Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Lift-off dynamics in a simple jumping robot[1] JEFFREY AGUILAR, ALEX LESOV, KURT WIESENFELD, DANIEL I. GOLDMAN, Georgia Tech — Jumping is an important behavior utilized by animals to escape predation, hunt, reach higher ground, and as a primary mode of locomotion. Many mathematical and physical robot models use numerous parameters and multi-link legs to accurately model jumping dynamics. However, a simple robot model can reveal important principles of high performance jumping. We study vertical jumping in a simple robot comprising an actuated mass-spring arrangement. The actuator frequency and phase are systematically varied to find optimal performance. Optimal jumps occur above and below (but not at) the robot's resonant frequency f_0. Two distinct jumping modes emerge: a simple jump which is optimal above f_0 is achievable with a squat maneuver, and a peculiar stutter jump which is optimal below f_0 is generated with a counter-movement. A simple dynamical model reveals how optimal lift-off results from non-resonant transient dynamics. An expanded explanation of this work is provided at http://crablab.gatech.edu/pages/jumpingrobot/index.html

[1]This work was supported by the GEM Consortium, Burroughs Wellcome Fund, ARL MAST CTA, and NSF PoLS.

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Date submitted: 28 Nov 2012 Electronic form version 1.4