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Stick-slip transition at the granular critical state NICK GRAVISH, PAUL UMBANHOWAR, DANIEL I. GOLDMAN — We study the force on a flat plate (3.8 cm width, 7.0 cm depth) dragged at constant velocity v through the surface of a granular medium (250 μm glass beads) as a function of volume fraction $0.57 < \phi < 0.63$. The dynamics of the drag force F_d are sensitive to ϕ: we find a sharp transition in the form of F_d at a critical volume fraction $\phi_c = 0.605$. For $\phi < \phi_c$, F_d increases with time and saturates, while for $\phi > \phi_c$ F_d exhibits an initial peak followed by periodic oscillations at frequency f about a constant mean. The standard deviation in force (a measure of the fluctuations) shows a sharp transition at ϕ_c. The force oscillations suggest that the granular media periodically jams and flows as the plate is horizontally translated. Examining the bed surface we observe a spatially periodic scalloped feature of length λ which is equal to v/f, independent of v, and increases linearly with ϕ for $\phi > \phi_c$. By measuring the displaced volume after the drag ΔV, we observe a transition from media compaction ($\Delta V < 0$) for $\phi < \phi_c$ to dilation ($\Delta V > 0$) for $\phi > \phi_c$.

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