Inria

Offer #2024-08163

Research Internship for Simulation of time-dependent wave propagation problems in complex media with adaptive finite elements (F/M)

Contract type : Internship

Level of qualifications required : Master's or equivalent

Fonction : Internship Research

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).

Context

Accurate simulation of time-dependent wave propagation phenomena is of central interest in many areas of physics and engineering. Finite element and discontinuous Galerkin methods have become very popular to perform such simulations, due to their ability to handle complex propagation media. The ANR project APOWA aims at improving the reliability and efficiency of these discretization methods through the use of a posteriori error estimators and adaptive mesh refinements.

The internship will take place in the context of the APOWA project, funded by the French national research agency ANR. The goal of the internship is to discover the topics at the heart of the project, before the intern continues with a PhD thesis, also funded by the APOWA project.

Assignment

A posteriori error estimation for wave propagation is very involved; [1,3,4] are some pioneering contributions paving the way to a sound numerical analysis. A novel approach to a posteriori error estimation of finite element discretizations of time-dependent wave propagation problems has been recently introduced in [2]. Currently, it applies to the second-order formulation of wave propagation problems. There are, however, many advantages in working with the (equivalent) first-order formulation. This last formulation will be the center of interest in the internship.

Main activities

The objectives of the internship are threefold. First (i), the intern will become familiar with the numerical analysis of wave propagation problems and a posteriori error estimation, and in particular become familiar with [2]. Then (ii), he/she will adapt the techniques developed in [2] for the second-order formulation (1) of the wave equation to the first-order formulation (2). Finally (iii), the intern will develop a computer code to perform one-dimensional simulations, thereby implementing a finite element discretization of (2) and the newly developed a posteriori error estimator.

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: the number depends on the number of days the trainee is actually present at the centre.
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)

Remuneration

According to the legal scale in force

General Information

- **Theme/Domain :** Numerical schemes and simulations
  Scientific computing (BAP E)
- **Town/city :** Villeneuve d'Ascq
- **Inria Center :** [Centre Inria de l'Université de Lille](#)
- **Starting date :** 2025-04-01
- **Duration of contract :** 6 months
- **Deadline to apply :** 2024-10-31

Contacts

- **Inria Team :** [RAPSODI](#)
- **Recruiter :**
  Chaumont-frelet Theophile / Theophile.Chaumont@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

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.