**The Center for Control, Dynamical Systems, and Computation**
**University of California at Santa Barbara**
**Presents**

# Metastable Legged-Robot Locomotion


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**Abstract:**

A variety of impressive approaches to legged locomotion exist; however, the science of legged robotics is still far from demonstrating a solution which performs with a level of flexibility, reliably and careful foot placement that would enable practical locomotion on the variety of rough and intermittent terrain humans negotiate with ease on a regular basis. In this talk, we present a methodology for designing control algorithms to move a legged robot across such terrain in a qualitatively satisfying manner, without falling down very often. We feel the definition of a meaningful metric for legged locomotion is a useful goal in and of itself. Specifically, the mean first-passage time (MFPT), also called the mean time to failure (MTTF), is an intuitively practical cost function to optimize for a legged robot, and we present a systematic, mathematical process for obtaining estimates of this MFPT metric. Of particular significance, our models of walking on stochastically rough terrain generally result in dynamics with a fast mixing time, where initial conditions are largely “forgotten” within 1 to 3 steps. Additionally, we can often find a near-optimal solution for motion planning using only a short time-horizon look-ahead. Although there are clearly important classes of optimization problems for which long-term planning is required to avoid “running into a dead end” (or off of a cliff!), we demonstrate that many classes of rough terrain can in fact be successfully negotiated with a surprisingly high level of long-term reliability by selecting the short-sighted motion with the greatest probability of success. The methods used throughout have direct relevance to machine learning, providing both an approach toward reducing state space dimensionality and mathematical tools for obtaining a scalar metric quantifying performance of the resulting reduced-order system.


**About the Speaker:**

Katie Byl is currently a postdoctoral fellow, working on control of a robot fly at the Microrobotics Laboratory at Harvard University. She received her S.B., S.M., and Ph.D. degrees in mechanical engineering from MIT. Her research is in dynamic systems and control, with particular interest in modeling and control techniques to deal with the inherent challenges of underactuation and stochasticity that characterize bio-inspired robot locomotion and manipulation in real-world environments. She enjoys road cycling, camping, scrabble, and dog agility and was once a professional gambler on the now-infamous MIT Blackjack Team.