OFFRE DE STAGE DE MASTER

Spécialité doctorale :

- ☐ Biostatistique
- ☐ Electronique
- ☐ Informatique
- ☐ Mathématiques et modélisation
- ☑ Mécanique et Génie civil
- ☐ Physique
- ☐ SYstèmes automatiques et Microélectroniques

Date limite de validité de l'offre :

ENCADREMENT DU STAGE

Encadrant principal : Katerina Ioannidou

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Titre en français :

Titre en anglais : Up-scaling of fracture properties of cemented materials: from nano to micro

Profil(s) de candidats souhaité(s) : Master of physics, mechanics or chemistry, and interested more in numerical simulations.

Présentation du sujet :

Context: Concrete, cement and mortars despite being widely used are intrinsically fragile materials with a low tensile strength due to the broad distribution of pore sizes, ranging from nm to mm. Failure mechanisms in these materials initiate with the formation of cracks that can be due to the material itself or arise from external conditions such as excessive loading, temperature gradients and chemical attack. Cracks endanger the durability of cement as aggressive liquids and gasses may penetrate into the matrix along these cracks and cause damage. Insufficient knowledge of cement microstructure formation hinders the design of smart cement mixes that self heal or do not crack. Indeed, tougher materials permit an increased resistance in extreme conditions, or the use of less material while achieving comparable performances. To design tougher materials, one needs to understand the relationship between composition, structure and toughness. Elastic moduli typically increase with connectivity and bond energy, however hardness shows non-monotonic behaviours, which highlights the fact that fracture energy is not simply the energy required to break bonds and to create a new surface. This project aims to study the the fracture behaviour of cement at the sub micron scale using simulation, and compare with experimental and simulation results.

Methodology: The study of the fracture behaviour of cement will be based in Molecular Dynamics simulations. The configurations of cement consist of cohesive nano-grains that aggregate in a porous

structure. The simulation procedure consists of introducing a notch and a small tensile stress is progressively applied followed by stress relaxation. The mechanical properties and the fracture behaviour will be characterised and linked to the structure and composition. The simulations will be performed using the LAMMPS code in the cluster of MUSE-UM. The simulation results will be compared with existing experimental measurements. The ultimate goal is the description of fracture through different length scales from nano, to sub micron, to macro. These result can be used to inform classical homogenisation modelling.

INFORMATIONS SUPPLEMENTAIRES UTILES

Bibliographie :

Lieu du stage : Laboratoire de Mécanique et Génie Civil (LMGC)

Particularités de l'encadrement :

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