

2021-04163 - Post-Doctoral Research Visit F/M [BIOCORE-POSTDOC2021] Modelling and control of algae-bacteria interactions in a biofilm

Contract type : Fixed-term contract
Level of qualifications required : PhD or equivalent
Fonction : Post-Doctoral Research Visit
Level of experience : Recently graduated

About the research centre or Inria department

The Inria Sophia Antipolis - Méditerranée center counts 34 research teams as well as 8 support departments. The center's staff (about 500 people including 320 Inria employees) is made up of scientists of different nationalities (250 foreigners of 50 nationalities), engineers, technicians and administrative staff. 1/3 of the staff are civil servants, the others are contractual agents. The majority of the center's research teams are located in Sophia Antipolis and Nice in the Alpes-Maritimes. Four teams are based in Montpellier and two teams are hosted in Bologna in Italy and Athens. The Center is a founding member of Université Côte d'Azur and partner of the I-site MUSE supported by the University of Montpellier.

Context

BIOCORE team applies and develops mathematical and computational methods from Control Theory and Dynamical Systems to the study of models of biological networks (genetic networks, metabolic networks, signaling networks...) and microbial community in bioreactors.

See: <http://team.inria.fr/biocore>

Web page of Olivier Bernard <http://www-sop.inria.fr/members/Olivier.Bernard/>

Within the framework of the ANR PhotoBiofilm Explorer which will provide experimental data.

The post-doc takes place within the framework of the **PhotoBiofilm Explorer** project, involving 6 partners, among which the Laboratory of Oceanography from Villefranche in which validation experiments will be carried out.

There is an urgent need to identify new drugs to deal with major health challenges such as the control of serious pathogens which have gained resistance against current antibiotics. **Microalgae constitute a source of eukaryotic organisms to be explored for the production of more efficient and biologically active compounds.** They have gained interest lately for innovative solutions in various applications and they are now recognized as a valuable and sustainable source for food and feed. They are classically cultivated in photobioreactors or raceways as **liquid suspension**. To further enhance productivity at reduced environmental cost an innovative approach has been developed consisting in growing microalgae in a **biofilm** on a moving conveyer belt. A biofilm is an assemblage of microorganisms associated to a surface and embedded in a secreted matrix of extracellular polymeric substances. Surprisingly, **most of the tested biofilms are extremely resistant to biological contamination.** Even when adding glucose, the cellular ratio bacteria/microalgae in the biofilm remains strongly controlled to a very low value suggesting that some compounds released by microalgae (and/or associated native bacteria within the biofilm) are able to inhibit invaders and play a significant role in the biofilm resilience and stability. These compounds are known to reach concentrations high enough to also impact planktonic microorganisms in the neighbourhood of the biofilm.

Frequent interactions with all the partners to better understand the underlying biological processes is required, and to integrate the latest acquired data. In the end, an implementation of the model will be carried out with matlab together with the development of toolboxes for calibration, validation and optimisation.

Assignment

So far, the developed algal biofilm models did not include bacteria, nor the production of allelopathic compounds. The first objective of the project is to **develop a model of the production of molecules providing the resistance of the biofilm.** The second objective is to **include a bacterial compartment in this model to account for the possible interactions.**

The post-doc will then have to calibrate this model with data from the PhotoBiofilm Explorer project and improve it to deal with the periodic light supply on the biofilm process. Once calibrated, an extensive simulation campaign must be carried out with the objective of determining the optimal operating conditions to maximise the algal biomass or the nutrient removal rate. On-line control strategies will be finally derived from the identification of the optimal operating modes.

Main activities

Main activities :

- Literature review
- Model development
- Model implementation with Matlab
- Parameter identification
- Model optimisation

Skills

Technical skills and level required : Expertise in modelling biological systems. Optimization of systems given by ordinary differential equations

Scientific languages (Matlab, Scilab or Python).

General Information

- **Theme/Domain** : Modeling and Control for Life Sciences
Scientific computing (BAP E)
- **Town/city** : Sophia Antipolis
- **Inria Center** : CRI Sophia Antipolis - Méditerranée
- **Starting date** : 2022-03-01
- **Duration of contract** : 3 months
- **Deadline to apply** : 2021-12-14

Contacts

- **Inria Team** : BIOCORE
- **Recruiter** :
Bernard Olivier / Olivier.Bernard@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success

Team working, collaboration with biologists.

Instruction to apply

Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :

As part of its diversity policy, all Inria positions are accessible to people with disabilities.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Remuneration

Gross Salary: 2653 € per month