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