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Dynamic traversal of high bumps and large gaps by a small legged robot SEAN GART, NASTASIA WINEY, RAFAEL DE LA TIJERA OBERT, CHEN LI, Johns Hopkins University — Small animals encounter and negotiate diverse obstacles comparable in size or larger than themselves. In recent experiments, we found that cockroaches can dynamically traverse bumps up to 4 times hip height and gaps up to 1 body length. To better understand the physics that governs these locomotor transitions, we studied a small six-legged robot negotiating high bumps and large gaps and compared it to animal observations. We found that the robot was able to traverse bumps as large as 1 hip height and gaps as wide as 0.5 body length. For the bump, the robot often climbed over to traverse when initial body yaw was small, but was often deflected laterally and failed to traverse when initial body yaw was large. A simple locomotion energy landscape model explained these observations. For the gap, traversal probability decreased with gap width, which was well explained by a simple Lagrangian model of a forward-moving rigid body falling over the gap edge. For both the bump and the gap, animal performance far exceeded that of the robot, likely due to their relatively higher running speeds and larger rotational oscillations prior to and during obstacle traversal. Differences between animal and robot obstacle negotiation behaviors revealed that animals used active strategies to overcome potential energy barriers.

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