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Simulation of actuated synthetic cilia expelling microorganisms from a surface HENRY SHUM, ANURAG TRIPATHI, University of Pittsburgh, JULIA YEOMANS, University of Oxford, ANNA BALAZS, University of Pittsburgh — The continual motion of cilia provides a defense against biofouling for a variety of marine organisms. Inspired by this natural solution, we perform numerical simulations to study the interactions between actuated, biomimetic cilia and model microswimmers that are hydrodynamically attracted to bare surfaces and therefore behave similarly to fouling organisms. The 3-dimensional fluid flow is coupled to the motion of the cilia and swimmers using an integrated lattice Boltzmann and immersed boundary method. We show that a sparse array of actuated cilia, through which the organisms are able to swim, is able to robustly expel swimmers. The average residence time of the swimmers in the ciliary layer is reduced if the motion of the cilia generates a net fluid flow, but for relatively fast swimmers, the steric interaction with the moving cilia alone is sufficient to "knock" the organisms away from the surface. As the demonstrated mechanisms for antifouling do not rely on specific chemical or physical properties of the surface or swimmer, actuated cilia can potentially protect microfluidic devices, filtration membranes or ship hulls from a wide range of fouling species.

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