

PhD Position

Cost Models of Synthetic Genetic Circuits

Topic profile

theory/math



coding



Tags

#synthetic biology

#mathematical modeling

#gene translation

Supervision

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Context

Recent advances in the ability to engineer organisms promise to deliver high impact biotechnology solutions: designer microbes for applications in bio-sensing, smart therapeutics, bioproduction, biomaterials, and biofuels. However, it is currently very challenging to move the proof-of-principle demonstrations from the controlled environment of the lab towards real world applications. This is often because expression of heterologous genes constituting the synthetic genetic circuits results in additional burden for the cell, leading to the circuit's rapid loss due to mutation and negative selection. Yet, no framework currently exists for accurately estimating at the design stage the cellular cost of circuit expression over time.

We are looking for

Prerequisites are a Master degree in a relevant subject (e.g., computer science or biology) and coding experience (preferably in Python). We expect a curious, driven attitude and interest to collaborate on an experimental setup in the wet-lab. The PhD position is funded for the full duration of three years.

Research

The primary objective of the project is to build quantitative models for calculating the expression costs of synthetic genetic circuits and using them to enable design choices that improve the long-term evolutionary robustness of the circuits. We hypothesize that there is a quantifiable upper limit on the size of a synthetic circuit that can be stably implemented inside a single cell. This size-limit is determined by the cumulative expression cost of the different genetic parts (sensors, regulators, and effectors) used in the circuit as well as the time spent in its different "states". Consequently, the robustness of the circuit can be improved by reducing the cost of the more expensive states and the time-integrated cost over different states. In this project, we integrate methods from synthetic biology, chip design, and distributed computing to formalize a budgeting framework for synthetic genetic circuits, with the aim of substantially improving their design for long-term functionality.

The team

You will be part of an interdisciplinary research team at [Laboratoire Méthodes Formelles](#) in the [ENS Paris-Saclay](#), near Paris, working at the interface between computer science and synthetic biology.

You are interested or would like to join us?

Please mail your questions or, in case you would like to apply, a short statement of interest and a curriculum vitae to Matthias Függer (mfuegger@lmf.cnrs.fr) and Thomas Nowak (thomas@thomasnowak.net). Applications until the end of April 2024 will receive full consideration. The position is fully funded by the ANR project COSTXPRESS and is expected to be taken up at the beginning of October 2024.