

Abstract Submitted
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Sensitivity of Granular Hopper Flows to Boundary Conditions

JOHN WAMBAUGH, ROBERT BEHRINGER, Duke University — Granular hoppers provide an excellent experimental system for studying continuum descriptions of granular materials in part because there exist the well-established Jenike radial solutions. (Moreea, S. B. M. and Nedderman, R. M., Chem. Eng. Sci., 51, 3931–3942 (1996)) In the case of a perfectly symmetrical right hopper there are multiple constitutive relations that lead to the Jenike solutions. When asymmetry is introduced by tilting the hopper with respect to gravity, these constitutive relations lead to different predictions of how the granular flow will circulate. (Gremaud, P.A., Matthews, J.V. and Schaeffer, D. G., SIAM J. Appl. Math., 64, 583–600 (2003) and personal communications) This experimental study finds that the Matsuoka-Nakai constitutive relation most accurately describes granular flow, but only for moderate tilt angles and only for a specific range of wall roughnesses. In more extreme cases, the velocity field is found to change substantially. We believe our results may allow for discrimination between different soil mechanics descriptions of dense granular flows.

John Wambaugh
Duke University

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