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UPSCALING FROM PARTICLE MICRO-MECHANICS TO INDUSTRIAL-SCALE PROCESSES

KEVIN J. HANLEY*, JIN Y. OOI*, STEFANOS-ALDO PAPANICOLOPULOS*, STEFAN LUDING† AND VANESSA MAGNANIMO†

* School of Engineering, Institute for Infrastructure and Environment, The University of Edinburgh
Edinburgh EH9 3FG, UK
{k.hanley, j.ooi, s.papanicolopulos}@ed.ac.uk

† Multi Scale Mechanics (MSM), Faculty of Engineering Technology, MESA+, University of Twente
PO Box 217, 7500 AE Enschede, The Netherlands
{s.luding, v.magnanimo}@utwente.nl

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ABSTRACT

Recent years have seen tremendous progress in particle-scale computations, experimental studies and the development of new theories for granular, particulate and powder systems. Despite these advances, considerable challenges remain due to the multi-scale nature of industrial particle systems: contact and particle properties at the micro-scale influence the behaviour of processes such as mixing, milling and agglomeration at the macro-scale. These challenges include the bridging and jamming of flows in silos, segregation/mixing issues in multi-ingredient products, caking or clumping in cohesive powders, and deterioration of particulate product quality. Addressing these problems is significant in a vast range of industrial sectors, ranging from minerals, agriculture and food processing to plastics, consumer and personal care products, pharmaceuticals and the environment.

Robust upscaling approaches are essential to transfer information provided by different experimental and numerical approaches between widely varying length scales from μm to m. This session will report on the recent research in upscaling methods towards modelling industrial processing of particulate solids. Examples of these upscaling methods include: upscaling from DEM/DEM–CFD through coupling with PBM; the transition to multi-scale, particle-based, continuum constitutive models; representing groups of primary particles as larger 'mesoparticles' in DEM simulations (sometimes referred to as 'coarse graining'). All of these methods have the common factor of enabling the simulation of industrial-scale processes at acceptable computational cost.

The subject of this session is aligned with an EC-funded Innovative Training Network led by the organisers: 'Training in Upscaling particle Systems: Advancing Industry across Length-scales' (TUSAIL) [1].

REFERENCES

[1] TUSAIL H2020 PROJECT: https://cordis.europa.eu/project/id/955661