IFPRI Project Abstract

Discrete Element Method Round Robin

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Project Objective:

The discrete element method is a powerful numerical technique capable, if used correctly, of quantitatively reproducing the dynamics of diverse particulate systems – including those of relevance to the powder-handling industries. This is a big "if", however, as quantitative accuracy is only possible when simulations are rigorously calibrated against detailed powder characterisation measurements and, at present, there exists no industry-wide Best Practice for the calibration of DEM simulations. In the IFPRI Round Robin, we intend to gain first-hand insight into current industry practices and, in doing so, establish what works well and what requires improvement, and thus develop, for the first time, a standardised Best Practice for DEM simulation.

Approach:

The main focus of the project is to conduct detailed interviews with multiple industry partners, establishing their current procedures for the calibration of a range of different materials and systems (specifically 7 distinct materials, and 3 test systems). The methodologies discussed are then put into practice by the PI and his team, and used to produce a series of simulations calibrated by the distinct methods suggested. Each simulation produced is then directly, quantitatively compared to detailed experimental data from the "real" system modelled, thereby establishing the success (or lack thereof) of each calibration method tested. The results obtained repeating this for all 9 sets of 21 experiments will provide valuable insight into what does (and what doesn't) work in terms of DEM calibration, allowing us to establish a clear Best Practice.

Recent Results:

- Completion of interviews with industry practitioners to gain understanding of current calibration methods
- Development of new DEM digital twins (Granutools GranuPack, Granutools GranuFlow, Resodyn RAM, Pascall mixer)
- Re-creation of all calibration methods at UoB
- Completion of PEPT experiments for validation of calibrated DEM models
- Validation of DEM models, and analysis of results to determine effectiveness of methods attempted

Next Steps:

Care has been taken during this Round Robin to address all of the most significant difficulties associated with DEM modelling (small particles, cohesive particles, aspherical particles, bimodal distributions…) leaving, we believe, relatively few open questions in this area. **However**, the work has only explored dry systems, whereas in industry many systems also involve a fluid phase, be it gas or liquid. Further work in the same vein exploring the modelling of solid-liquid systems (e.g. fluisided beds, spotted beds, stirred tanks etc.) could prove of value.