

Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website www-csc.utt.fr)

Supervisor's name : HELLOU Given names : Mustapha

Status (prof., assistant prof., \bar{o}) : Prof

Laboratory : Laboratory of Civil and Engineering Mechanics Website address : www.insa-rennes.fr/gcgm
Institution : INSA Rennes Website address : www.insa-rennes.fr

Scientific competence of the supervisor:

Fluid mechanics; porous media; multiphase flow; fluid and solid transport; Mass transport; Diffusion/Convection; Upscaling methods.

Two major publications in the field proposed for the PhD :

1. Modelling Particle Capture Efficiency with Lattice Boltzmann, J. Fan, F. Lominé, M. Hellou, Communications in Computational Physics, Global Science Press, 2018, 23 (4), pp.932-950
2. Multiscale periodic homogenization of ionic transfer in cementitious materials, K. Bourbatache, O. Millet, A. Ait Mokhtar, Heat Mass Transfer, 52(8), pp 1489-1499, 2016

Website address of the personal page :

Supervisor's email : mustapha.hellou@insa-rennes.fr

Description of the research work proposed for a PhD **Topic # (see list) :** IV-6, IV-12, VI-3

Title : Modelling of diffusion-convection of reactive species - Application to dissolution and precipitation within porous materials

Subject :

The study of the mass transport phenomena in porous media is of major interest in several domains, among them civil engineering, mechanics and geomechanics, hydrogeology and nuclear industry. In all these domains, the knowledge of mass transfer properties at the macro-scale (the scale of the structure), taking into account the multi-physics coupling involved at the micro scale, is fundamental to dispose of accurate predictive models for engineers. The interaction between the transported species and the solid matrix can lead to porosity modification, which in turn leads to the change in mechanical and/or transport properties (permeability and diffusivity).

This PhD will be focused on the numerical modelling of multispecies transport in saturated porous media. More specifically, this work will be limited to the modelling of dissolution/ precipitation reactions and their consequences on solid matrix. The scientific challenge in this work is to develop numerical tool allowing the follow-up of the microstructure evolution under external severe solicitations and characterized its consequences at the macro-scale in terms of transport properties. To succeed, a part of this work will be devoted to the development of numerical code of transport coupled to chemical reaction. In parallel homogenization procedure will be developed to upscaling the coupled reactive transport in the aim to determine the macroscopic behavior of porous media.

Keywords :

Porous media; Geochemistry; Diffusion/convection; Fluid flow; Lattice Boltzmann Method (LBM); Homogenization technique; Permeability; Diffusivity; Dissolution/ Precipitation.

Expected collaborations :

" LASIE University of La Rochelle, France
" OSUR, Geosciences, Rennes, France
" IRSTEA, Rennes, France
" LAMPA, Angers, France

Background required from the applicant :

The candidate should have a Master of Science with good knowledge of Fluid Mechanics and transport phenomena. He/she should ideally be familiar with porous materials and/or convection diffusion processes and/or upscaling techniques, and have a good notions of computer (numerical) programming.

Existence of a PDF file detailing the proposal ("yes" or "no") : yes

(see guidelines on the website www-csc.utt.fr)