Directed navigation at low Reynolds fluid dynamics

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The study of propulsion mechanisms at very low Reynolds number has been the subject of many theoretical and experimental studies since the classical work of Taylor [1]. As has been indicated by Purcell, the exceptional constraints of the low Reynolds hydrodynamics introduce very interesting features for the problem of swimming in this condition [2]. A very comprehensive review of the subject can be found in reference [3].

Here after a very short look at the micron scale hydrodynamics, we will concentrate on a specific swimmer: A hydrodynamical micro-swimmer, inspired by biological chemotaxis along circular paths [4], that can swim and find its target [5, 6]. This system is essentially a stochastic low Reynolds swimmer with ability to move in two dimensional space and sense the local value of the chemical concentration emitted by a target. We show that by adjusting the geometrical and dynamical variables of the swimmer we can always achieve a swimmer that can navigate and search for the region with higher concentration of a chemical emitted by a source.

A theoretical framework for studying the interplay between the chemotaxis mechanism and the flow dynamics inn biological systems and also a proposal for assembling an artificial search machine are the advantages of the model introduced here.

References

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