Master internship in microfluidics/acoustics at IEMN (Université de Lille):

Streaming flow induced by a micro-swimmer

Duration: 4-6 months
Anticipated starting date: from January 2023
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In the past few years, researchers have managed to propel micrometer sized swimmers in a 2D plane by exciting them with ultrasound [1] (Fig. 1, left). The underlying physical mechanisms to achieve this propulsion are the following: (i) the acoustic actuation sets the tail of the swimmer into vibration, (ii) the interaction of the vibrating tail with the surrounding liquid creates a flow called microstreaming (which, mathematically, is induced through nonlinear effects), (iii) the microstreaming exerts a relative force between the swimmer and surrounding liquid allowing the swimmer to be pushed forward. However, no study has yet revealed the detailed mechanisms of microstreaming involved.

The objective of the internship is to experimentally and theoretically study the streaming flow induced around the tail of a microswimmer. For this, we will design and fabricate different types of tails, and study the physical phenomena that appear when they are excited with ultrasound. Inspired by already existing studies on similar 2D structures [2] (see also Fig. 1, right), the main goal will be to understand the streaming flows induced around acoustically excited 3D tails.

The candidate must have a strong interest in experimental work and a background in fluid dynamics and/or acoustics.

The internship could be followed by a PhD thesis, with the aim to optimize the tails and implement them on real 3D swimmers with possible applications in the medical field.

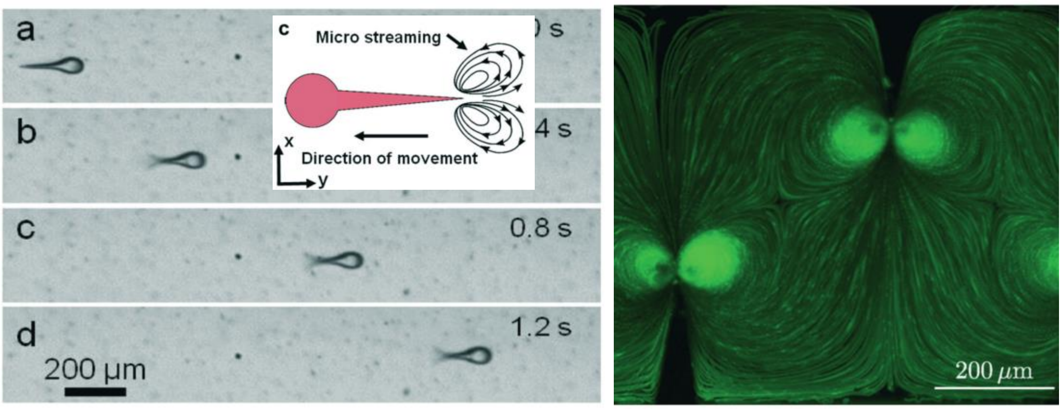

Fig. 1 : Left – forward motion of an acoustically excited microswimmer (snapshots) and shematic principle (inlet) (from [1]).
Right – visualisation of streaming flow induced around a tail-like 2D structure (from [2]).

[1] Kaynak, Murat, et al. "Acoustic actuation of bioinspired microswimmers." *Lab on a Chip* 17.3 (2017): 395-400.
[2] Nama, Nitesh, et al. "Investigation of acoustic streaming patterns around oscillating sharp edges." *Lab on a Chip* 14.15 (2014): 2824-2836.