

Energy Expertise

// Energy Systems

Main expertise areas

- Low voltage DC networks
- Control and operation of flexible hybrid AC/DC networks
- Integration of energy storage
- Uncertainty in large scale energy systems models
- Mathematics of energy systems
- Decentralised control in power networks
- Smart grid communications
- Power system optimisation, methods and formulations (optimal power flows, security-constrained optimal power flows)

Background

Over the coming years, electrical energy systems will become more complex based on a smart grid paradigm with a much greater number of customers and generators interacting with the network. This will require management of greater level of variability and uncertainty due to higher penetrations of renewable generation which has variable and uncertain output, and demand (e.g. charging of electric vehicles). There is also a desire to plan, operate and maintain the system based on cost and reliability risk analysis, as opposed to using traditional approaches such as requiring the system to be operable with any one or two components on outage. Researchers at Durham are working to meet these challenges developing new mathematical and statistical technologies into system operation and planning.

Research team

Dr. Behzad Kazemtabrizi - Renewable Energy Integration, control of modern power systems, smart grids, reliability evaluation

Dr. Hongjian Sun - Smart Grids, renewable energy resources, cognitive radio, and cooperative communication techniques

Prof. Michael Goldstein - reliability and risk modelling, uncertainty analysis, Bayesian statistics

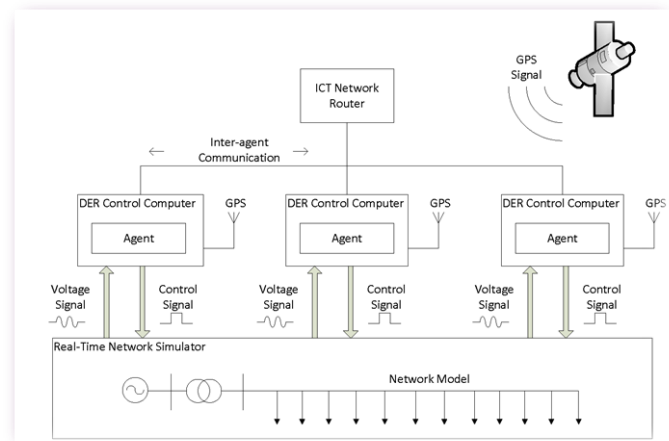
Dr. Rui Carvalho - Optimisation, data science, and decentralised control.

Dr Jun Jie Wu: Developing techno-economic models and energy footprints of microalgae biorefineries and energy using pressure retarded osmosis.



Research projects

- **National Centre for Energy Systems Integration** Looking for the first time at the energy system as a whole; gas, power, renewables, heating and cooling, the centre will pave the way to a flexible smart infrastructure, to help empower customers, understand future supply and demand, directly address energy security risk and reduce carbon emissions (Simon Hogg, Jon Gluyas, Simone Abram, Michael Goldstein, Tooraj Jamasb).
- **Testing and Evaluating Sophisticated information and communication Technologies for enabling a smartEr grid (Testbed) project** a major interdisciplinary EU-funded project coordinated by Durham to build and test sophisticated ICT to facilitate the successful implementation of smart grid applications (Hongjian Sun).
- **High Energy And Power Density Solutions to Large Energy Deficits** Studying the interface between local DC networks and the main AC power system (Behzad Kazemtabrizi & Mahmoud Shahbazi)
- **Energy Storage for Low Carbon Grids** Valuation of storage at whole system level, including in day-to-day operation, security of supply, and markets (Gruff Edwards, Sarah Sheehy & Matthias Troffaes)
- **Pumped Thermal Energy Storage** Technology specific modelling of thermal energy storage for power system optimisation applications (Chiara Bordin, Ahmad Ibrahim and Behzad Kazemtabrizi)
- **Uncertainty in large scale energy systems models** Statistical analysis to give better links between large scale techno-economic models and real energy systems, with the aim of better policy decision making (Michael Goldstein)
- **The Autonomic Power System** Developing methods for analysis and control of highly decentralised power systems (Manolis Loukarakis, Jiangjiao Xu, Antony Lawson, Michael Goldstein)
- **Mathematical Foundations for Energy Networks** Developing new mathematical approaches to managing complexity and uncertainty in future energy networks (Rui Carvalho)
- **SmarterEMC2** Scalable communication solutions to support ICT tools for smartgrid services (Hongjian Sun)



Contact Details:

Durham Energy Institute (DEI)
Durham University
Durham, DH1 3LE, U.K.

Tel: +44 (0)191 334 2649

Email: dei.admin@durham.ac.uk