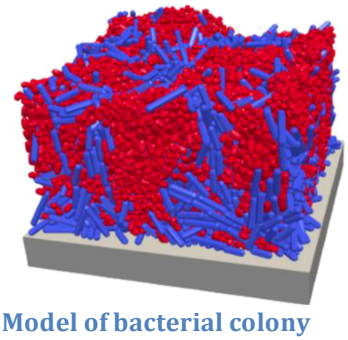
Master project & PhD in research
Stage de M2 recherche & Thèse

Research topic	Modelling bacterial populations & biofilms in heterogeneous environments.
Lab	Institute of Fluid Mechanics, Allee Camille Soula, 31400 Toulouse, France.
Salary	**Master**: monthly stipend of about 500-600 euros net (negotiable for foreigners). **PhD**: between 17.000 and 21.000 euros net / year (funding for 3 years).
Funding /Project	European Research Council. ERC Starting Grant. Project BEBOP.
Follow up	Funding is available for a PhD position after the master.
Main supervisor	Yohan Davit, yohan.davit@imft.fr, tel: +33 5 34 32 28 82.
Dates	**Master**: applications until December 2018. Internship of 4 to 6 months in 2019. **PhD**: applications until April 2019 or until fulfilled.
Example publication	Cell morphology drives spatial patterning in microbial communities. WPJ Smith, Y Davit, J Osborne, W Kim, KR Foster and J Pitt-Francis. PNAS (2017).
Background	Applied mathematics, or physical modelling, or fluid mechanics.
Other	For more info about research activities @ IMFT, http://yohan-davit.com

Context. This Master/PhD is part of a large project (BEBOP, 2019-2024) funded by the European Research Council. The goal of BEBOP is to figure out how we can use bacteria to control the properties of porous structures (e.g. porosity, permeability). We envision that this will unlock a new generation of biotechnologies, such as self-repairing construction materials or self-cleaning bioreactors. The main scientific obstacle to this technology is the lack of understanding of the biophysical mechanisms associated with the development of bacterial populations within complex porous structures. Therefore, the first scientific objective of BEBOP is to gain insight into how fluid flow, transport phenomena and bacterial communities (biofilms) interact within connected heterogeneous structures. To this end, we will combine microfluidic and 3D printed micro-bioreactor experiments; fluorescence and X-ray imaging; high performance computing bringing together CFD, individual-based models and pore network approaches. The second scientific objective of BEBOP is to create the primary building blocks toward a control theory of bacteria in porous media and to construct a demonstrator bioreactor for permeability control.



Model of bacterial colony (bacillus in blue, coccus in red) from Smith et al., PNAS (2017)

Role. The successful applicant will develop innovative models of the growth of bacterial communities. The idea of the PhD position following this Master is to develop a high performance computing framework for the simulation of bacterial communities growing within porous structures, including couplings between the mechanics of the community, transport phenomena (nutrients, molecular signalling) and fluid flow. The code will use PELICANS/CALIF3S for CFD (collaboration with J.-C. Latché). The goal of the Master project is to explore the different modelling paradigms (e.g. phase-field approaches or individual-based models) and to develop a proof-of-concept code for a small community. The actual research is flexible and can be adapted to the expertise of the successful candidate. I am looking for somebody extremely motivated who is willing to pursue this work as a PhD student and who will be fully involved in the project and in the group (2 PhDs + 1 postdoc starting in 2019, other positions will also be opened later on).

How to apply? Send a cover letter, a CV (highlighting your level in English) and copies of transcripts (including lectures followed and grades/rankings when available) to yohan.davit@imft.fr (please indicate ERC_BEBOP_Modelling in the e-mail title). Retained candidates will be interviewed.