

A Laboratory-Based Three-Phase Smart Grid Sensor Network Testbed

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A laboratory-based three-phase sensor network testbed for the Smart Grid was developed at the Smart Grid and High-Power System Laboratory of The University of Hong Kong. The setup is featured by a scaled three-phase transmission-line model, visualization of sensor measurement, optical communication network, and integration with global positioning system (GPS). The three-phase transmission-line model consists of three power cables and two transmission towers in which various types of sensors, including magnetic sensors, infrared sensors, strain gauges, and accelerometers, are installed to monitor the condition of the transmission lines and the transmission towers. Magnetic sensors and infrared sensors are employed as advanced sensors, which can provide more accurate and comprehensive information of the transmission line. The sensor data is transferred to a computer for analysis and visualization. A graphical user interface (GUI) was designed in LabVIEW to integrate the data acquisition and display the measurement results, including cable position, inclination and vibration of the tower, and frequency and waveform of the cable current. The host computer also forms an IP network with five remote computers, via optical fibers and an optical interface card, for testing various communication protocols. The topology and connectivity of the network are graphically displayed. The sensor network is integrated with GPS and can perform synchronized measurement with the GPS timing. This sensor network testbed provides a platform for the implementation testing, experimentation, and feasibility evaluation of new sensor applications under test in the Smart Grid.

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