Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Segregation modeling for particles varying in both size and density[1] YIFEI DUAN, PAUL B. UMBANHOWAR, JULIO M. OTTINO, RICHARD M. LUEPTOW, Northwestern University — Granular materials tend to segregate by particle size and density when sheared. In particle mixtures varying in size or density alone, small particles sink (driven by percolation) and light particles rise (driven by buoyancy). However, when the constituent species vary from each other in both size and density, which particles will rise or sink is difficult to predict. In particular, modeling the segregation of mixtures of large, heavy particles and small, light particles is challenging due to the opposing effects of the two segregation mechanisms. Using discrete element method (DEM) simulations of combined size and density segregation, we find that the local segregation velocity is well described by a model that depends linearly on local shear rate and quadratically on species concentration. Concentration fields predicted by including this segregation model in a continuum transport equation match DEM simulation results well for different combinations of particle size and density ratios. Surprisingly, the direction of segregation for a range of mixtures of large, heavy and small, light particles depends on the local species concentration.

[1]Funded by NSF Grant No. CBET-1929265.

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Date submitted: 03 Aug 2020 Electronic form version 1.4