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DISCRETE MODELING OF GRANULAR SHEAR FLOWS: PARAMETER STUDY

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ABSTRACT

The published literature analysis has shown the importance of thermal energy in granular media for industrial processes in applications as diversified as powder metallurgy, chemical reactors (catalysts beds), food technology [1], thermal insulating [2] or even simply storing particles in a silo after drying [3]. Only few studies are interested in the understanding of heat transfers resulting from thermo-mechanical effect. However, these complex phenomena with multi-physical characteristics are an essential stake in the world of industry and transports. For instance, the strong frictions (braking, jamming) would be responsible for half of ignitions of explosive atmospheres but they are also a dreadful cause of fires in vehicles and accidents. One of the difficulty is to be able to predict the friction forces and the temperatures in the friction zone from the intrinsic properties of bodies in contact.

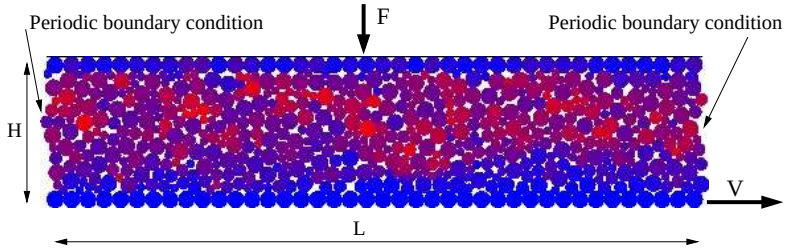

Figure 1: Scheme of shearing plan.

The first part of this work consists in using the Discrete Element Method (DEM) for the contact detection, the determination of contact forces and the kinematic parameters by using MULTICOR software [4, 5]. In a second time, heat transfers by contact as well as the energy generation by friction have been studied and implemented in MULTICOR. We started to investigate the problem of heat generation in the granular material subjected to shearing solicitation at imposed velocity (V) and a uni-axial load (F) (Fig. 1). Two cases of shearing will be studied: quasi-static and dynamic regimes.

Through this mechanical example, we have studied the effects of various parameters such as the friction coefficient, the restitution coefficient or the grain sizes on the shear flows. Besides, the effect of contact time on heat transfer will be investigated.
At the end, we show the validations of MULTICOR's predictions and some results in the literature as in [6, 7].

REFERENCES

[1] O. Laguerre, S. Ben Amara, and D. Flick. Heat transfer between wall and packed bed crossed by low velocity airflow. *Applied Thermal Engineering*, vol. 26:1951–1960, 2006.

[2] S. Melka and J.J. Bzian. L'isolation thermique par les matriaux granulaire. *Revue Gnrale de Thermique*, vol. 36:345–353, 1997.

[3] W.R. Ketterhagen, J.S. Curtis, C.R. Wassgren, A. Kong, P.J. Narayan, and B.C. Hancock. Granular segregation in discharging cylindrical hoppers: A discrete element and experimental study. *Chemical Engineering Science*, article in press, 2007.

[4] J. Fortin, O. Millet, and G. de Saxce. Numerical simulation of granular materials by an improved discrete element method. *Int. J. Numer. Meth. Engng*, vol. 62:639–663, 2005.

[5] J. Fortin and P. Coorevits. Selecting contact particles in dynamics granular mechanics systems. *Journal of Computational and Applied Mathematics*, vol. 168:207–213, 2004.

[6] W.L. Vargas-Escobar and J.J. McCarthy. Conductivity of granular media with stagnant intersitial fluids via thermal particle dynamics simulation. *International Journal of Heat and Mass Transfer*, vol. 45:4847–4850, 2002.

[7] F. da Cruz, S. Emam, M. Prochnow, J.-N. Roux, and F. Chevoir. Rheophysics of dense granular materials: Discrete simulation of plane shear flows. *Physical Review E*, vol. 72, 2005.