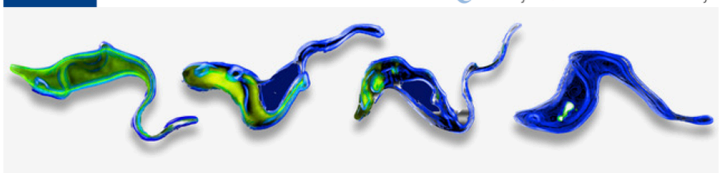

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Run and Tumble Behavior of E. Coli

E. coli is a multi-flagellated bacterium with a prolate spheroidally-shaped body and several left-handed helical flagella (typically between 2 and 5). The helical flagella are rotated by a motor, enabling the bacterium to propel forward. E. coli generally has two modes of swimming: (i) 'run'with a straight swimming direction, and (ii) 'tumble'during which the bacterium can change its swimming direction [1-3]. During the run stage, all flagella rotate anticlockwise, such that they bundle into a single propeller. During the tumble stage, one or more flagella switch to the clockwise rotation, so that they leave the bundle and facilitate E. coli to change its swimming direction. In our work, we investigate how different E. coli properties, including body and flagella geometry, flagella stiffness and the strength of actuation, govern the run-and-tumble behavior of these bacteria. We establish a realistic E. coli model and validate it using available experimental observations [1-3]. The model properly captures the running speed of E. coli, rotational frequency of the head and flagella, tumbling time and angle in comparison to experimental measurements [1-5]. Furthermore, our simulations show that the stiffness of a hook (the short part of a flagellum which connects it directly to the motor) plays an important role in the run-and-tumble behavior, which has also been suggested in experimental studies [6-7]. This detailed model of E. coli helps us better understand its swimming behavior, and allows the exploration of E. coli locomotion in more complex realistic environments such as with walls [8].

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