Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Robot locomotion on weak ground FEIFEI QIAN, CHEN LI, Georgia Institute of Technology, PAUL UMBANHOWAR, Northwestern University, DANIEL GOLDMAN, Georgia Institute of Technology — Natural substrates like sand, soil, and leaf litter vary widely in penetration resistance. Little is known about how animals (and increasingly robots) respond to this variation. To address this deficit, we built an air fluidized bed trackway, in which we control penetration resistance of 1 mm granular substrates down to zero by increasing the upward flow rate, Q, to the fluidization transition. Using a 2.5 kg bio-inspired hexapedal robot as our model locomotor, we systematically study how locomotion performance (average forward speed, v) varies with penetration resistance, limb kinematics, and foot morphology. Average robot speed decreases with increasing Q, and decreases faster for robots with higher leg frequency or narrower leg width. A previously developed model, which captured the robot's performance on granular media with $Q = 0$, also captures the observed performance for weakened states with $Q > 0$. A single dimensionless control parameter from the model, which combines gait and ground parameters, determines v for all penetration resistances. Our ground control technique and modeling approach provide a way to probe and understand the limits of locomotor performance on yielding substrates.

Feifei Qian
Georgia Institute of Technology

Date submitted: 03 Aug 2012 Electronic form version 1.4