Better understanding of the movements of C.elegans worm will make a big difference in biomedical research

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One might wonder why researchers would even care about the nuances of the one-millimeter long nematode worm, let alone take the time to study them. But the answer is simple: they can provide powerful insights into human health and disease.

New research performed at Texas Tech University and published in the journal *Physics of Fluids* demonstrates just that. By studying how this tiny worm swims, the researchers hope to provide insights into applications from drug screening to setting the stage for designing smart soft robots.

Why the Worm?

The nematode Caenorhabditis elegans has long been an important organism in biology and medicine labs. It was at the center of three Nobel Prize winning investigations, and biologists routinely use this worm for studies that range from genetics, to behavior and neurobiology, to disease pathogenesis. Its genome was one of the first to be fully mapped, and at least 50% of its genes are similar to those found in humans. In addition, though its nervous system is nowhere near as complex as the human's, a complete map of its 302 neurons with 7,000 connections is known. Since a library of mutants where genes are knocked out is also available, C. elegans has become a powerful model for screening drugs, including ones for neurological diseases like

Parkinson's.

The basic idea behind drug screening is to expose different worms to different drugs and see what happens. Since swimming is one of the worm's main observable behaviors, gaining a comprehensive understanding of the nematode's motion in various mechanical environments is very important for developing a sensitive screen to test drug compounds that affect nerve cells or muscles and may, for example, help alleviate symptoms for people with incurable diseases.

A precise model of the nematode's swimming patterns will lead to better drug screening and will also enable reverse engineering of the worm's neural system, explained Jerzy Blawzdziewicz, one of the authors of the new study.

"The worm executes a finite set of body shapes," he said. "We have described these gaits mathematically, and now we have combined the gait models with accurate models of the flow generated by the nematode body during swimming. This unique approach has led us to determine the dependence of swimming velocity on the form of the gait and allowed us to model the turning maneuvers of the worm." The next step is to develop locomotion models that combine the reported hydrodynamic analysis with a new description of neuromuscular control of the nematode body.

Blawzdziewicz and his collaborator Siva Vanapalli are enthusiastic about the prospects. "Our future quantitative studies of nematode navigation through complex environments will benefit analyses of the behavioral response of nematodes exposed to compounds affecting neurons or muscles in drug screening assays. Moreover, we anticipate that our studies may find applications in engineering of smart, millimeter-scale soft robots."

The article, "Nematode Locomotion in Unconfined and Confined Fluids" by Alejandro Bilbao, Eligiusz Wajnryb, Siva Vanapalli, and Jerzy Blawzdziewicz appears in the journal *Physics of Fluids*.

More information: dx.doi.org/10.1063/1.4816718

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