

Srinivasan, Manoj; Holmes, Philip

How well can spring-mass-like telescoping leg models fit multi-pedal sagittal-plane locomotion data? (English) Zbl 1400.92052

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Summary: Idealized mathematical models of animals, with point-mass bodies and spring-like legs, have been used by researchers to study various aspects of terrestrial legged locomotion. Here, we fit a bipedal spring-mass model to the ground reaction forces of human running, a horse trotting, and a cockroach running. We find that, in all three cases, while the model captures center-of-mass motions and vertical force variations well, horizontal forces are less well reproduced, primarily due to variations in net force vector directions that the model cannot accommodate. The fits result in different apparent leg stiffnesses in the three animals. Assuming a simple fixed leg-angle touch-down strategy, we find that the gaits of these models are stable in different speed-step length regimes that overlap with those used by humans and horses, but not with that used by cockroaches.

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