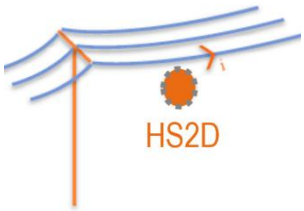
2023-2024 Internship proposal: SNCF Réseau-G2Elab collaboration

Novel contactless DC high-intensity current sensor for railway network monitoring.

Abstract

G2Elab (Grenoble) collaborates with the French railway company SNCF Réseau towards the development of a contactless magnetic device to monitor in real-time the high-intensity currents flowing through the network of overhead cables, to optimise electrical power consumption and reduce energy waste in this major industrial field.

Our novel instrument numerically analyses the multiple signals from an array of individual magnetic sensors (magnetometers) placed near the target cable, to determine the current inside while rejecting the signal from other nearby cables and from the environment.



This patented HarmoSense2D technology exploits the spatial harmonic properties of the global magnetic field, to segregate the different present sources and automatically calibrate the relative position of the target cable.

Several demonstrator prototypes have been built, which can precisely identify AC or DC currents of various intensity levels, depending on the specifications of the individual magnetometers chosen:

sensitivity, offset, range, stability, noise level, linearity, bandwidth…

HarmoSense2D is a promising non-contact technique: it can be non-invasively installed on existing cables without service interruption, either permanently or for one-shot measurement monitoring missions.

Challenge

We used high-performance research-grade magnetometers so as to assess our technology's maximum potential. Nevertheless such high performance comes at the price of limitation on some specifications ; real-life applications imply using available off-the-shelf magnetometers and choosing the one best adapted to the requirements of the current-sensor.

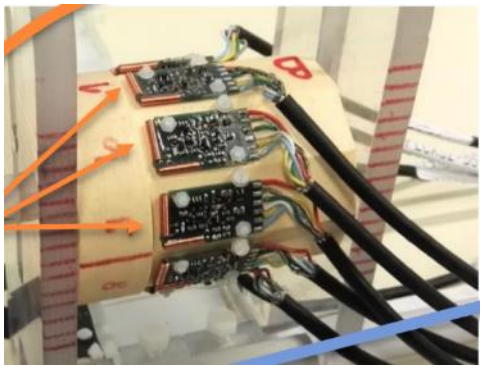
In this respect railway monitoring poses a strong challenge on the specifications:

- trains consume very high intensity currents => extended magnetic field range;
- DC currents are widespread => DC-capable magnetometers (eliminating AC-only magnetometers);
- short-circuit identification requires detection of rapid transient current peaks => high bandwidth;

The present internship aims at finding the best magnetometer to answer this triple challenge, in order to progress one step closer towards practical applications in a (hopefully commercialized) industrial device.

Project description

- identify the most suitable magnetometers on the market;
- comparatively test them in realistic conditions with/without background magnetic perturbations;
- determine (numerically) the impact of their intrinsic noise on the global sensor's performance;



According to project progress:

- implement the best fit into a new prototype sensor array;
- observe and characterise sensor array behaviour.

Profile & requested skills

We look for a motivated student with experimental skills: a background in signal acquisition or instrumentation is required.

Basic knowledge of magnetostatics will be an additional asset. The student should exhibit and team work capabilities.

Scientific & technical environment

The candidate will **work in Grenoble**, within a small G2Elab team at ENSE3 / GreEn-ER, in the heart of an exceptional scientific environment. The work will be performed in the framework of an existing collaboration with SNCF Réseau.

Subject could be continued with a PhD thesis / Engineering mission: *to be discussed*

Allowance Internship allowance will be financed by SNCF Réseau (6 months, ~1000 €/month gross)

Contact Applicants should send CV and motivation letter to orphee.cugat@grenoble-inp.fr

Reference Benjamin Wilsch, PhD (2016) https://theses.hal.science/tel-01599037/