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Optimal resistance in impact and penetration of parallel rods in a granular medium[1] YANG DING, LIONEL LONDON, MATEO GARCIA, DANIEL GOLDMAN, Georgia Institute of Technology, School of Physics — Inspired by foot and toe morphology in sand-running lizards, we study in laboratory experiment and experimentally validated Molecular Dynamics (MD) simulation the resistance force during penetration of parallel rods (diameter 1.27 cm) into a granular medium of plastic spheres (diameter $d = 0.6$ mm) as a function of rod separation l. We measure the normal force exerted on the rods by the medium both during normal penetration at constant velocity (≈ 10 cm/sec) and during normal impact after freefall (impact velocity ≈ 2.5 m/sec). For constant velocity penetration, the resistance force increases linearly with increasing penetration depth. The slope of this curve (force/depth) displays a maximum as a function of l at $l \approx 1.6d$. In the impact studies, we observe a maximum in the collision force at $l \approx 1.6d$ and a minimum in penetration depth at $l \approx 2d$. The extrema are correlated with an increase in lateral force between the rods indicating that jammed grains increase the effective surface area during penetration.

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