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Impact and intrusion of the foot of a lizard running rapidly on sand CHEN LI, University of California, Berkeley, TONIA HSIEH, Temple University, PAUL UMBANHOWAR, Northwestern University, DANIEL GOLDMAN, Georgia Institute of Technology — The desert-dwelling zebra-tailed lizard (*Callisaurus draconoides*, 10 cm, 10 g) runs rapidly (∼10 BL/s) on granular media (GM) like sand and gravel. On loosely packed GM, its large hind feet penetrate into the substrate during each step. Based on above-ground observation, a previous study (Li et al., JEB 2012) hypothesized that the hind foot rotated in the vertical plane subsurface to generate lift. To explain the observed center-of-mass dynamics, the model assumed that ground reaction force was dominated by speed-independent frictional drag. Here we use x-ray high speed video to obtain subsurface foot kinematics of the lizard running on GM, which confirms the hypothesized subsurface foot rotation following rapid foot impact at touchdown. However, using impact force measurements, a resistive force model, and the observed foot kinematics, we find that impact force during initial foot touchdown and speed-independent frictional drag during rotation only account for part of the required lift to support locomotion. This suggests that the rapid foot rotation further allows the lizard to utilize inertial forces from the local acceleration of the substrate (particles), similar to small robots running on GM (Qian et al., RSS 2012) and the basilisk (Jesus) lizard running on water.

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