Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Modeling segregation pattern formation in biaxial spherical tumbler flow MENGQI YU, PAUL UMBANHOWAR, JULIO OTTINO, RICHARD LUEPTOW, Northwestern University — Flow of size bidisperse granular particle mixtures in a half-full spherical tumbler rotating about two perpendicular axes exhibits segregation patterns that can be observed through the transparent tumbler wall. The patterns resemble predictions based on dynamical systems analysis including non-mixing structures and unstable manifolds, but also depend on the underlying flow field, relative strength of segregation, and collisional diffusion. Discrete element method (DEM) simulations enable precise characterization of the three-dimensional structures of the segregation pattern and statistical analysis of particle movement in the flow. Axial drift of large particles during rotation about a single axis results in migration toward double bands near the rotation poles. At the same time, chaotic advection redistributes large particles in regions outside of non-mixing structures. As a result of both mechanisms, large particles accumulate in regions where axial bands coincide with non-mixing structures. Comparison of particle trajectories in size bidisperse and monodisperse mixtures provides further insight into the interaction between segregation, diffusion, and the underlying flowing field that results in pattern formation.

Mengqi Yu
Northwestern University

Date submitted: 01 Aug 2019 Electronic form version 1.4