

Locomotor transitions in complex 3-D terrain

Ratan Othayoth, Qihan Xuan, Yaqing Wang, Chen Li; Johns Hopkins University

To move through complex 3-D terrain, animals and robots must transition across different modes of locomotion. By contrast, most mechanistic understanding of terrestrial locomotion deals with generating and stabilizing near-steady-state locomotion in a single mode (e.g., walk, run). We do not well understand how animals use physical interaction to make robust locomotor transitions, and how robots should do so. To begin to fill this knowledge gap, our lab studied simplified model systems of diverse challenges in complex 3-D terrain (Othayoth et al, 2021, *Proc. Roy. Soc. B*). Modeling locomotor-terrain interaction using a potential energy landscape approach advanced understanding of how the stereotyped, probabilistic locomotor transitions of self-propelled animals and robots are constrained by physical interaction. Across model systems, locomotor transitions are barrier-crossing transitions on a potential energy landscape. Systematic variation of locomotor and terrain parameters revealed terradynamic principles of locomotor-terrain interaction. These insights allowed us to discover of a suite of strategies to elicit, facilitate, suppress, or avoid locomotor transitions, which not only advanced understanding of how animals make locomotor transitions (or lack thereof) but also increased robot performance.