Obstacles no barrier to higher speeds for worms, researchers find

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Caenorhabditis elegans. Image: Wikipedia.

Obstacles in an organism's path can help it to move faster, not slower, researchers from New York University's Applied Math Lab at the Courant Institute of Mathematical Sciences have found through a series of experiments and computer simulations. Their findings, which appear in the *Journal of the Royal Society Interface,* have implications for a better understanding of basic locomotion strategies found in biology, and the survival and propagation of the parasite that causes malaria.

Nematodes, which are very small worms, and many other organisms use a snake-like, undulatory motion to propel forward across dry surfaces and through fluids. There are, however, many instances where small organisms must make their way through a fluid-filled environment studded with obstacles that are comparable in size to the swimmers themselves. Nearly all microscopic nematodes, about one millimeter in length, face such barriers when moving through wet soil—the soil's granules serve as hurdles these creatures must navigate. Similarly, the malaria parasite's male gametes, or reproductive cells, must swim through a dense suspension of their host's blood cells in order to procreate. A similar situation arises for spermatozoa moving through the reproductive tract.

In the Journal of the Royal Society Interface study, the Applied Math Lab (AML) group sought to understand how efficiently such undulating organisms can move through obstacle-laden fluids. To do so, they conducted a study comparing experiments using live worms, the nematode C. elegans, with the results of a computer model of a worm moving in a virtual environment. In the experiment, the worms swam through a very shallow pool filled with a lattice of obstructing micro-pillars while the computer simulation gave a benchmark of a worm moving blindly without sensing and response.

Surprisingly, C. elegans was able to advance much more quickly through the lattice of obstacles than through a fluid in which their movement was unimpeded.

"If the lattice is neither too tight nor too loose, the worms move much faster by threading between and pushing off the pillars," the researchers wrote.

The second surprise was that the computer simulation gave very similar results, reproducing the fast motions of the worm in the lattice, but also showing complex "life-like" behaviors that had been interpreted as coming from sensing and response of the worm to its local environment.

These results enhance our understanding of biological locomotion through tortuous environments like soils or the reproductive tract, showing how real organisms can take advantage of what seems a defiant complexity, and offer intriguing insights into how the reproductive processes of dangerous parasites might be interrupted.

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