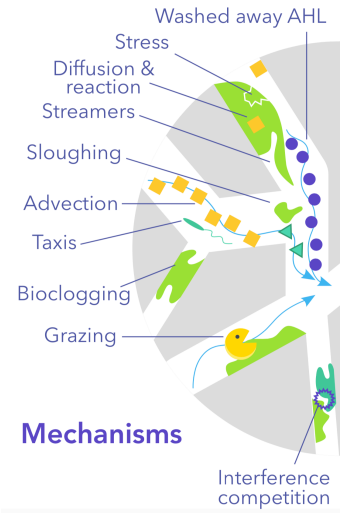
Stage de M2 recherche avec financement de thèse

Research topic	Bacterial biofilms in porous structures: from biophysics to control.
Lab	Institute of Fluid Mechanics, Allee Camille Soula, 31400 Toulouse, France.
Salary	**Master 2**: monthly stipend of 500-600 euros net. **PhD CNRS**: 20.590 euros net / year (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 2**: Internship of 4 to 6 months in 2020. Flexible. **PhD CNRS**: Applications until fulfilled.
Example publication	Cell morphology drives spatial patterning in microbial communities. PNAS (2017).
Background	Mechanics/Engineering or Biophysics or Microbiology/Bacterial ecology.
Other	For more info about research activities @ IMFT, http://yohan-davit.com

Context. This work is part of a larger project (BEBOP, 2019-2024) funded by the European Research Council. The long-term goal of BEBOP is to develop new generations of biotechnologies, such as self-repairing construction materials or self-cleaning bioreactors, that rely on the **use of bacteria to control the properties of porous structures**. The main scientific obstacle to such technologies is the lack of understanding of biophysical mechanisms associated with the growth of bacterial populations within complex porous structures. For instance, in a connected environment, how do local changes affect the global behaviour of the system, e.g. how does bio-clogging of one pore modify the flow in the rest of the porous structure? What are the different types of feedback mechanisms and nonlinear dynamics?



The first scientific objective of BEBOP is therefore to gain insight into how fluid flow, transport phenomena and bacterial communities interact within connected structures. To this end, we combine microfluidic and 3D printed micro-bioreactors; 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.

Role during the internship. *I am looking for someone extremely motivated who is willing to pursue this work as a PhD student and who will be fully involved in the project.* The goal of the internship is to build a response surface for the permeability of a porous medium colonized by bacteria. When bacteria grow within porous media, they generate clogging that modifies the flow pattern and tends to induce a decrease of the permeability. The spatial distribution of biofilms (bacteria + polymers) and thus the permeability both depend upon a variety of parameters, such as the flowrate, concentration of nutrients, the presence of predators, or the type of porous structure. Based on experimental data available in the lab, the idea of the internship is to create a simple meta-model for the evolution of the permeability as a function of these parameters. Depending on the profile of the candidate, emphasis can be put either on the theory, experiments or even computations.

Role during the PhD. Funding is available for a PhD (3 years) following the internship. The applicant will be part of the BEBOP team, which involves another PhD student (3D printing, bioreactors, x-ray imaging), a theoretician/postdoc (modelling, nonlinear dynamics), and two experimenters/postdocs (microfluidic, bioreactors). The PhD is expected to be a key element in fostering discussions within the team and to interact with biologists, including members of the Foster Lab (University of Oxford, https://zoo-kfoster.zoo.ox.ac.uk/) specialized in Microbial Ecology. The goal of the PhD is to use existing experimental and simulation frameworks in order to extract general principles associated with the biophysics of bacteria in porous media and create the first building blocks of a control theory that could be used in engineering. To some extent, the focus of the work can be tailored to the profile and interest of the candidate.

Background. The successful candidate will have a background either in mechanics/engineering, or in biophysics, ideally with knowledge of the biology of microorganisms, or in microbiology/microbial ecology.

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_BiophysicsControl in the e-mail title).