, and Optimization of Electric Power Systems,” *IEEE Trans. Power Syst.*, 2018.

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[3] G. T. H. Daniel A. Haughton, “A Linear State Estimation Formulation for Smart Distribution Systems,” *IEEE Trans. POWER Syst.*, vol. 28, no. 2, pp. 1187–1195, 2013.

[4] Y. Lin, S. Member, and A. Abur, “Robust State Estimation Against Measurement and Network Parameter Errors,” *IEEE Trans. Power Syst.*, vol. 33, no. 5, pp. 4751–4759, 2018.

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