Institut de Physique de Nice
CNRS - UMR 7010
EQUIPE Microfluidique, physIco-chiMie et bIologie aux interfaCes (MIMIC)

Master 2 Internship

Swimming of biflagellate zoospores: a new type of microswimmer.

Topics: microfluidics, biophysics of microorganisms, microswimmers, time lapse microscopy, data analysis.

Oomycetes are major plant pathogens that significantly affect various crops among which most of agronomic species and varieties. Among those pathogens, the telluric oomycete *Phytophthora parasitica* produces infectious particles called *zoospores* that swim in the soil to reach and infect the roots. In collaboration with plant biologists (Eric Galiana and coll. at INRAE, Sophia-Antipolis), we showed that microfluidics device are promising technic to study how zoospores response to environmental stimuli such as ionic gradients (Galiana et al. [1]) and we recently characterized zoospores swimming showing that zoospore constitute an interesting new type of micro-swimmers (Tran et al. [2]).

To go further, we are now developing new microfluidics devices to study zoospore behavior under other type of stimuli such as electric field, confined environments, or signals from plant roots. Indeed, root secrete a set of molecules that can constitute signals perceived by pathogens to initiate the infectious cycle.

The M**aster student's work will focus on:**

1- **Design and fabrication of microfluidic devices to study zoospores under specific conditions** (with or without plant root (Massalha *et al*., [3]), obstacles or electric fields).

2- **Imaging and characterizing the swimming of *P. parasitica zoospores*.** Combining time lapse microscopy and image analysis, the student will study the movement of the zoospores during an experiment with kinetics parameters under the effects of electric fields, confinement, signals from roots.

This work is part of an interdisciplinary research project (PRO-ZOOM) which brings together plant **biologists (ISA, INRAE)** and **physicists (INPHYNI)** and funded by the **UCA^{JEDI} IDEX (2 students gratification and other costs).** The two teams meet the same scientific questions by combining experiments in plant genetics, cytology and physics ([1,2][4]). During the internship, the Master student will broaden his field of expertise through regular meetings and exchanges with the other Master student recruited at ISA and who will determine whether there is a correlation between rhizospheric pH or cation fluxes, the activity of cation pumps and the accumulation of zoospores around the root during infection.

Moreover, this study will be in partnership with the start-up **KLEARIA (Sophia-Antipolis)** for aspects linked to microfluidic systems development.

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Ph.D Thesis possible to continue.

[1] Galiana E, Cohen C, Thomen P, Etienne C, Noblin X. 2019 Guidance of zoospores by potassium gradient sensing mediates aggregation. J. R. Soc. Interface 16: 20190367.

[2] Q.D. Tran, E. Galiana, F. Peruani, P. Thomen, C. Cohen, F. Orange, X. Noblin. To be submitted.

[3] Hassan Massalha, Elisa Korenblum, Sergey Malitsky, Orr H. Shapiro, and Asaph Aharoni. 2017. Live imaging of root–bacteria interactions in a microfluidics setup. PNAS 114 (17) 4549-4554

[4] Ilaria Bassani, Corinne Rancurel, Sophie Pagnotta, François Orange, Nicolas Pons, Kevin Lebrigand, Franck Panabières, Laurent Counillon, Xavier Noblin, Eric Galiana, Transcriptomic and Ultrastructural Signatures of K+-Induced Aggregation in Phytophthora parasitica Zoospores. Microorganisms 8 (7), 1012 (2020).