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Paused intrusions improve robot jumping performance in granular media[1] CHRISTIAN HUBICKI, JEFFREY AGUILAR, ALLISON KIM, JENNIFER RIESER, AARON AMES, DANIEL GOLDMAN, Georgia Institute of Technology — Modeling locomotion of robots requires understanding the physics of interaction with the environment. Previously [Aguilar & Goldman, Nat. Phys., 2015] we studied vertical jumping on granular media with a robot consisting of a position controlled mass in series with a spring connected to a circular foot; a granular resistive force theory model containing a depth dependent force modified to account for added mass captured performance over a wide range of parameters. We have now discovered that while continuous intrusion into loosely packed granular media results in forces which increase monotonically with depth, brief (˜500 ms) pauses during intrusion result in force overshoots (10-35%) relative to the force at that depth during continuous intrusion. Laser speckle measurements of the grains beneath the intruder reveal a settling of sub-grain-scale motion over 10-1000 ms time scales; we hypothesize that this results in jammed states beneath the foot. To test if this effect can be exploited to improve jump performance, we program the robot using continuous and paused thrust (20-30 ms) behaviors. While both jumps yield identical jump heights in a bulk reaction force model, the paused maneuvers jump 10-40% higher than their counterparts.

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