Project Proposal

Data-driven and learning-based control approaches for cybergenetics

Project Description (*max 500 words*)

The problem of devising controllers to tame the dynamics of synthetic biological systems is becoming a crucial part of Systems and Synthetic Biology, giving rise to the emerging field of cybergenetics. In the external control paradigm, the control algorithm is implemented on a PC (or microcontroller) and the control input is delivered to the cells via some external actuators. Typically, in the literature, model based approaches are used to synthesize a controller. However, some key challenges of this approach include: (i) the lack of a precise knowledge of the model of the system under control; (ii) the intrinsic stochasticity of the processes considered; (iii) the presence of noise in the measurements. This project aims at overcoming these challenges by exploring a data-driven/learning approach to external cellular control. The idea is to develop novel control techniques that do not necessarily require the identification of a mathematical model. The techniques will be benchmarked against state-of-the-art approaches both in-silico, via realistic simulators and, in-vivo. As such, the project will include both a methodological component (including control methodology development, synthesis of key performance indicators, study of stability and robustness properties) and an experimental, hands-on, component on the systems under control.

Supervisor(s), Lab/Group details, other additional info.

Mario di Bernardo (DIETI)
Diego di Bernardo (DICMAPI/TIGEM)
Giovanni Russo (UNISA)
Lucia Marucci (Bristol)

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