PhD in Analysis and Control of Future Smart Grids

Key words: power systems, smart grids, renewable energy, power converters, control for ancillary services, power systems with high penetration of power electronics

Context: Ecole Centrale Nantes (ECN) is fully involved in Renewable Energies (RE) technologies such offshore and onshore wind, wave and solar energy. ECN tackles some important thematics of control of modern power systems and grids both in teaching and research.

The *system view* will be promoted as a way to face challenges of smart grids of the future: stability issues due to massive integration of power electronics and renewables, new grid reinforcements (HVDC lines/grids), new renewable energies and their integration to the grid and ancillary services, etc. Because of increased dynamic interactions and complexity, problems can no longer be treated one by one based on separation hypothesis and next solutions packed together. A *system-based approach*, which takes into account dynamic interactions and a *global/system view* (as much as possible) is needed. For this, the actual framework of reflection/knowledge in power systems both at the specification as well as at the methodological levels will be enriched with concepts for modeling, analysis and control from the automatic control community. This should be finely merged with the knowledge about materials (power converters, new technologies of renewable generators etc.).

These thematics are strongly integrated in the H2020 POSYTYF project (https://posytyf-h2020.eu/). This project is a Research and Innovation action of the European Commission (EC) focused on the development of an innovatory concept of Dynamic Virtual Power Plant (DVPP). The latter is supposed to allow an optimal portfolio of dispatchable and non-dispatchable RE sources. Dynamics in the sense of stability assessment and control for RE sources participation to ancillary services are the main focus areas of the project.

The PhD proposed here will focus on development and hardware-in-the-loop implementation and validation of control solutions for the DVPP. More specifically, a comparison between *centralized* and *decentralized* control approaches for various RE generators is targeted.

Tasks: The candidate will:

- Invest in existing controls in the POSYTYF team and also, develop new control methodologies
- Implement and test several controls in the hardware-in-the-loop POSYTYF benchmark which exists in the LS2N lab (**Hardware:** One 20 kW Permanent magnet synchronous generator, One 20 kW synchronous generator, One 20 kW Doubly-fed Induction generator, One 20 kW DC source for solar PV emulation; **Software:** Opal-RT real-time simulation environment (RT-LAB, e-MEGASIM & e-PHASOR) coupled to the aforementioned hardware

Competences needed:

- The candidate should have background and knowledge in interconnected power systems and transmission grid and experience in hardware-in the-loop with hardware based on power electronics and generators (rotating machines) with consistent grid simulation for the real-time emulation (Preferably using OPAL-RT real-time simulator)
- Working knowledge of MATLAB/Simulink Simscape environment

Schedule:
Recruitment: As soon as possible
Duration: 36 months
Work will take place in ECN, Nantes-France.

Contact:
B. Marinescu, Ecole Centrale Nantes,
Head of the *Dynamics of Smart Grids* team of LS2N-ECN, Coordinator of the H2020 POSYTYF and Erasmus DREAM projects,
Bogdan.Marinescu@ec-nantes.fr,
(33) 2 40 37 69 46