2018-00262 - PhD Position / Numerical schemes and simulations / Image based lifetime evaluation of self-healing CMCs coupling solid mechanics and a parallel finite element simulation of the healing process in 3D crack networks [ANR VISCAP]

**Contract type :** Public service fixed-term contract  
**Level of qualifications required :** Graduate degree or equivalent  
**Function :** PhD Position  
**Level of experience :** Recently graduated

**Context**

**Host:** Inria Bordeaux – Sud-Ouest, CARDAMOM research team:  
https://team.inria.fr/cardamom/  
Within the framework of a public partnership with the French National Research Agency (ANR): ANR VISCAP

**Assignment**

**Assignments :**

The main objective of this PhD is to develop a parallel library allowing the simulation of the lifetime of a SH-CMC, starting from 3D images (e.g. tomographs) of the material. The main milestones of the work will consist in:  
(i) developing a graph representation of the network of domains, using crack detection algorithms developed by the LCTS laboratory;  
(ii) design a method of generation of the constrained unstructured triangulations respecting the numerous interfaces present in the material (multi-layer matrix);  
(iii) design and implement the necessary physical pre-processing of the realistic data acquired from the image to define the computational parameters of the simulation;  
(iv) set up a parallel algorithm coupling all the domains in the network, as well as the crack network to the solid mechanics solver;  
(v) apply the resulting tool to the simulation of real materials.

*For a better knowledge of the proposed research subject:*


**Collaboration :**

The recruited person will be in connection with:

- Mario RICCHIUTO : mario.ricchiuto@inria.fr  
- Cécile DOBRZYNSKI : cecile.dobrzynski@math.u-bordeaux.fr  
- Guillaume COUEGNAT : couegnat@cts.u-bordeaux.fr

**Main activities**

The key scientific contributions will be related to:

- the finite element formulation involving the coupling of 2D domains criss-crossing in the 3D network, and in particular comparing approaches involving fitting all the intersections, with cut-finite elements or other embedded methods  
- the efficient hybrid parallelization of the main library as well as of the coupling with the solid mechanics solver (in house solver by LCTS)  
- the application to realistic simulations and in particular to new experimental images and measurements acquired in the VISCAP project

**Interaction with the VISCAP WPs :**

Strong interactions are expected with another PhD devoted to the development of an improved PDE and FEM model of a single crack transversal to the fibers, with a simplified representation of longitudinal cracks impinging on this one. Strong interactions also with *(or even partial participation to)* the experimental activities related to the imaging of SH-CMCs.

**Skills**

**Technical skills and level required :** C/C++, FORTRAN, PYTHON  
**Languages :** French, English  
**Relational skills :** Team working

**Benefits package**

- Subsidised catering service  
- Partially-reimbursed public transport  
- Social security  
- Paid leave
Remuneration
Fix term contract
Duration: 36 months
Gross Salary: 1982€ / month (before taxes) during the first 2 years, 2085€ / month (before taxes) during the third year

General Information
- **Theme/Domain**: Numerical schemes and simulations
  - Scientific computing (BAP E)
- **Town/city**: Talence
- **Inria Center**: CRI Bordeaux - Sud-Ouest
- **Starting date**: 2018-04-01
- **Duration of contract**: 3 years
- **Deadline to apply**: 2018-08-31

Contacts
- **Inria Team**: CARDAMOM
- **Recruiter**:
  Ricchiuto Mario / mario.ricchiuto@inria.fr

About Inria
Inria, the French National Institute for computer science and applied mathematics, promotes “scientific excellence for technology transfer and society”. Graduates from the world’s top universities, Inria’s 2,700 employees rise to the challenges of digital sciences. With its open, agile model, Inria is able to explore original approaches with its partners in industry and academia and provide an efficient response to the multidisciplinary and application challenges of the digital transformation. Inria is the source of many innovations that add value and create jobs.

The keys to success
The candidate will be required to have very good programming skills and familiarity with engineering and mechanical problems related to the proposal. In particular a strong background in scientific computing and in particular high level/object oriented programming (C/C++/Fortran, Python, etc). A good background in applied maths, and in particular PDE modeling, and numerical methods is also required.

Conditions for application
Thank you to send:
- updated CV
- cover letter
- letters of recommendation
- Master Degree Transcripts (please include your "Transcripts" document with your cover letter or with the letters of recommendation)

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.

**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.