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Role of the Semi-lunar Process in Locust Jumping

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Role of the semi-lunar process in locust jumping

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The biomechanical and neural components that underlie locust jumping have been extensively studied [1-4]. Previous research suggested that energy for the jump is stored primarily in the extensor apodeme and in the semi-lunar process (SLP) [5], a thickened band of cuticle at the distal end of the tibia. As it has thus far proven impossible to experimentally alter the SLP without rendering a locust unable to jump, it has not been possible to test whether the energy stored in the SLP has a significant impact on the jump, or how that energy is applied during the jump.

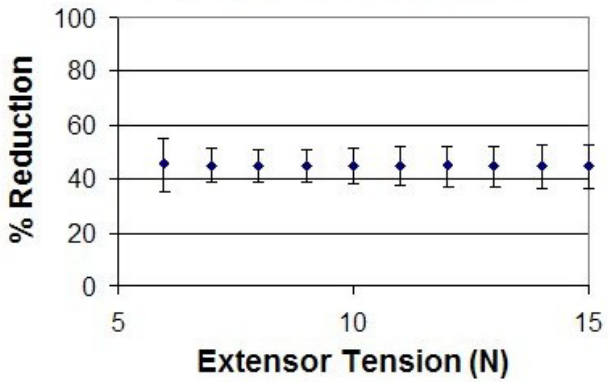

Figure 1
Percentage reduction in jump distance without semi-lunar process. Loss of the SLP reduced the distance jumped by approximately 45% across the entire range of extensor tensions tested. Each point is n = 20.

To address problems such as this we have developed a software toolkit, AnimatLab, which allows researchers to build and test virtual organisms. We used this software to build a virtual locust, and then asked how the SLP is utilized during jumping, and how manipulation or removal of the virtual SLP influences jump dynamics (figures 1 and 2). The results show that without the SLP the jump dis-

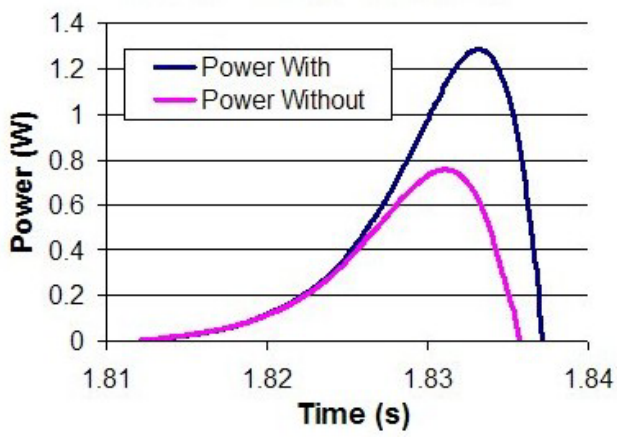

Figure 2
Power during jump impulse. The power during the early phase of the jump is almost identical, but without the SLP it peaks early and the power from the late phase of the jump is almost entirely missing. This has a significant impact on the jump distance.

tance was reduced by almost half. Further, the simulations were also able to show that loss of the SLP had a significant impact on the final phase of the jump impulse which prevented the full extension of the tibia against the ground. Power for the jump during the initial phase was almost identical between the two cases, but without the SLP the power peaked early and there was a significant difference in the power for the late phase of the jump.

Acknowledgements

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