Experimental and computational analysis of bacterial self-replicators

Keywords : mathematical modeling, microfluidics, bacterial genetics, control theory

Project description

The growth of bacteria is fundamentally an optimization problem which consists in allocating resources to cellular functions so as to maximize growth rate or another fitness criterion. Simple ordinary differential equation models, called self-replicators, have been used to formulate this problem in the framework of optimal and feedback control theory, which has allowed a variety of observations in microbial physiology to be explained. The predicted resource allocation schemes of bacteria can be experimentally quantified using state-of-the-art techniques in molecular biology and biophysics.

The aim of the PhD thesis (Master2 internship) is (a) to generalize the self-replicator models so as to be able to take into account a broader range of phenomena in bacterial physiology and (b) to validate the model predictions using a combination of fluorescent reporter genes, time-lapse fluorescence microscopy, microfluidics, automated image analysis, and signal processing algorithms. The PhD project will be carried out at Inria Grenoble - Rhône-Alpes and the Laboratoire Interdisciplinaire de Physique (LIPhy), in the framework of the recently-accepted ANR project Maximic.

Student requirements

Applicants may come from different disciplinary backgrounds - physics, biology, computer science, or mathematics. We expect them to be strongly motivated by interdisciplinary work combining experimental work in the lab with the mathematical modeling of biological systems and data analysis. Basic knowledge in microbiology and previous experience with some of the above-mentioned techniques would be appreciated. Good relational skills are important for the project, as it will be carried out in an interdisciplinary and international environment.

Contacts

For more information on the position, please contact Hidde de Jong at Hidde.de-Jong@inria.fr or hans.geiselmann@univ-grenoble-alpes.fr

References:

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