

Internship Offer: VoltControl

Decentralized Voltage Control in the Electrical Sub Transmission Grid

Duration: 5 to 6 months

Desired start: Between March 2026 and July 2026

Internship level: Master's / Final-year Engineering student

Location: Laboratory of Signals and Systems (L2S), French research laboratory located in Paris-Saclay University - RTE Chair "The Digital Transformation of Electricity Networks"

Contact: Patrick Panciatici and Sorin Olaru.

1 RTE Chair at CentraleSupélec

The RTE Chair is a partnership between RTE and CentraleSupélec, coordinated by Prof. Sorin Olaru. For several years, RTE has been studying the potentialities offered by digital technologies in the management of the electrical system.

Building on its close scientific and educational relationships with CentraleSupélec, RTE has sought to strengthen this collaboration and establish this new partnership in the long term in order to accelerate its innovation processes and benefit from the scientific expertise of leading research teams with which to interact in the field of engineering sciences.

RTE is the operator of the French high- and extra-high-voltage transmission network. RTE provides a public service mission by guaranteeing the proper functioning and security of the power system in France. It operates, maintains, and develops the transmission grid to meet the needs of its customers, while ensuring economic efficiency, environmental responsibility, and supply security.

Its central role in the French and European power system makes RTE a unique pioneer in anticipating energy futures.

2 Context

Large-scale power systems are undergoing radical change. The transition to a low-carbon or even zero-carbon economy is driving electricity generation from non-carbon sources and increasing electrification in energy-intensive sectors. This shift raises critical questions about the integration of renewable energy into the grid, which power system stakeholders must address.

As complexity grows, ensuring reliable operation becomes more challenging. Modern power systems, now intricate cyber-physical networks, require advanced engineering solutions. Renewable energy sources—primarily solar and wind—are inherently variable and rely on stochastic primary power flows. They typically connect to the AC grid via power electronic converters at various power and voltage levels, introducing highly controllable elements capable of rapid response.

To manage this complexity, automatic control is essential, leveraging feedback strategies to mitigate disturbances and enhance performance while avoiding costly, over-sized infrastructure. However, as more active devices emerge at the system's edge, centralized control becomes impractical and fragile. In this context, distributed control is a necessity.

A structured approach based on hierarchical control and protection strategies is required to ensure stability and efficiency in large power systems undergoing transition, taking into account the inherent separation of time scales in system dynamics.

3 Internship Objectives

The work proposed in this internship focuses on secondary voltage control in the sub-transmission grid. Maintaining the voltage magnitude within the normal range is essential to prevent the disconnection of loads and generation units by their protection systems, as this could result in cascading failures and blackouts. The recent blackout in the Iberian Peninsula demonstrates how poorly designed primary and secondary voltage controls can lead to a massive blackout. Grid operators can design secondary voltage controls that coordinate the voltage setpoints of the primary voltage controls, which are traditionally provided by generating units. This prevents units from reaching their reactive power limits by utilizing all possible degrees of freedom, including capacitors, reactors, tap changer setpoints, and topology.

RTE has such a system for its 400 kV transmission grid (RSCT), but it does not have secondary voltage control for the sub-transmission grid which needs to account for different degrees of freedom.

The main objective is to investigate the feasibility of a local advanced control based on Model Predictive Control. The idea is to update the test case already available for congestion management developed in a recent PhD thesis. Matlab test case and Simulation.

4 Internship Plan

The main steps are as follows:

1. Understanding and formulating of the problem
2. Understanding the existing test case, reviewing and upgrading the modeling to capture voltage and reactive behaviors.
3. Performing simulations that create interesting initial conditions and contingencies that lead to voltage/reactive issues.
4. Developing computation of sensitivity matrices necessary to develop MPC.
5. Implementing a first MPC that acts only on the primary voltage controller's setpoints.
6. Designing an approach to using discrete actions in MPC : switching capacitors and reactors.

This internship is intended to lay the groundwork for more in-depth doctoral study on the same topic. Students interested in pursuing a Ph.D. after the internship will be given priority consideration.

Thanks to the RTE Chair at CentraleSupélec, this work will be carried out in close collaboration with RTE.

Profile and Skills

The selected student must have strong analytical skills, be capable of working autonomously, and have a logical approach to problem-solving. Knowledge of automatic control, electrical engineering, and mathematical programming is desirable. The student will perform software development and data preparation tasks. Proficiency in MATLAB and an interest in programming are preferred.