3iA Côte d'Azur
Interdisciplinary Institute for Artificial Intelligence

Ph.D. research topic

- Title of the proposed topic:

Machine Learning for target detection and tracking with distributed fiber optic sensing
Applications to transport networks monitoring

- Research axis of the 3IA: AI FOR SMART AND SECURE TERRITORIES
- **Supervisor (name, affiliation, email):** **Cédric RICHARD, Lagrange, UCA**
  cedric.richard@unice.fr
- The laboratory and/or research group: Lagrange Lab, UCA

Apply by sending an email directly to the supervisor.
The application will include:

- Letter of recommendation of the supervisor indicated above
- Curriculum vitæ.
- Motivation Letter.
- Academic transcripts of a master's degree(s) or equivalent.
- At least, one letter of recommendation.
- Internship report, if possible.

- Description of the topic:

Optical fiber, in addition to being a means of transmitting information, is also a material that is very sensitive to environmental variations. When a laser light pulse travels through an optical fiber, it interacts with tiny impurities in the material and optical backscattering occurs. Processing this response provides estimates of the local variations in acoustic pressure along the fiber. This technique, called Distributed Acoustic Sensing (DAS), is currently experiencing growing interest in an increasing number of applications.
The analysis of DAS data along entire fiber links can potentially revolutionize the management of transport networks, and becoming a key component for managing smart cities. Within this sector, one emerging application for DAS is the continuous monitoring over large areas of traffic patterns on roads, highways but also railways. The aim of the thesis work will be to devise efficient methods for vehicles' detection, classification and tracking along fiber links. Issues such as large data volumes, instrument noise, complex nature of the moving sources, directionality of the DAS measurements, and coupling of the ground movement to the fiber make the use of machine learning techniques very appealing. The PhD candidate will review existing literature on DAS signal processing with a focus on machine learning approaches. Indeed, little work has been done and there are only a few preliminarily contributions in the

literature, which involve RVM, GMM and MLP. The PhD candidate will analyze the properties of vehicle signals that can be used to better isolate and interpret traffic patterns. She/he will propose machine learning techniques, possibly coupled with sensor array signal processing algorithms, to process DAS data and monitor traffic over long distances. In this sense, the PhD student will have to propose algorithms based on solid foundations for a better resolution of the problem. The novelty of the application and the relative lack of a framework for DAS data processing should ensure fast dissemination of this work. In addition, data with ground truth information are already available.