Energetics and stability of human locomotion

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In this talk, I will preview our recent work at understanding two complementary aspects of human locomotion. Energetics on the one hand, and stability/robustness on the other.

First, towards an energy optimality based predictive theory of human locomotion, we will show the predictions of energy optimizations with a multisegment model of a human compared with about ten different human subject experiments involving steady straight line walking. We will draw attention to aspects in which the theory is still lacking, and aspects which are easy for the theory to predict.

We will then present related experimental and theoretical work on human energetic optimality under various other circumstances: such as gait transition with time and distance constrained locomotion (work with Leroy Long), preferred speeds while locomotion along circular and otherwise curved paths (work with Geoff Brown), and unnatural gaits such as sideways (crab-like) locomotion (work with Matthew Handford).

Next, I will describe current work with Yang Wang in trying to delineate the dynamics around the roughly periodic locomotion: (1) by attempting to fit linear models to naturally variable human locomotion data (following Revzen) using simple models and a patchwork of Poincare sections (2) by examining the transient dynamical response to self-imposed transients during treadmill locomotion.