



**Offer #2024-07523**

## **PhD Position F/M Nonlinear observer design using AI tools**

**Contract type** : Fixed-term contract

**Level of qualifications required** : Graduate degree or equivalent

**Fonction** : PhD Position

### **About the research centre or Inria department**

The Inria University of Lille centre, created in 2008, employs 360 people including 305 scientists in 15 research teams. Recognised for its strong involvement in the socio-economic development of the Hauts-De-France region, the Inria University of Lille centre pursues a close relationship with large companies and SMEs. By promoting synergies between researchers and industrialists, Inria participates in the transfer of skills and expertise in digital technologies and provides access to the best European and international research for the benefit of innovation and companies, particularly in the region.

For more than 10 years, the Inria University of Lille centre has been located at the heart of Lille's university and scientific ecosystem, as well as at the heart of Frenchtech, with a technology showroom based on Avenue de Bretagne in Lille, on the EuraTechnologies site of economic excellence dedicated to information and communication technologies (ICT).

### **Assignment**

This thesis project is devoted to solution of a localization problem for mobile robots using the conventional and modern approaches, based on AI tools.

The conventional problem of bearings-only target motion analysis (BOTMA) is studied in the project. It assumes that the two mobile agents, monitor and target, are on the same plane and that they (or at least target) have a constant speed during the observation time period. The goal is to estimate the position of a target, namely two coordinates of geographical location and the projections of the speed on two axes, from a set of available perturbed bearing measurements collected by the monitor.

This project is performed in collaboration with IIT Delhi.

### **Main activities**

Development of various state and/or parameter estimation algorithms for linear dynamical systems subjected to nonlinear noisy measurements by combining modern methods from the theories of control, estimation, and artificial intelligence.

Physics-informed neural networks (PINNs) can be used to approximate the behavior of the target, or an alternative implementation of an observer. This recently developed framework allows one to use neural networks for nonparametric estimation by simultaneously approximating a system model, an observer (or a controller) and the respective Lyapunov function, which can be used to verify the stability and convergence of the estimation error.

#### **References:**

- Perez, A.-C. Contribution à la trajectographie passive sous-marine. HDR, Toulon, 2021.
- Le Cadre, J. P. and Jauffret, C. Discrete-time observability and estimability analysis for bearings-only target motion analysis. *IEEE Transactions on Aerospace and Electronic Systems*, 33, 1 (Jan. 1997), 178--201.
- Ristic, B. and Sanjeev, A. M. Tracking a manoeuvring target using angle-only measurements: Algorithms and performance. *Signal Processing*, 83 (June 2003), 1223--1238.
- Schiassi E., D'Ambrosio A., Drozd K., Curti F., Furfaro R. Physics-Informed Neural Networks for Optimal Planar Orbit Transfers. *Journal of Spacecraft and Rockets*. 59(3), 2022, pp. 834--849.
- Umar B. Niazi M., Cao J., Sun X., Das A., Johansson K.H. Learning-based Design of Luenberger Observers for Autonomous Nonlinear Systems. arXiv:2210.01476, 2022.
- Aranovskiy S., Efimov D., Sokolov D., Wang J., Ryadchikov I., Bobtsov A. Switched Observer Design For a Class of Locally Unobservable Time-Varying Systems. *Automatica*, 130(8), 2021, pp. 109715.
- Ballesteros-Escamilla M., Polyakov A., Efimov D., Chairez I., Poznyak A.S. Non-parametric Identification of Homogeneous Dynamical Systems. *Automatica*, 129(6), 2021, pp. 109600.

## Skills

The candidate should have experience in analysis of nonlinear dynamical systems and/or theory of control and estimation. The main mission will be analysis of existing results on the topic of the thesis, development of new theories and its practical verification. It is in general desirable to have a solid background in applied mathematics. The candidate should also be comfortable with English (oral and written).

## Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

## Remuneration

1st and 2nd year: 2100€ gross per month

3rd year: 2190€ gross per month

## General Information

- **Theme/Domain** : Optimization and control of dynamic systems  
Instrumentation et expérimentation (BAP C)
- **Town/city** : Villeneuve d'Ascq
- **Inria Center** : [Centre Inria de l'Université de Lille](#)
- **Starting date** : 2024-10-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2024-05-31

## Contacts

- **Inria Team** : [VALSE](#)
- **PhD Supervisor** :  
Efimov Denis / [Denis.Efimov@inria.fr](mailto:Denis.Efimov@inria.fr)

## About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

**Warning** : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

## Instruction to apply

CV + Cover Letter

### Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

### Recruitment Policy :

As part of its diversity policy, all Inria positions are accessible to people with disabilities.