



Energy Institute System Modelling and Optimisation Virtual Summer School

July 26th – July 30th

Chaired and Hosted by: Prof. Andrew Keane

The electrical grid is undergoing a transformation and is central to the ongoing energy transition. It is a critical infrastructure for societies and one of the most complex man-made systems ever developed. The modelling of this system of systems remains a major high level research challenge and solutions and technologies deployed on the system often call on innovative development and use of optimisation methods. Coupled with this are emerging data driven methods being applied to power system challenges reflecting the increasing volume and complexity of data generated from and communicated throughout the power system. The aim of the Summer School is to provide a structured series of 45-minute Masterclasses covering the topics encapsulated by the description above. The aim of each contribution is to deepen the audience's understanding of each topic with Q&A and discussion encouraged. The Summer School is sponsored and organised by the UCD Energy Institute and the SFI ADEPT Project.

where: zoom (links to be provided closer to the date)

Agenda

Monday 26th: *Advanced Tools for System Modelling*



10:00

Manuel Marin (KTH - TBC): Spine Toolbox is an open-source software to manage data, scenarios and workflows for energy grids modelling and simulation. This presentation will focus on some of the main capabilities of the SPINE toolbox.

11:00

Valentín Rigoni: 'Open-DSOPF: An open-source unbalanced three-phase OPF formulation' - presentation of the public libraries and example of DER modelling and integration with the OPF formulation. Examples showing potential interactions with OpenDSS.



Tuesday 27th: *Novel techniques and tools for power system Optimisation*

10:00

Alireza Soroudi (Optimisation modelling tools , Open Source/Commercial)

- ❖ What is optimisation? Why do we need it?
- ❖ Some general examples in GAMS and Pyomo
- ❖ Cons and Pros of commercial and open source tools
- ❖ Optimisation elements
- ❖ Examples (Power System and General

11:00

Frederik Geth (CSIRO - Australia): Applications of distribution network optimization models

- ❖ How can optimization help us develop smarter network solutions?
- ❖ Gaps between network simulation and optimization
- ❖ Role of optimization in: state estimation, system identification, coordination and control, planning and differential privacy
- ❖ Validation and benchmarking of optimization models through open tools

12:00

Alireza Nouri (Optimisation in distribution systems)

- ❖ What is convex optimization (basics, simple examples, advantages, applications)
- ❖ How to apply convex relaxation to solve optimization problems in distribution systems (examples of applications)
- ❖ Advances in convex optimization in power systems (an introduction to relaxation tightening)

Wednesday 28th: *Emerging Methods*

10:00

Valentín Rigoni: 'Machine learning applications for the future power system' Applications of regression analysis, clustering techniques and artificial neural networks for tackling various challenges associated with DER integration.

11:00

Mohammad Jafarian (Statistical modelling to deal with uncertainty in distribution systems)

- ❖ Uncertainty in distribution systems
- ❖ Statistical modelling (definition, categories, differences compared to machine learning)
- ❖ Discriminant analysis (description, particular attractions for distribution system analysis)
- ❖ Gaussian Process Regression (description, applications in distribution systems)



Thursday 29th: *Applications*

14:00

Bob Currie (Kevala Technologies, USA): A distributed energy resource management system (DERMS) is a platform for the management of aggregations of distributed energy resources. DERMS are expected to become a crucial aspect of future energy grids as they aggregate, simplify and optimize resources for a coordinated support to the power system.

14:45

Abbas Rabiee: Green hydrogen, A new flexibility source for security constrained scheduling of power systems with renewable energies

- ❖ Security-constrained multi-period optimal power flow (SC-MPOPF) model including the Power-to-Hydrogen (P2H) units
- ❖ Modelling the behaviour of electrolyser: reactive power support by P2H units and hydrogen storage capability
- ❖ Characterization of the P2H demand flexibility in the proposed SC-MPOPF model,
- ❖ Wind curtailment control by large-scale P2H units.

15:30

Ciara O'Dwyer: Spine is a Horizon 2020 project which has developed an end-to-end energy modelling toolbox, enabling the open, practical, flexible and realistic planning of future European energy grids. This talk will present one of the case studies which highlights Spine's capabilities. Case study C3 demonstrates integrated energy system planning while maintaining high operational detail, with a focus on long-term (hydrogen) storage

16:15

Federico Prystupczuk: Hybrid Power Electronic Transformer Model for System-Level Benefits Quantification in Energy Distribution Systems” - Presentation of the Hybrid Transformer concept, its potential applications and benefits in the LV distribution network, and a modelling approach for power flow simulations including power electronics losses.

Friday 30th: *Closing*

Early dinner at **Camden Yard by village markets** at **5pm**

<https://irishvillagemarkets.ie/location/camden-yard-by-village-markets/>

- We will be meeting at 5pm at the market location and bring food to **Iveagh Gardens**
- The market offers 3 food trucks: Pinchos, Hong Kong Barbecue and Golden Brown
- There are other take away options in the area

