The locomotion of Jumping Species.

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Abstract

Jumping locomotion is present in many organisms, such as plants, fungi, insects and vertebrates which describe a wide variety of jumping mechanisms. Surprisingly, jumping organisms are limited to a very narrow range of take-off velocity (below 6 m/s). To explain the jumping limit observed in nature, we propose a definition of jumping that encompasses a diversity of organisms. We introduce a physical model which provides an understanding of the limit. The model hand over kinematic and dynamic constraints added to biological aspects.
The main results are that general mechanical considerations provide an upper bound for the take-off velocity of any jumper, animate or inanimate, rigid or soft body, animal or vegetal. The take-off velocity is driven by the ratio of released energy to body mass. Further, the mean reaction force on a rigid platform during push-off is inversely proportional to the characteristic size of the jumper. These general considerations are illustrated in the context of Alexander's jumper model which can be solved exactly and which shows an excellent agreement with the mechanical results. These aspects of the jump can be applied to understand the limit of nature and the construction of artificial devices to jump's way locomotion.

Finally, we complement the jumping research with a case of study of a very good jumper, the jerboa(rodent). This is a highly manoeuvrable bipedal rodent, with multiple tail behaviors such, that the tail is elevated and actively controlled during locomotion, provides support during standing, and acts as a fifth limb for juvenile jerboas when learning to walk. We collect experimental data obtained specifically from the tail of Jerboa and we proposed models representing its through an elastic structure. The first approach helps in developing a model of the particular S shape of the animate tail; the second one allows to calculate bending stiffness of the tail with experimental mechanics and elastic model (inanimate tail).

Dedication

To my parents,
Raquel and Salvador.

To my husband and my daughter,
Ricardo and Francisca.

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Contents