

## **ALSTOM Internship proposal #1:**

### ***Multisensor system for reliable odometry of underground railway vehicles***

Localize precisely objects in the absence of GPS, for example in tunnels, is a very complex task which is still a research topic while increasingly needed for industry and services. At ALSTOM, we design systems able to manage a full underground network of driverless metro. Driverless metros estimate their location through odometers which measure the wheel rotation rather than the train displacement. However, the iron contact with the rail is subject to slipping/sliding which add uncertainty to the real train position. We measure the opportunity and the potential improvements brought by other sensors to estimate the localization, for example inertial sensors, camera/LIDAR, radar....

However, as risks for human is at play, our developments are constrained by safety norms which requires to characterize precisely the possible failures of our materials and algorithms, and to demonstrate that the probability of occurrence of each failure is sufficiently low. To our knowledge, none of the previously mentioned sensors is individually able to fit with these hard safety constraints.

The proposition of this internship is to find the best sensors architecture so that the combination of all of them provides a sufficiently precise estimation of the train location, while having a sufficiently low probability of error. For this purpose a predictive filter (Kalman, extended Kalman, particle filter...) will be developed to combine optimally the data of the different sensors and reduce the global probability of error. According to the precision of the different devices described in their technical sheet the final system shall reach a target performance while keeping a reasonable cost.

This internship could evolve to a CIFRE PhD co-supervised by ALSTOM (St-Ouen headquarters) and Antoine Manzanera (U2IS-ENSTA Paris) from Autumn 2025. During the PhD, we will implement and test the sensors architecture.

The candidate shall be currently in M2 or shall have validated a master degree. The internship is planned to last 6 months (shorter duration is negotiable), will start in 2025 (start date is negotiable), is located in St Ouen (accessible by Metro 13 & 14) and will be remunerated 1300€/month.

ALSTOM is a fully international company leader of green mobilities. All application will be considered independently of nationality, age, gender or handicap.

Contact: Send your CV to [gabriel.sulem@alstomgroup.com](mailto:gabriel.sulem@alstomgroup.com)