

## Post-doc Position

### « PFV embedding LBM: a new numerical tool for micro-hydro-mechanical couplings »

#### Project summary

This project is related to the mechanics of dense multiphase mixtures composed of solid grains and two (immiscible) fluids. The objective is to develop a new numerical method for the direct simulation of multiphase granular systems at the microscale, enabling numerical experiments and the determination of effective hydro-mechanical properties through numerical homogenization. The proposed method can be summarized as a multiscale integration of a micro-continuum method (here Lattice-Boltzman, LBM [1]) into an original pore-network approach of multiphase flow in deformable systems. The latest (hereafter "PFV" method) is a new approach of grain-fluid couplings developed by the PI and co-workers, initially for one fluid phase [2] and more recently for two phases [3]. The granular (solid) phase will be modeled using the discrete element code Yade-DEM [4], to which this project in itself will contribute.

The objectives of the post-doc are: 1/ efficient implementation of the multiscale coupling between the LBM method and the PFV method; 2/ validation by comparison with tomography data on water retention in glass beads; 3/ solutions of reference problems of local drainage/imbibition events in granular microstructures for evaluating classical approximations of the invasion criteria.

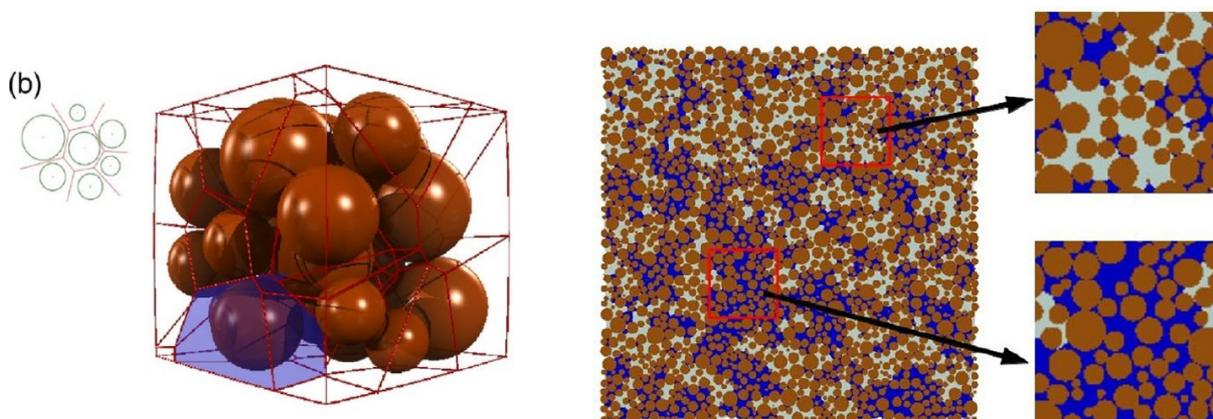
The successful applicant will participate in the supervision of a PhD work (just started) and will contribute to the work done in collaboration between 3SR and the Hydrology group at Utrecht University (Pr. S.M. Hassanizadeh).

[1] CFD code Palabos (<http://www.palabos.org>)

[2] Catalano et al. (2014). Int. J. for Numerical and Analytical Methods in Geomechanics, 38(1), 51-71.

[3] Yuan et al. (2016) Advances in Water Resources. doi:10.1016/j.advwatres.2015.11.018.

[4] Šmilauer et al. (2010). Yade Documentation. <http://yade-dem.org>



**Fig. 1.** Left: decomposition of the pore space of a sphere packing by Regular Triangulation in the DEM-PFV method, after [6]; Right: distribution of wetting and non-wetting phases resulting from a simulated drainage, after [7].

## Location and practical aspects

The successful applicant will be hosted by the laboratory 3SR in the Geomechanics group. He/she will work under the supervision of Dr Chareyre from Laboratory 3SR.

The gross salary will be 2518 euros/months, equivalent to a net salary of 2037 euros/month.

## Qualifications of the applicant

Candidates with a background in porous media science, multiphase flow and interface problems are welcome.

Previous experience and achievements in relation with one or more of the following aspects will be greatly appreciated (please provide details if relevant):

- discrete numerical modeling of granular media (the DEM, typically)
- viscous two-phase flow with surface tension in porous media
- high performance computing and hybrid C++/Python programming
- collaborative software development (and the related tools), please provide references

## Applications

Interested candidates should send their CV and cover letter to Bruno Chareyre (bruno.chareyre\_a\_3sr-grenoble.fr).

Deadline for the application: september 30<sup>th</sup>, 2016.