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"La mente è come un paracadute.
Funziona solo se si apre"
A. Einstein

Design of Molecular Circuits for the Realization of Synthetic Biological Control Systems

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Abstract

Systems and synthetic biology can be considered, to some extent, as the application at the molecular and cellular level of the methods of systems and control theory, combined with the tools of biotechnology. From this perspective, it is not surprising that the number of control engineers, actively involved in this area of research, is rapidly increasing. In this talk we will discuss how systems and control theory may contribute to the development of novel methods for the principled design of novel synthetic biological devices. First, we will briefly illustrate the main approaches adopted so far to design and implement a feedback control system in living cells. Subsequently, we will focus on the problem of designing embedded molecular control systems, i.e., whether it is possible to design each block of the feedback loop as a chemical reaction network (CRN), without the need for exogenous non-biological control devices. This problem naturally establishes a link with the concept of modularity, i.e., how different types of elementary molecular circuits can be assembled to accomplish more complex functions. In synthetic biology this problem is closely related to the property known as retroactivity. The main part of the talk will deal with a specific module of the classical control loop, namely the subtractor block. We will introduce a CRN-based design that realizes this function and will investigate the dynamical properties of this system using nonlinear system analysis. Finally, the retroactivity of some alternative realizations of the subtractor module will be investigated, showing how it is possible to achieve zero-retroactivity.

Aula Conferenze, Via dei Taurini 19, Roma — Giovedì 16 Novembre 2017 alle ore 15:00