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Flow modulation based control of granular stratification in heaps
PAUL B. UMBANHOWAR, YI FAN[1], DAVID MCDONALD[2], JULIO M. OTTINO, RICHARD M. LUEPTOW, Northwestern University — Gravity driven flows of initially mixed granular media composed of non-monodisperse particles spontaneously segregate for a wide range of particle and flow parameters. For heaps of size-bidisperse particles formed in the quasi-two-dimensional geometry of a vertical Hele-Shaw cell, segregation is in the form of stratified layers of large and small particle-rich bands that are nominally parallel to the free surface of the heap. Stratification occurs at low fill rates where flow down the heap manifests as a series of intermittent and irregularly sized avalanches. This non-steady flow causes variation in stratum thickness and streamwise extent. In this talk we describe how temporal modulation of the fill rate can generate ordered strata at high fill rates. In particular, we show how, for a duty cycle variation of the flow rate, the modulation parameters determine the wavelength and streamwise extent of the layers. We explain our results in terms of the dependence of the dynamic repose angle on flow rate. Finally we describe how the upstream extent of the strata increases with decreasing gap width and is related to the jamming probability of the large particles.

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