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A mechanism of low-Reynolds-number propulsion enhancement
ALEXANDER LESHANSKY, Department of Chemical Engineering, Technion-IIT, Haifa 32000 — Is has been known for some time that some microorganisms can swim faster in high-viscosity gel-forming polymer solutions. The qualitative explanation of this phenomena first offered by H. Berg and L. Turner (Nature **278**, 349, 1979) suggested that propulsion enhancement is a result of flagellum pushing on quasi-rigid loose polymer network. Following this hypothesis we consider inertia-less propulsion in a model heterogeneous environment composed of sparse array of stationary obstacles embedded into a viscous Newtonian solvent. It is demonstrated that for some propulsion techniques, including transverse surface waves and rotating helical filament, the propulsion speed (for the prescribed swimming gait) is enhanced when compared to the locomotion through viscous solvent. It is shown that locomotion is not only advantageous speed-wise, but is also more hydrodynamically efficient. The results of the rigorous numerical simulations of the rotating "shish- kebab" filament propelled through a random sparse matrix of stationary spherical obstructions are in a very close agreement with the predictions of proposed modified resistive force theory based on effective media approximation.

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