3iA Côte d'Azur
Interdisciplinary Institute for Artificial Intelligence

Doctoral research topic

- Title of the proposed topic:
  Machine Learning methods for source separation in distributed fiber optic sensing data
- 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 including the list of the scientific publications
- Motivation letter
- Letter of recommendation of the thesis supervisor

- 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, over distances ranging from 40km up to 140km with some systems. This technique, called Distributed Acoustic Sensing (DAS), is currently experiencing growing interest in an increasing number of applications, e.g., traffic transportation monitoring, structural health monitoring, and natural hazards detection, to cite a few. As telecom fibers are ubiquitous in urban environments, DAS appears as a breakthrough concept to upgrade existing fiber optic networks to acoustic sensor arrays, and a key component for managing smart cities.

The team has gained substantial experience in machine learning for road traffic monitoring. They are now keen to thoroughly explore the additional opportunities presented by this technology for capturing and processing the pulse of a city. In particular, in many applications, DAS suffers from the multi-source aliasing problem and low-frequency noise, especially in noisy environments. Indeed, when multiple sources exist in the vicinity of a same sensing unit, their signatures mix and estimation of individual sources is disturbed by the other co-occurring sources. The aim of the doctoral research work will be to devise efficient algorithms for source

separation in DAS measurements. Issues such as large data volumes that can exceed 1 To per day and per fiber, instrument noise, complex nature of the moving sources, and directionality of the DAS measurements, make the use of machine learning techniques very appealing. The doctoral student will propose deep learning methods for source separation of DAS data. Experiments will be carried out on urban, costal and underwater noisy data.

The novelty of the application and the relative lack of a framework for processing DAS data should ensure fast dissemination of this work.