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Tracking the translational and rotational motions of a swimming helical magnetotactic bacteria

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Magnetotactic bacteria are ubiquitous motile single-cell organisms that biomineralize magnetic nanoparticles, allowing them to align with the Earth's magnetic field and navigate their aquatic habitats. We are interested in the swimming mechanism of one particular type of magnetotactic bacteria, Magnetospirillum magneticum, which has a helical body and use two helical flagella to move up and down magnetic field lines. We take advantage of both the helical shape of the cell and the possibility to align them with magnetic fields to precisely measure both their translational and rotational motions from phase microscopy images. This allows us to precisely measure both the translational and rotational friction coefficients of these micron-size chiral particles, and from them calculate the propulsion forces exerted by the body and the flagella of the cell. Our results suggest that for this bacterial species cell body rotation significantly contributes to cellular propulsion.

Keyword-1

Cell swimming and propulsion

Keyword-2

Single cell tracking

Keyword-3

Low Reynolds # hydrodynamics

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