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Swimming dynamics and efficiency in diatom chain colonies

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Diatoms are among the most abundant microorganisms found in both oceanic and freshwater environments worldwide. While some species drift passively with ambient currents, others employ various strategies for movement or self-propulsion. One species in particular, called Bacillaria Paxillifer, forms colonies of stacked rectangular cells that slide along each other while remaining parallel. This unique collective motion leads to beautiful and nontrivial trajectories at the colony scale. By using a numerical method developed to simulate articulated bodies in Stokes flows, we show that the swimming speed of such microorganisms changes non-monotonically with the sliding delay between pairs of cells. The observed swimming efficiency as a function of the number of oscillations along the colony exhibits several local maxima, contrary to what is commonly observed in flagellate microorganisms. In addition, the optimal cell aspect ratio found with our simulation matches those observed in real diatom chain.

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