

Energy Expertise

// Smart Grid Research & Laboratory

Main expertise areas

Power System:

- Modelling and Optimization
- Decision making under uncertainty
- Reliability evaluation
- Renewable Generation Integration
- Energy Storage Systems
- Demand Side Management
- Smart Metering

ICT System:

- ICT-Power System Integration
- Machine Learning & AI
- Wired/Wireless Communications
- Big Data Analysis
- Internet of Things

Smart Home/Building:

- Home Energy Management
- Energy Efficiency Improvement
- Smart Home Demo

Green Vehicles:

- Charging & Management Algorithms
- Vehicle-to-Grid (V2G) Integration
- Vehicle-to-Everything (V2X) Communications



Durham University Smart Grid Laboratory

Background

The Smart Grid Laboratory hosts a low-voltage network and a wide range of low carbon technologies. It has been designed to enable research on the solutions to resolve network constraints driven by the transition to a Net Zero economy.

The Laboratory consists of an experimental low voltage distribution network, 2 Real Time Digital Simulators (RTDS) system which connect to the experimental network via 3-phase Power Amplifier, a PV Emulator, a Wind Generation Emulator, an Electrical Energy Storage (EES), Microgrid testbed and Smart Meters. The system is fully instrumented with precise measurement boards, integrated with high-speed data communication network, and human-machine interface.



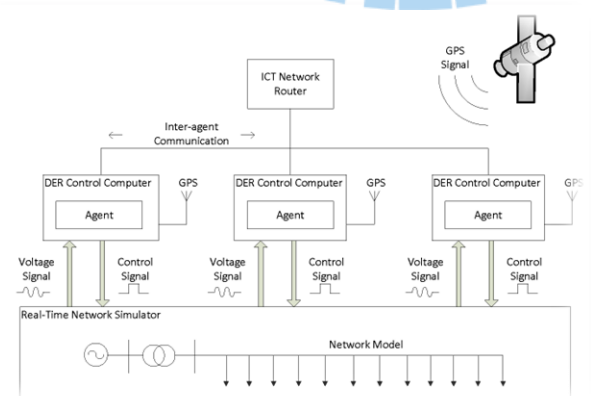
Prof. Hongjian Sun and Dr Behzad Kazemtabrizi

Recent projects

- EPSRC project: Decarbon8 - An integrated network to decarbonise transport
- National Grid Project: Combined Visual Data Twin Project
- EU Horizon 2020 Project: Testing And Evaluating Sophisticated Information And Communication Technologies For EnaBling ScalABLE Smart Grid Deployment
- EPSRC: Centre for Energy Systems Integration (CESI).
- EPSRC: HOME-Offshore – multidisciplinary multi-partner project on investigating measures for enabling large-scale offshore wind integration
- Offshore Renewable Energy Catapult: Novel power systems planning tools for infrastructure planning of offshore wind transmission infrastructure under severe uncertainty (industry-sponsored studentship sponsored by ORE Catapult)

Research examples

- Developing systems to coordinate multiple networks which can reliably transmit data, and then manage ICT system resources to efficiently extract useful information for supporting smart grid applications
- Operational planning and optimisation in flexible active distribution networks with large-scale renewable resource integration
- Collaborative project with Offshore Renewable Energy Catapult on developing novel power systems planning methods for infrastructure planning of offshore wind transmission systems under severe uncertainty
- Multidisciplinary multi-partner project on investigating measures for enabling large-scale offshore wind integration
- Modelling of pumped thermal electricity storage systems for grid-scale storage applications and grid integration studies
- Demonstrating that a self-organizing network of distributed energy resource controllers can derive network topology information for making smart control decisions. The methodology includes controller hardware operating on a network that runs in closed-loop operation with real-time distribution network simulation using RTDS.
- Designing smart pricing schemes to enhance demand side management functionalities. It adopts multi-objective optimization approaches that empower various market actors in smart grids. In addition, the privacy concerns of consumers are addressed.
- Studying the impact of network flexibility in enhancing network stability and security of operation
- Evaluating the impact of large-scale renewable energy integration into power system stability and security



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