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Chemotaxis of *Caenorhabditis elegans* in complex media: crawling, burrowing, 2D and 3D swimming, and controlled fluctuations hypothesis[1] AMAR PATEL, ALEJANDRO BILBAO, Dept. of Mechanical Engineering, Texas Tech University, MIZANUR RAHMAN, SIVA VANAPALLI, Dept. of Chemical Engineering, Texas Tech University, JERZY BLAWZDZIEWICZ, Dept. of Mechanical Engineering, Texas Tech University — *Caenorhabditis elegans* is a powerful genetic model, essential for studies in diverse areas ranging from behavior to neuroscience to aging, and locomotion and chemotaxis are the two key observables used. We combine our recently developed theory of nematode locomotion and turning maneuvers [Phys. Fluids 25, 081902 (2013)] with simple models of chemosensation to analyze nematode chemotaxis strategies in 2D and 3D environments. We show that the sharp-turn (pirouette) chemotaxis mechanism is efficient in diverse media; in particular, the nematode does not need to adjust the sensing or motion-control parameters to efficiently chemotax in 2D crawling, 3D burrowing, and 2D or 3D swimming. In contrast, the graduate-turn mechanism becomes inefficient in swimming, unless a phase-shift is introduced between the sensing signal and modulation of body wave to generate the gradual turn. We hypothesize that there exists a new "controlled fluctuations" chemotaxis mechanism, in which the nematode changes the intensity of undulation fluctuations to adjust the persistence length of the trajectory in response to a variation in chemoattractant concentration.

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