Offer #2022-04404

Development and application of high order finite element solvers for nanoscale light-matter interactions

Contract type : Fixed-term contract

Renewable contract : Yes

Level of qualifications required : Graduate degree or equivalent

Other valued qualifications : Thèse

Fonction : Temporary scientific engineer

Level of experience : Recently graduated

About the research centre or Inria department

The Inria Sophia Antipolis - Méditerranée center counts 37 research teams and 9 support departments. The center's staff (about 600 people including 400 Inria employees) is composed of scientists of different nationalities (250 foreigners of 50 nationalities), engineers, technicians and administrators. 1/3 of the staff are civil servants, the others are contractual. The majority of the research teams at the center are located in Sophia Antipolis and Nice in the Alpes-Maritimes. Six teams are based in Montpellier and a team is hosted by the computer science department of the University of Bologna in Italy. The Center is a member of the University and Institution Community (ComUE) "Université Côte d'Azur (UCA)".

Context

Atlantis is a joint project-team between Inria and the Jean-Alexandre Dieudonné Mathematics Laboratory at Université Côte d'Azur. The team gathers applied mathematicians and computational scientists who are collaboratively undertaking research activities aiming at the design, analysis, development and application of innovative numerical methods for systems of partial differential equations (PDEs) modelling nanoscale light-matter interaction problems. In this context, the team is developing the DIOGENeS [https://diogenes.inria.fr/] software suite, which implements several Discontinuous Galerkin (DG) type methods tailored to the systems of time- and frequency-domain Maxwell equations possibly coupled to differential equations modeling the behaviour of propagation media at optical frequencies. DIOGENeS is a unique numerical framework leveraging the capabilities of DG techniques for the simulation of multiscale problems relevant tonanophotonics and nanoplasmonics.

Assignment

The main objective of this assignement is to further enhance the capabilities of the DG-type high order finite element solvers developed in the framework of the DIOGENeS software suite, and to demonstrate the benefits of these solvers through the study of realistic uses cases pertaning to various applications of nanoscale light-matter interactions. In particular, the team is now actively collaborating with potential end-users of the DIOGENeS software suite who are raising various modeling issues that need to be addressed prior to simulating such realistic uses cases.

Main activities

More precisely, the successful candidate will be assigned two main tasks. On one hand, he/she will develop new methodological functionalities in the various components of the DIOGENeS software suite. These new features are concerned with generic core properties of DG-type high order finite element methods for the system of time-domain and frequency-domain Maxwell equations coupled to appropriate differential models of the behaviour of nanostructured materials under optical illumination, and with the geometrical modeling of nanoscale devices involved in concrete applications. This part of the work will be conducted in close collaboration with Ph.D and postdoctoral fellows of the team who are currently investigating innovative finite element solvers for the solution of the PDE models relevant to nanophotonics and nanoplasmonics. On the other hand, he/she will be in charge of several numerical studies dealing with the concept of metasurfaces, which are at the heart of planar photonics also referred as flat optics or metaoptics. During the last decade, metasurfaces have been extensively studied due to their ability to precisely control the phase, amplitude, and wavefront of light. These light-matter interactions are mediated by ensembles of subwavelength meta-atoms, made of plasmonic or high dielectric refractive index materials, which have thicknesses within the range of the operating wavelength. Our team is currently engaged in several collaborations with researchers from academic

laboratories and private companies, to exploit the DG-type high order finite element solvers of the DIOGENeS software suite for the design of metasurfaces. In particular, this position could lead to a permanent job with one of the team's industrial partners.

Skills

Candidates will hold a Master degree or a PhD degree in applied mathematics/scientific computing or computational wave physics or computational photonics.

Required skills:
- Sound knowledge of numerical analysis and development of finite element type methods for computational physics;
- A concrete experience in numerical modeling for computational electromagnetics will be an asset;

- Strong programming skills and exposure to object-oriented model;

- Knowledge and experience of Fortran 95/2000x and Python programming languages;

- Fluent spoken and written English.

Benefits package

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities

Remuneration

Gross salary : between 2632€ and 2936€ (depends on the experience)

General Information

- **Theme/Domain :** Numerical schemes and simulations
  Scientific computing (BAP E)
- **Town/city :** Sophia Antipolis
- **Inria Center :** Centre Inria d'Université Côte d'Azur
- **Starting date :** 2022-04-01
- **Duration of contract :** 12 months
- **Deadline to apply :** 2022-08-31

Contacts

- **Inria Team :** ATLANTIS
- **Recruiter :**
  Lanteri Stéphane / Stephane.Lanteri@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.