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

2018-00691 - [NACHOS] Development and application of high order finite element solvers for nanoscale light-matter interactions

**Contract type:** Public service fixed-term contract  
**Renewable contract:** Oui  
**Level of qualifications required:** PhD or equivalent  
**Fonction:** Temporary scientific engineer  
**Level of experience:** From 3 to 5 years

### 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

NACHOS is a joint project-team between Inria and the Jean-Alexandre Dieudonné Mathematics Laboratory at University Nice Sophia Antipolis. 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 to nanophotonics and nanoplasmonics.

### Assignment

The main objective of this assignment 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 pertaining 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 either related to 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, or with modeling issues specific to 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 conducted in close collaboration with external (academic and industrial) partners of the team, leveraging the DG-type high order finite element solvers of the DIOGENeS software suite.

### Skills

Candidates will preferably hold 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...
- 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 95/2000;
- 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)