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Enhanced penetration forces with simultaneous granular intruders[1] PAUL UMBANHOWAR, Northwestern University, LIONEL LONDON, YANG DING, DANIEL GOLDMAN, Georgia Institute of Technology — To better understand how the geometry and actuation of biological and mechanical feet affect locomotor performance on flowable ground, we examine the constant velocity insertion into granular media of two horizontal, parallel rods as a function of rod separation s. Our experiments and simulations show that while the force F required to maintain a constant velocity increases linearly with the penetration depth d in all cases, the slope F/d is a non-trivial function of rod separation. As s is increased from zero, F/d initially increases, reaches a maximum value at ≈ 2 grain diameters, and then slowly decreases to twice the value of F/d for a single rod at large separation. Examining force correlations and flow intermittency between the rods, we show that a model of cooperative arching and jamming explains the salient features of our results.

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Paul Umbanhowar
Northwestern University

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