Offer #2024-07642

Post-Doctoral Research Visit F/M Advancing Hybrid AI: Integration of Data-Driven and Model-Based Approaches for Enhanced Autonomous Driving

Contract type: Fixed-term contract
Level of qualifications required: PhD or equivalent
Fonction: Post-Doctoral Research Visit
Level of experience: Recently graduated

About the research centre or Inria department

The Inria centre at Université Côte d'Azur includes 37 research teams and 8 support services. The centre's staff (about 500 people) is made up of scientists of different nationalities, engineers, technicians and administrative staff. The teams are mainly located on the university campuses of Sophia Antipolis and Nice as well as Montpellier, in close collaboration with research and higher education laboratories and establishments (Université Côte d'Azur, CNRS, INRAE, INSERM ...), but also with the region's economic players.

With a presence in the fields of computational neuroscience and biology, data science and modeling, software engineering and certification, as well as collaborative robotics, the Inria Centre at Université Côte d'Azur is a major player in terms of scientific excellence through its results and collaborations at both European and international levels.

Context

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Every year Inria International Relations Department has a few postdoctoral positions in order to support Inria international collaborations.

The postdoctoral contract will have a duration of 12 to 24 months. The default start date is November 1st, 2024 and not later than January 1st, 2025. The postdoctoral fellow will be recruited by one of the Inria Centres in France but it is recommended that the time is shared between France and the partner's country (please note that the postdoctoral fellow has to start his/her contract being in France and that the visits have to respect Inria rules for missions).

Partnership between Inria and KAIST:

This Post-doc subject is proposed in the context of the associated team AISENSE involving the AVELAB at KAIST and the ACENTAURI Team at Inria. Both research groups have a high level of expertise in the field of autonomous vehicles. The AVELab has so far focused on end-to-end machine learning approaches for advanced sensing an situation awareness to handle unexpected novel situations. The research areas of the ACENTAURI team from Inria in Sophia Antipolis are complementary. ACENTAURI focuses on hybrid AI proposing to combine model-based approaches with data-based approaches (machine learning). The fusion of sensor data for situation awareness are of greatest scientific interest here. The main scientific objective of the collaboration project is to study how to build a long-term perception system in order to acquire situation awareness for safe navigation of autonomous vehicles. The perception system will perform the fusion of different sensor data (lidar and vision) in order to localize a vehicle in a dynamic peri-urban environment, to identify and estimate the state (position, orientation, velocity, ...) of all possible moving agents (cars, pedestrians, ...), and to get high level semantic information. To achieve such objective, we will compare different methodologies. From one hand, we will study model-based techniques, for which the rules are pre-defined accordingly to a given model, that need few data to be setup. On the other hand, we will study end-to-end data-based techniques, a single neural network for aforementioned multi-tasks (e.g. detection, localization, and tracking) to be trained with data. We think that the deep analysis and comparison of these techniques will help us to study how to combine them in a hybrid AI system where model-based knowledge is injected in neural networks and where neural networks can provide better results when the model is too complex to be explicitly handled. This problem is hard to solve since it is not clear which is the best way to combine these two radically different approaches. Finally, the perception information will be used to acquire situation awareness for safe decision making.

Application modalities:

Interested candidates must send the following application files:
The proposed hybrid AI system will be evaluated on Inria autonomous vehicles. For the experimental evaluation, the candidate will work in close collaboration with a PhD student and an R&D engineer who will be in charge of the experimental platform.

References:
Main activities

The work will be broken down into stages as follows:

- Conduct an extensive review of existing literature on hybrid AI (i.e. combination of data-driven techniques with model-based reasoning).
- Identify key theoretical concepts and frameworks relevant to the integration of data-driven and model-based approaches.
- Formulate a conceptual framework for hybrid AI, outlining the principles and methodologies underlying its implementation.
- Develop novel methodologies for integrating data-driven learning and model-based reasoning in hybrid AI systems.
- Conduct preliminary evaluations to assess the feasibility and effectiveness of the proposed methodologies.
- Develop prototype hybrid AI system tailored to the specific application domain considered in the AISENSE associated team, incorporating the methodologies developed in earlier phases.
- Conduct comprehensive testing and validation of the prototype systems using simulated and real-world datasets.
- Evaluate the performance of the developed hybrid AI systems against benchmark datasets and existing AI approaches.
- Refine the hybrid AI models and improve their performance.
- Write a report for the design, development, and deployment of the proposed hybrid AI systems.
- Disseminate research findings through international conference presentations and international journal publications.

Skills

The candidate should preferably have a PhD in Robotics or related topics, solid foundations in software development (C / C++, Python, LINUX, ROS, Git). A good level in read / written / spoken English is also important.

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 (after 6 months of employment) 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

Gross Salary: 2788 € per month

General Information

- **Theme/Domain**: Robotics and Smart environments Scientific computing (BAP E)
- **Town/city**: Sophia Antipolis
- **Inria Center**: Centre Inria d’Université Côte d’Azur
- **Starting date**: 2024-11-01
- **Duration of contract**: 2 years
- **Deadline to apply**: 2024-05-31
**Contacts**

- **Inria Team**: ACENTAURI
- **Recruiter**: Malis Ezio / Ezio.Malis@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.

**The keys to success**

He / she should also be endowed with a strong passion for multidisciplinary studies and all aspects of research ranging from fundamental work to experimental work.

**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**

**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.