Offer #2025-08786

PhD Position F/M - Artificial Intelligence for structural resilience optimization under severe vibration stress: Application to fatigue testing of Military Vehicles

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 Rennes - Bretagne Atlantique Centre is one of Inria's eight centres and has more than thirty research teams. The Inria Center is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Context

The project involves three partners: Inria, Leria and DGA TT.

Inria is the National Research Institute for Digital Science and Technology. This center for scientific excellence is currently directing the *French Digital Programs Agency* and is on the frontline of digitalization in Europe while conducting world-class research covering a wide range of disciplines: computer science, mathematics, and simulation software. International and industrial collaborations, ground-breaking research, software development, artificial intelligence, quantum- and cyber technologies and deep tech startups are the DNA of the institute. Inria ranks 16th

worldwide at the AI Research ranking while being the number one European institute for frontier research in digital sciences.

LERIA (Laboratory for Computer Science Research in Angers) is a dynamic research unit of the University of Angers, bringing together around 40 members, including 23 faculty researchers and a vibrant community of PhD students and collaborators. Its scientific focus lies at the intersection of Artificial Intelligence and Optimization, with research spanning from theoretical models for knowledge representation and reasoning to advanced algorithms for solving complex combinatorial problems. Bridging fundamental research and real-world applications, LERIA actively contributes to both academic and industrial innovation in intelligent computing.

DGA TT (French Procurement Agency - Land Techniques) is the French defense center dedicated to supporting and evaluating all land-based military systems. Its teams specialize in combat systems, ergonomics, weaponry, protection, robotics, and vehicle dynamics. With key sites in Bourges and Angers, the Angers facility focuses on the characterization and real-world testing of military vehicles, including their dynamic behavior and resistance to harsh environments. Spanning over 150 hectares, the site offers specialized tracks and state-of-the-art facilities to simulate extreme mechanical and climatic conditions - ensuring that equipment performs reliably under the most demanding scenarios.

Recruiting team: The recruited researcher will join a multi-disciplinary team involving established, **full-time research scientists** of all ages, MSc, PhD and postdocs (~30 ppl). The training programme intends to prepare candidates for scientific positions, either in academia or industry, by working in a research-intensive environment which fosters both scientific excellence (world-class researchers and over 65 prestigious ERC grants) and entrepreneurship (over 200 startups launched and a dedicated Inria Startup Studio). You will also have access to an extensive portfolio of training courses on digital science and technology, scientific programming or Artificial Intelligence. The candidate will have the opportunity to share his time in Rennes and Angers, through a flexible programme. He will be recruited by Inria in the Beaulieu Scientific Campus of University of Rennes, Bretagne (France), a medium town (~220.000 inhabitants) close from Paris and from the sea, with an intense student life (25% of the population). and Angers (France’s top city to live in, 2022) and Rennes (1st student city in France, 2024, and 8th in Europe for quality of life, 2019) both offer an exceptional quality of life, a rich history, vibrant culture, and a thriving economy.

Assignment

This PhD project aims for an advance in the simulation and design of metamaterials - engineered structures with unique physical properties surpassing natural materials. It aims to develop automated finite element methods to enhance numerical modeling, focusing on precision and efficiency in simulations while enabling predictive design of adaptive systems. The research targets critical defense

technologies, including stealth, cloaking, and wave manipulation, with applications spanning multispectral furtivity, dynamic resilience, and active wave modulation, relevant to both defense and civilian contexts.

This PhD project, titled "Artificial Intelligence for Optimizing the Mechanical Resilience of Systems under Severe Vibratory Stress: Application to Fatigue Testing of Military Vehicles" aims to advance the methodologies of the NF X 50-144 standard, a key framework for environmental testing in mechanical engineering. The research will harness artificial intelligence (AI) to improve vibration analyses, offering new insights into the resilience of complex systems under extreme conditions, with a focus on defense applications.

Vibration analysis plays a vital role in ensuring the durability and reliability of military vehicles and their embedded systems, such as armament, communication, and sensor technologies. These systems face intense and variable vibrational stresses from diverse operational environments, including rugged terrains and dynamic scenarios, which current testing approaches, based on simplified assumptions, often fail to fully capture. This project will explore AI-driven solutions to address these challenges, enhancing the ability to predict fatigue and mechanical performance through advanced techniques like classification of non-stationary signals and innovative modeling and classification approaches.

The research will tap into the potential of AI tools, such as autoencoders and other learning frameworks, to process complex vibration data and uncover patterns which traditional methods overlook. By refining how we assess and interpret these signals, the project aims to deliver more robust and adaptable solutions for evaluating system behavior. As AI becomes a cornerstone of future defense technologies, this work will position you at the forefront of innovation, contributing to both scientific progress and strategic advancements in military resilience.

Offered in collaboration with Inria, the University of Angers, and DGA Land Techniques, this PhD provides a unique platform for candidates passionate about AI, mechanical engineering, and defense. The outcomes will directly enhance the reliability of military vehicles, with broader implications for industries like aerospace and automotive, potentially shaping standards used by leading organizations. Based between Rennes and Angers, the project combines access to cutting-edge resources with a multidisciplinary team, offering an exceptional opportunity to make a meaningful impact in a high-stakes field.

Main activities

This PhD, blending AI and mechanical resilience for military vehicles, seeks motivated MSc (or soon-to-be) graduates with the following qualifications:

- **Graduation Topics**: Ideal profiles are those with backgrounds in computational mechanics, AI/data science and/or advanced scientific computing. Candidates can come from various MSc-level curriculums

involving signal processing, machine learning, computational mechanics (vibration, fatigue, or structural dynamics), vehicle engineering (e.g., mechatronics), physics or applied mathematics. Experience in implementing numerical methods in high-level programming languages (Matlab, Python, Julia, …) is essential.
- **Academic Excellence**: Outstanding curriculum with top-class grades, reflecting a strong academic track record. Candidates are expected to possess outstanding problem-solving abilities and a proven aptitude for teamwork.
- **Computer Literacy**: Proficiency in navigating advanced algorithms and theoretical concepts, with strong analytical skills.
- **Citizenship**: Should be an EU citizen due to the defense-related nature of the project.
- **Passion and Drive**: Enthusiasm for AI, defense applications, and advancing engineering solutions.

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

2 200 per month

General Information

- **Theme/Domain :** Optimization and control of dynamic systems
  Scientific computing (BAP E)
- **Town/city :** Rennes
- **Inria Center :** Centre Inria de l'Université de Rennes
- **Starting date :** 2025-10-01
- **Duration of contract :** 3 years
- **Deadline to apply :** 2025-06-02

Contacts

- **Inria Team :** I4S
- **PhD Supervisor :**
  Droz Christophe / christophe.droz@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

Application & selection procedure:

- Submit your **initial application documents** on this platform. These initial applications will be screened on a rolling basis.
- Shortlisted candidates will be invited to an online interview and then be asked to provide complementary transcripts, diploma and at least one letter mentioning the student's approximate ranking within their class.
- As soon as the best candidate has been identified, the offer will be removed from the application platform.
- The application will be evaluated by a Defense Selection Committee. Final results will be communicated shortly after and the PhD will begin in Oct. 2025.

Initial application documents:

- Field '**CV'**: A detailed curriculum vitae (indicating your nationality and current country of residence).
- Field '**Motivation'**: In one page or less, please outline your interest in this position and tell us about your most significant achievement.
- Field '**Recommendation'**: A recent/MSc 2 academic transcript.
- Field '**Other documents'**: Grades for the last three semesters and any additional document to support your application.

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.