

Master Thesis in the Research Field: Control and Automation Systems

Analysis of different distribution networks and validation of a voltage regulation algorithm using distributed measurements on a real-time simulator

The non-uniform behaviour of Renewable Energy Resources (RES) and varying loads introduce new operating conditions and complexities in the electrical grid. One of the major problems is the maintenance of the voltage within acceptable limits. The project 'i-Automate' at the institute ie³ focuses on implementing protection and control functionalities onto an existing power quality hardware. The measurement devices are installed across the distribution grid and the measurement values are sent to a central controller which is responsible for maintaining the voltage at all points of the network within acceptable limits. The electrical grids are simulated in a real-time simulator (RTS) in Simulink. The advantages of using the RTS include the simulation of the electrical at a μ -second speed and extraction/feedback of the analogue/digital signals from/to the RTS. The voltage control implementation will be validated in a real-world German electrical grid.

One of the current research topics at ie³ includes investigating the similarities and differences between the distribution networks across the world. For this purpose, real-world network data are being obtained from different partners. The different distribution networks have different operating characteristics and network topologies. For example, distribution networks in cold countries vary extensively from distribution networks in typically warm countries. This particular thesis deals with the distribution network of Fluvius, a Belgian utility company.

The scope of the thesis is three-fold. First, the student should analyse and identify unique features of Belgian distribution networks in comparison with the German and other distribution networks. Second, the student has to convert the available network data in different formats (Ex. Text file, Excel, PowerFactory, NEPLAN) to Simulink. Then the network can be ported to the RTS, so that the implemented voltage control functionality can be validated. Third, suitable test processes are to be developed for closed-loop simulations. The student will work on the literature research (first part of thesis) at KU Leuven, Technology Campus in Gent, Belgium and the (second and third parts) at TU Dortmund, Germany.

This work is recommended to be structured in the following way:

- Literature review of fundamental differences between different distribution networks
- Familiarisation of the implemented voltage regulation algorithm
- Import the distribution networks into the RTS
- Test and adaptation of the voltage regulation algorithm with different distribution grids
- Drawing of results
- Documentation of the work

The work is to be documented in English and the results are to be reported in a presentation.

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