

ALSTOM Internship proposal #2:

Computer Vision based odometry and navigation for underground railway vehicles

Computer vision is one of the most developing research field and has growing applications in everyday life and in the industry. At ALSTOM, we design systems able to manage a full network of driverless metro. Driverless metros are completely blind and obtain location information and authorization to move through sensors and digital messages. We measure the opportunity and the potential improvements brought by a reliable vision algorithms to our systems: it could spot a structural element of the tunnel which felt, passengers walking on tracks, inform about the permissive / restrictive nature of a signal, or determine position / speed of the train with much lighter sensors than what is commonly used.

However, several constraints are specific to our environment. Metros are going from well-lit stations to dark tunnels, their environment is repetitive, and our developments are constrained by safety norms which constraint the family of algorithms which can be used.

The purpose of this internship is to study how to integrate computer vision algorithms to our systems. We are in particular interested in measuring displacement and speed (visual odometry), and we would like to determine the architecture of visual sensors to use (RGB camera, LIDAR, event cameras...) and the most reliable algorithms with the required precision and safety.

Nowadays, self-supervised deep network models have shown superior performance in both 3d estimation (depth prediction) and pose inference (visual odometry) on academic benchmarks for ground vehicles. It is expected that their application to railway vehicles should be facilitated by the constrained path. However, many challenges are faced by the adaptation of trained networks to a different environment.

The objective of this internship is then, first, to study the existing visual odometry methods for ground autonomous vehicles and select the most promising ones. Then, propose one or several adapted vision architectures and acquisition setups, and participate in an acquisition campaign driven by ALSTOM. The next task will consist in adapting / retraining the algorithm on the videos acquired from the railway vehicle and evaluate the possibility to adapt to this context. The result shall inform a comparison between deterministic and AI based algorithms and show for each step of the image analysis what is the additional value to use AI, how reliable it is, and whether it is acceptable in a safety algorithm.

This internship could evolve to a CIFRE PhD co-supervised by ALSTOM (St Ouen headquarters) and Antoine Manzanera (U2IS-ENSTA Paris) from Autumn 2025.

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