Name of the course: Real-Time Simulation and Hardware in the Loop Testing of Inverter Based Resources

Teacher: Fabio D'Agostino; e-mail: fabio.dagostino@unige.it

Duration of the course: 12 hours

Credits: 3

Language: English.

Aims of the course: The course aims to introduce participants to real-time simulations and hardware-in-the-loop (HIL) testing for inverter-based resources (IBR). It covers advanced modelling of IBR, implementation in Opal-RT, control loop setup for power amplifiers, and HIL testing. The course is designed to provide a practical understanding of setting up a HIL facility to test a Type-4 Wind turbine emulator, coordinated with a Battery Energy Storage System, and scale up resources at the power system level.

Teaching programme:

Part 1) Introduction to Real-Time Simulation

- Definition and importance of Real-Time Simulation
- Introduction to Opal-RT Simulator, applications, and examples

Part 2) Advanced modelling of Inverter Based Resources (IBR)

- Understanding IBR: concepts and components
- Advanced techniques in modelling and implementing IBR in Opal-RT

Part 3) Setup of the Power HIL Testing

- Understanding power amplifiers and system loop limitations
- Setting up a HIL configuration with power amplifiers and real-time simulator

Part 5) Showcase of small-scale emulator of wind turbine Type-4 IBR

- Introduction to wind turbine Type-4 IBR (full size converter)
- Introduction to rapid prototyping and step-by-step analysis of the emulator

Part 6) Power Hardware in the Loop Testing

- Techniques and considerations in Scaling Up IBR for power system studies
- Conducting HIL testing with power amplifier and wind emulator

Each section includes a mix of theoretical concepts and practical applications to provide a comprehensive understanding of the subject. The course is designed to be interactive, with opportunities for students to ask questions and engage in discussions.

Exam modality:

Written multiple-choice questionnaire proposed and completed during the last lesson of the course.

Bibliography:

Slides provided by the teacher.