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Animal and robot experiments to discover principles behind the evolution of a minimal locomotor apparatus for robust legged locomotion[1]

BENJAMIN MCINROE, HENRY ASTLEY, Georgia Tech, SANDY KAWANO, NIMBioS, RICHARD BLOB, Clemson University, DANIEL I. GOLDMAN, Georgia Tech — In the evolutionary transition from an aquatic to a terrestrial environment, early walkers adapted to the challenges of locomotion on complex, flowable substrates (e.g. sand and mud). Our previous biological and robotic studies have demonstrated that locomotion on such substrates is sensitive to both limb morphology and kinematics. Although reconstructions of early vertebrate skeletal morphologies exist, the kinematic strategies required for successful locomotion by these organisms have not yet been explored. To gain insight into how early walkers contended with complex substrates, we developed a robotic model with appendage morphology inspired by a model analog organism, the mudskipper. We tested mudskippers and the robot on different substrates, including rigid ground and dry granular media, varying incline angle. The mudskippers moved effectively on all level substrates using a fin-driven gait. But as incline angle increased, the animals used their tails in concert with their fins to generate propulsion. Adding an actuated tail to the robot improved robustness, making possible locomotion on otherwise inaccessible inclines. With these discoveries, we are elucidating a minimal template that may have allowed the early walkers to adapt to locomotion on land.

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