Swimming at low Reynolds number

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Swimming at low Reynolds number is a topic that has emerged since the seminal works of Taylor and Purcell [4, 3]. The aim is to understand the swimming capabilities of microorganisms such as spermatozoa, bacteria or microalgae. The talk is meant as an introductory talk for the minisymposium "Mathematical modeling of low Reynolds number swimming". The goal is to present an overview of the problem, showing the counterintuitive obstruction given by the Scallop Theorem, and the inefficiency of reciprocal shape changes. We will show how to produce loops in the space of shapes and why Control theory has been so successfull [2]. Several techniques can then be understood to propel biological as well as artificial microorganisms [1, 5].
Several questions will be raised during the talk, some of them being answered in the subsequent talks of the Minisymposium. In particular the way for biological filament to produce curvature and eventually motion will be of particular interest since the complex fluid-structure interaction and the activation mechanism that produces the deformation itself remains, to a large extent, a mystery.

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[2] F. Alouges, A. DeSimone, A. Lefebvre. *Optimal Strokes for Low Reynolds Number Swimmers : An Example.* Journal of Nonlinear Science, **18(3)**, 277–302, 2008. doi :10.1007/s00332-007-9013-7.

[3] E. M. Purcell. *Life at low Reynolds number.* American Journal of Physics, **45(1)**, 3–11, 1977.

[4] G. I. Taylor. *Analysis of the swimming of microscopic organisms.* Proc. R. Soc. Lond. A, **209**, 447–461, 1951.

[5] M. Zoppello, A. Desimone, F. Alouges, L. Giraldi. *Self-propulsion of slender micro-swimmers by curvature control : N-link swimmers.* International Journal of Non-Linear Mechanics, **56**, 2013. doi :10.1016/j.ijnonlinmec.2013.04.012.

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