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Hydrodynamic entrapment of uni-flagellated bacteria with flexible flagellum near a flat surface

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Entrapment of swimming bacteria near surfaces may lead to biological processes such as biofilm formation and wound infection. Previous experimental observations of *Vibrio alginolyticus* showed an interesting dependence of entrapment near surfaces on the mode and average swimming speed of the population. Near-surface cell concentration of puller type *V. alginolyticus* is increased, while a decreased concentration of pusher type cells is observed as the swimming speed of bacteria increases [1]. Motivated by these observations, we numerically investigate the locomotion of a model bacterium using an elastohydrodynamic model [2] for the flagellum in either puller or pusher mode. In this model, the boundary integral technique and Kirchhoff rod model are employed respectively to calculate the hydrodynamic forces on the swimmer and model the elastic deformations of the flagellum which consists of a very flexible short hook and a relatively stiff long filament. Our numerical results demonstrate that hydrodynamic interactions between the model bacterium and the solid wall causes the puller type to be attracted to the surface, whereas the pusher type either escapes from or is attracted to the surface. Depending on the flagellum/hook stiffness, the motor torque, and the cell body aspect ratio, the model *V. alginolyticus* exhibits different escaping angles or swims next to the surface on a circular trajectory. These research findings can be used not only in understanding uni-flagellated bacterial behaviour but also in designing bacteria-mimicking micro-robots with biomedical and environmental monitoring applications.

REFERENCES

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