SuperGrid Institute
Shaping power transmission

Job offer

SuperGrid Institute is recruiting an Intern

"Electro-mechanical mode identification in power systems: HIL/PHIL experiments"

SuperGrid Institute brings together 180 employees, of 28 different nationalities who work together within a dynamic environment in the city of Lyon. As an independent research and innovation centre, we are dedicated to developing technologies for the future power transmission system, the "supergrid", including HVDC & MVDC technologies.

As a multi-disciplinary research centre with advanced simulation capabilities & multiple test platforms, including numerous associated laboratories, SuperGrid Institute uses its comprehensive expertise to provide a wide range of services and solutions to support our customers in developing power systems, equipment and components. We specialise in system architecture and work on ensuring network security and stability while allowing for the integration of intermittent renewable energy sources. Find out more by visiting our website: **www.supergrid-institute.com**

General Context

We are on the verge of a crucial moment for electrical power systems, i.e., a moment of energetic transition and of new technological opportunities. For example, the rise of power-electronic conversion systems brings new opportunities to complement traditional AC grids with services and also, offering potential novel solutions to existing challenges. Another example is the increasing penetration of renewables (e.g., solar and wind[1]) in the electricity network, which is bringing new challenges such as extreme oscillatory network behavior and even potential network instability.

Model-based engineering has become the standard approach used for design, operation and control of power networks. Consequently, many activities required to make modern electrical grids operate are based on some underlying model[2]. These models can represent either a given device/component, e.g., a generator or HVDC terminal, the whole or a part of the electrical grid.

An important consequence of this transition described above pertains to the electrical grid dynamics. It is indeed observed that these dynamics become increasingly active, complex and time-varying[3] and require new methods for the model-based engineering methods used in power systems. In fact, recent major power outages can directly be related to the use of inaccurate models.

System identification (data-based modeling) is a promising and increasingly used technology that can potentially face the new challenges. Indeed, it allows to derive control-oriented and accurate models by extracting the underlying dynamics from the observed dynamical behavior of the system (i.e. through observed data)[4]. As opposed to many physical models, the dynamics of the actuators (e.g., HVDC link[5]) and the sensors (e.g., PMUs) are directly taken into account using this modeling technique and the models can easily be adapted if new dynamics are observed via the collected data[6].

[1] S. Boersma et al., "A tutorial on control-oriented modeling and control of wind farms," 2017 American Control Conference (ACC), Seattle, WA, 2017, pp. 1-18.
[2] Model validation using Phasor Measurement Unit Data, NASPI Technical Report, 20 March 2015.
[3] Yin, Congqi; Xie, Xiaorong; Xu, Shukai; Zou, Changyue, "Review of oscillations in VSC-HVDC systems caused by control interactions", The Journal of Engineering, 2019, 2019, (16), p. 1204-1207, DOI: 10.1049/joe.2018.8634
[4] M. Annergren, C. A. Larsson, H. Hjalmarsson, X. Bombois and B. Wahlberg, "Application-Oriented Input Design in System Identification: Optimal Input Design for Control [Applications of Control]," in *IEEE Control Systems Magazine*, vol. 37, no. 2, pp. 31-56, April 2017.
[5] J.-C. Gonzalez, ``*Transient stability of high voltage AC-DC electric transmission systems*", PhD thesis, Université Paris Sud, SuperGrid Institute, 2018
[6] R. Pintelon and J. Schoukens, System Identification : A Frequency Domain Approach, Wiley-IEEE Press, 2012.

Objectives / Missions

SuperGrid has recently started a project on the use of system identification in power systems. Two main objectives are formulated: 1) identify models for controller design and 2) estimate the evolution of the low damped modes in the network. Initial results have been obtained, but many open research questions remain to be answered. One leap towards successful system identification implementation is to test system identification in a HIL/PHIL platform that is combined with the high fidelity power system network HYPERSIM. This MSc project aims to do exactly that. The first (theoretical) part of this project will entail the design of appropriate identification experiments to e.g. identify a model for control design or to estimate low damped modes in the network. The second part of this project will be to test these identification experiments in the HIL/PHIL platform available in SuperGrid. The development of new software is necessary to successfully test identification in the HIL/PHIL platform. This project a challenging because both theoretical and practical skills are required for successful execution. This candidate is therefore able to learn a broad spectrum of interesting aspects that come along with system identification in power systems.

Candidate Profile

We are looking for a candidate who is motivated to get the most out of this (salaried) project for him/herself and Supergrid and who is able to work independently. It is the candidate's project hence being able to work independently is necessary and the supervisor at SuperGrid is available for discussions and support. The aim of the project is challenging, which allows the candidate to study/learn many interesting elements (system identification, programming, power system as application, laboratory setup). Strong programming skills and a decent mathematical background are required.

Other information

Applications should be sent to the following address: internship@supergrid-institute.com.

Start date:	**Ref. Budget:**
Place of work: SuperGrid Institute	**Duration**:

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SuperGrid Institute is an equal opportunities employer. We respect and value the diversity of our employees, their backgrounds and their experiences. Diversity is at the heart of our operations and we are committed to forbidding any discrimination within our management of human resources. SuperGrid Institute is dedicated to making all of its posts accessible to people with disabilities.