

## Ph.D thesis proposal

# Fault location for MV distribution networks using sparse distributed measurements

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**Starting Date:** December 2024 (36 months)

**Location:** Gif-sur-Yvette (in Paris area)

**Keywords:** fault location, MV distribution networks, digital substations, phasor measurement units, hardware-in-the-loop

### Context

Smart digital substations enable to improve the power system reliability thanks to more collected data in real time (or close to real time). As an example, grid operators (both TSOs and DSOs) need to identify and locate faults faster and faster to ensure the grid reliability and improve the quality of service. Additionally, they are interested in solutions for predictive maintenance that could enable a maintenance before a fault tripping. The fault location issue is more complex in radial distribution grids as only few measurements are available. Typically, in MV (medium voltage) grid currents and voltages are only measured in the primary substation (that connects MV grids to HV grids, at the TSO-DSO interface). Consequently, the capability to locate a fault precisely enough is quite low especially in a radial network with a large number of secondary lateral branches, and with uncertainties of network parameters (impedances) and power flows in radial branches. Nevertheless, new sensors – phasor measurement units (PMU) – are now proposed to get access to more synchronized data in a wider area network.

### Objectives and Research program

In the present PhD project, we propose to use PMUs that would be installed in only few MV/LV secondary substations to improve the fault location capabilities. A first algorithm developed during the PhD of A. Bach [1] [2] for line-to-ground faults will be extended to line-to-line faults, and the influence of distributed generators on the performances will be assessed. Furthermore, the initial algorithm will also be extended to transient faults as they occur in compensated neutral grounded MV grids. PMU recently bought by the GeePs will be used for experimental tests, either in a Hardware-In-the-Loop (HIL) approach or in on-site approach.

The research work will be organized as follows:

- Literature review on the following topics:
  - Fault location in compensated MV distribution networks
  - Phasor measurement units for MV networks (D-PMU)
  - Fault behaviour of distributed generators/active loads
- Modeling and analysis of permanent/transient faults using software such as EMTP-RV or Matlab/Simulink
- Extension of the previous fault location method [1][2] in case of line-to-line faults and transient faults.
- Optimization of additional measurement (e.g. PMU) placement and number
- Performance analysis: Sensitivity study of the method to uncertainties (line impedances, fault resistance and distance, production, consumption, measurement noise, sampling frequency).
- Tests with HIL approach/on-site measurements

### Candidate profile

- Eligible candidates should have a Master degree on electrical engineering.
- Experience in power system simulation and HIL would be an advantage.
- Good communication skills (both oral and written)

### Contact

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### References

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