Master thesis   Date: 31.05.2023

Implementation of a methodology for topology estimation based on LV measurements

In the process of the energy transition, large power plants such as nuclear and coal-fired power plants are being shut down in Germany and replaced by decentralised generation plants such as photovoltaic and wind power plants. This leads to a shift of feed-in from the transmission to the distribution grids and thus to bidirectional power flows. To detect inverting power flows and possible anomalies in medium and low-voltage electrical grids, state estimation algorithms are increasingly used. The calculations of state estimation algorithms are usually based on grid topology data, which must include changes such as the activation of switches. Since state estimation algorithms are to be carried out autonomously in the future, procedures are necessary that recognise these changes and automatically determine the current grid topology as well as the current grid state.

Within the scope of this thesis, an extensive familiarisation with publications for an automated, real-time and robust estimation of the grid topology in distribution grids based measurement data from digital local substations and smart meters is to be carried out first. In this step, among other things, it is possible to fall back on knowledge from theses already carried out at ie[3] as well as literature research that has been already carried out. The methods for automated topology detection, especially optimization and artificial neural networks, are to be investigated and evaluated with regard to their complexity, robustness and realisation in network operation. Afterwards, a suitable procedure is to be selected which is capable of recognising and estimating the current network topology on the basis of currently measured values. The procedure is to be implemented in a suitable development environment. A Python development environment available at the institute can be used for this. The functionality of the procedure will then be evaluated.

The following structuring of the work is proposed:

- Familiarisation with and literature research on the subject area
- Familiarisation with the development environment and Python
- Listing and qualitative evaluation of methods for automated topology estimation
- Development and implementation of a suitable procedure
- Generation of scenarios for the application of the procedure
- Exemplary application on the developed scenarios and evaluation of the procedure
- Variation of the availability of measurements and evaluation of the procedure with reduction of the network observability

Following this work, the results are to be reported in a presentation.
This thesis is now being awarded as a Master's thesis for students of electrical engineering and information technology, industrial engineering and automation and robotics.
Day of issue: dd.mm.yyyy
Day of submission: dd.mm.yyyy
Responsible: M. Sc. Thomas Schwierz, Thomas.Schwierz@tu-dortmund.de
                M. Sc. Thomas Oberließen, Thomas.Oberliessen@tu-dortmund.de