Smart Area Aachen – State Estimation in Distribution Grids

D. Echternacht, W. Feilhauer, U. Geulen, W. Schrieder, P. Zimmer

Supported by:
Federal Ministry of Economics and Technology
on the basis of a decision by the German Bundestag
03ET7009C

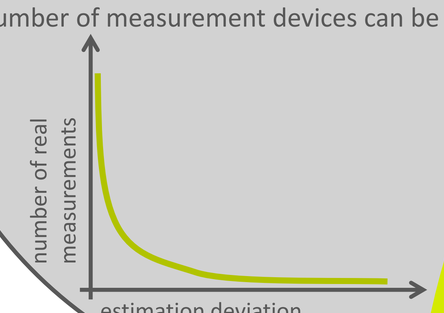
www.smartarea.de

- To evaluate and **verify** the calculated **estimation deviation** and optimal meter positions an **additional PSI control system**, identical to the existing one, is installed in the Stawag control center for verification tests.
- In the chosen **test area** in Aachen Richterich **11** out of 14 **substations** are to be equipped with **measurement equipment** (U, P, Q) and connected to the control center via **IEC 104**.

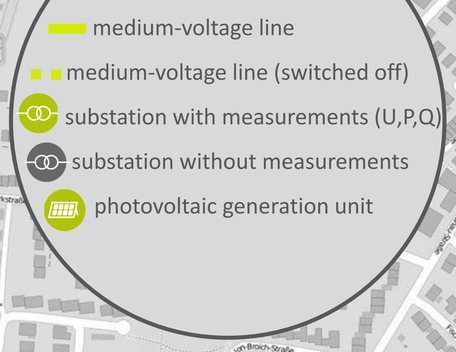
Verifying Developed Methods

Finding Optimal Meter Positions

- **Estimation deviation** can be **reduced by optimizing pseudo measurements**, e.g. using more sophisticated load profiles or by integrating **more measurement devices** (real measurements).
- As devices and required communication infrastructure are expensive additional devices' **positions** should be **chosen wisely.**
- The impact of additional measurement devices is evaluated using the presented methodology for calculating estimation deviation.
- Using a heuristic approach the optimal number and position for additional measurement devices is calculated.
- By varying the tolerated estimation deviation the relation between tolerated estimation deviation and required number of measurement devices can be derived.



Test Area Aachen Richterich



Introduction

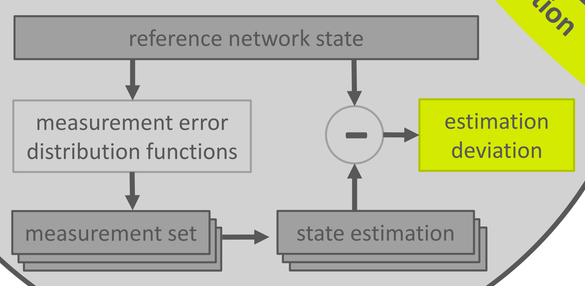
- **Smart Area Aachen** is about bringing together and **testing smart grid** technologies in a real world environment.
- The here presented **joint project** focuses on state estimation

State Estimation

- **State Estimation** in distribution grids (low- and **medium-voltage**) is facing multiple challenges:
  - **lack of real measurements**
  - increasing share of **unmeasured generation units**
- Knowledge of actual network state is important for other smart grid technologies.

Calculating Estimation Deviation

- The usage of **pseudo measurements** can **reduce** state estimation's **accuracy l**eading to a **deviation** between estimated and real network state.
- Starting with an artificial reference network state measurement sets superimposed with random measurement errors are generated in a **Monte Carlo Simulation** approach using the measurement error distributions.

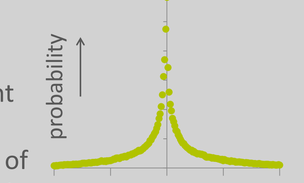


Pseudo Measurements

- Due to the lack of real measurements, **pseudo measurements** are inevitable **for observeability.**
- Generation of pseudo measurements for load and generation based on **load profiles** and **weather data.**
- **Quality of pseudo measurements** has significant impact on state estimation results.
- Comparison and evaluation of different generation methods is an important part of the joint project.

Measurement Errors

- To compare and evaluate pseudo measurements and their impact on state estimation accuracy the **measurement error is calculated.**
- To calculate measurement errors for e.g. small photovoltaic (PV) units a number of them is equipped with real measurement devices.
- Based on metrological data pseudo measurements are created and **compared to real data** for error calculation.



www.psienergy.de

www.stawag.de

www.iaew.rwth-aachen.de

Contact:
David Echternacht, E-Mail: de@iaew.rwth-aachen.de, Phone: +49 241 80 97671