Lift-off dynamics in a simple jumping robot\textsuperscript{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

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