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Dynamic Force Patterns of an Undulatory Microswimmer

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C. elegans is a millimeter-sized nematode which has served as a model organism in biology for several decades, primarily due to its simple anatomy. Using an undulatory form of locomotion, this worm is capable of propelling itself through various media. Due to the small length scales involved, swimming in this regime is qualitatively different from macroscopic locomotion because the swimmers can be considered to have no inertia. In order to understand the microswimming that this worm exhibits, it is crucial to determine the viscous forces experienced during its motion. Using a micropipette deflection technique in conjunction with high speed imaging, we have directly measured the time-varying forces generated by *C. elegans* during swimming. Furthermore, by analyzing the body's kinematics over time and applying a model of locomotion, we can compute the theoretical force curves. We observe excellent agreement between the measured and calculated forces. The success of this simple model has important implications in the understanding of microswimming in general.

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