Two-scale DEM-FEM numerical approach for granular media

M. Nitka*, T.K. Nguyen*, G. Combe*, C. Dascalu*, D. Caillerie*, J. Desrues*

* UJF-Grenoble-INP-CNRS
Laboratoire 3SR, BP53, 38041 Grenoble, France
e-mail: gaël.combe@ujf-grenoble.fr, web page: http://www.3s-r.hmg.inpg.fr/3sr/

ABSTRACT

The study considers a two-scale numerical scheme for the description of the behavior of granular materials. At the small-scale level, the granular structure consists of 2D round rigid grains, modeled by the discrete element method (DEM). At the macroscopic level, we consider a numerical solution obtained with the Finite Element Method (FEM). The link between scales is made using a computational homogenization method, in which the average REV stress response of the granular micro structure, together with the tangent moduli, are obtained in each macroscopic Gauss point of the FEM mesh as the result of the macroscopic deformation history imposed to the REV [1]. In this way, the numerical constitutive law and the corresponding tangent matrix are obtained directly from the discrete behavior of the microstructure. We discuss the principle of the computational homogenization applied to this association of FEM with DEM and we present examples of the two-scale computations, like drained and undrained biaxial tests.

REFERENCES

[1] M. Nitka, G. Combe, C. Dascalu, J. Desrues, “Two-scale modeling of granular materials: a DEM-FEM approach”, *Granular Matter*, 13(3), 277—281 (2011).