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Enhancement of microbial motility due to advection-dependent nutrient absorption¹ CARLOS A. CONDAT, MARIO E. DI SALVO, IFEG-CONICET and FaMAF - Universidad Nacional de Córdoba, Córdoba, Argentina — In their classical work, Berg and Purcell [Biophys. J. 20, 193 (1977)] concluded that the motion of a small microorganism would not significantly increase its nutrient uptake rate, if the nutrient consisted of high diffusivity particles. As a result, it has been generally assumed that nutrient transport to small microorganisms such as bacteria is dominated by molecular diffusion and that swimming and feeding currents play a negligible role. On the other hand, recent studies have found that flagellar motion may increase advection-mediated uptake. We formulate a model to investigate the hypothesis that fast-moving microbes may enhance their swimming speed by taking advantage of advection to increase nutrient absorption. Surprisingly, using realistic parameter values for bacteria and algae, we find that even modest increases in nutrient absorption may lead to a significant increase of the microbial speed. We also show that, optimally, the rate of effective energy transfer to the microbial propulsion system should be proportional to the speed for slow motion, while it should be proportional to a power of the speed close to two for fast motion.

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