Challenge

Transmission system operators (TSOs) are one of the key players for the success of the energy transition in Germany. Meanwhile, every third kilowatt-hour of gross electricity generation in Germany comes from renewable energies, mostly from fluctuating, weather-dependent sources. This also leads to a significant increase in expenses for grid operation. In addition to the traditional network expansion, the importance of energy data, forecasts and sensors for TSOs is also increasing. Extraordinary interventions by TSOs in the timetables of power plant operators (ReDispatch) and the control of wind power plants (Eisman) have gone from being an exception to the rule. It is therefore all the more important to automatically detect critical network situations in the control rooms and initiate appropriate countermeasures. This is where the DynaGridCenter research project comes in.

Control Room Functions

1. Dynamic system observability incl. identification and precise evaluation of dynamic reserves in the network
2. Process-oriented and continuous calculation and implementation of preventive and corrective control measures for system stabilization using high-precision synchronous measuring devices, e.g. PMU, RTU, taking into account modern communication interfaces to ensure process flows.
3. Intelligent measurement data evaluation / prioritization already at station level while maintaining performance and taking into account challenges in the field of IT security (cybersecurity)
4. Prediction of dynamic network behaviour in the event of an accident or fault
5. Continuous, hierarchical validation of the current or to be changed protection and controller settings in relation to the current network status
Main focus of Fraunhofer IOSB-AST

- Algorithms for dynamic system observability incl. identification and precise evaluation of dynamic processes in the network, AC/DC and Ultranet
- Intelligent DynaGridCenter measurement data evaluation application in compliance with performance and IT security aspects

Data Compression

- Hierarchical method for eliminating redundant information (spatial-time data compression)
- Compression rates: 3 to 18
- Lossless compression: full recovery of original data

Extraction of potential error patterns from historical data records

- Use of machine learning methods for outlier detection
- Automated evaluation of mass data
- Analysis of signal behavior in the time and frequency domain (e.g. wavelet transformation)
- Automated evaluation of critical network situations and dynamic network behavior

Online detection of network faults (e.g. generator failures)

- Detection of typical types of faults by pattern recognition in online operation
- Use of machine learning methods (e.g. artificial neural networks, support vector machines)
- Dynamic network simulations and evaluation of failure scenarios

Project consortium

- Advanced System Technology (AST) Branch of Fraunhofer IOSB
- Fraunhofer IFF
- TU Ilmenau
- Otto-von-Guericke-Universität Magdeburg
- Ruhr-Universität Bochum
- Siemens AG

1. Developed evaluation procedures based on PMU data
2. Analysis tool for evaluating dynamic network situations