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Sidewinding as a control template for climbing on sand HAMIDREZA MARVI, Georgia Institute of Technology, CHAOHUI GONG, MATTHEW TRAVERS, Carnegie Mellon University, NICK GRAVISH, Harvard University, JOSEPH MENDELSON, Georgia Institute of Technology and Zoo Atlanta, ROSS HATTON, Oregon State University, HOWIE CHOSET, Carnegie Mellon University, DAVID HU, DANIEL GOLDMAN, Georgia Institute of Technology
— Sidewinding, translation of a limbless system through lifting of body segments while others remain in static contact with the ground, is used by desert-dwelling snakes like sidewinder rattlesnakes *Crotalus cerastes* to locomote effectively on hard ground, rocky terrain, and loose sand. Biologically inspired snake robots using a sidewinding gait perform well on hard ground but suffer significant slip when trying to ascend granular inclines. To understand the biological organisms and give robots new capabilities, we perform the first study of mechanics of sidewinding on granular media. We vary the incline angle ($0 < \theta < 20^\circ$) of a trackway composed of desert sand. Surface plate drag measurements reveal that as incline angle increases, downhill yield stresses decrease by 50%. Our biological measurements reveal that the animals double the length of the contact region as θ increases; we hypothesize that snakes control this contact to reduce ground shear stress and so avoid slipping. Implementing this anti-slip strategy in a snake robot using contact patch modulation enables the robot to successfully ascend granular inclines.

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