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Finding the best swimming sheet[1] TOM IVES, ALEXANDER MOROZOV, SUPA, School of Physics & Astronomy, University of Edinburgh, UK — Many microorganisms propel through fluid environments by undulating their bodies or long thin organelles (flagella). The particular waveform of the undulations can often be changed by the organism to adapt to particular environmental conditions. It has been proposed in the literature that this adaptation is driven by the desire to optimise the swimming efficiency. However, it remains an open question as to whether this is indeed the optimised quantity for microorganisms. We study propulsion in Newtonian fluids at zero inertia for a model organism, the so-called Taylor waving sheet. We develop a numerical method that allows us to calculate flow fields for sheets of arbitrary waverforms in the bulk and next to a wall. We perform optimisations of various quantities that can potentially be optimised by a swimming microorganisms (efficiency, speed, etc.) and present the optimal waveforms. We also present a simple analytical model that yields similar results. We conclude that various optimal waveforms are very similar, both in the bulk and next to a boundary, and one cannot claim that optimising the swimming efficiency is the strategy adopted by undulating microorganisms.

[1]SUPA, School of Physics & Astronomy, University of Edinburgh, UK

Tom Ives
SUPA, School of Physics & Astronomy, University of Edinburgh, UK

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