BIOGRAPHY

Ricard Solé is an ICREA research professor (the Catalan Institute for research and Advanced Studies) currently working at the Universitat Pompeu Fabra , where he is the head of the COMPLEX SYSTEMS LAB located at the PRBB . He teaches courses on Biomathematics, principles of biological design and biocomputation. He completed degrees in both Physics and Biology at the University of Barcelona and received his PhD in Physics at the Polytechnic University of Catalonia. He is also External Professor of the Santa Fe Institute (New Mexico, USA), external faculty of the Center for Evolution and Cancer at UCSF, member of the Council of the European Complex Systems Society and member of the editorial board of PLoS ONE. He received a European Research Council Advanced Grant (ERC 2012).

PROJECT

European Research Council Advanced Grant
Project acronym: SYNCOM
Project full title: *Distributed Computation in Synthetic Consortia*

Synthetic biology is still far from producing flexible, programmable, scalable and predictable engineered constructs able to perform complex computations. The main problem has arisen from the fact that, in contrast to electronic designs where wires have identical nature, in a cell-based system each wire would correspond to a different molecular entity. In a joint effort between theoretical and experimental studies, we have established biological circuits with Distributed Computation capacity (Regot et al., 2011), opening the possibility to develop a novel method of properly design general purpose, LEGO-like multicellular systems able to partially avoid wiring limitation. Here, we propose to explore the limits of Distributed Computation in synthetic cellular systems. To this goal, we will extend our previous circuits to circuits with a higher complexity, never achieved to date as well explore the use of different cellular systems as a biological case study. Our preliminary data indicate that there are two aspects, which were not considered previously, that when combined with Distributed Computation, could permit a strong reduction or even eliminate the wires in biological computation; the first aspect is the use of inverse logic circuits and the second is the development of spatially restricted devices. We will set up the theoretical framework of these novel aspects and establish in vivo circuits spatially restricted cellular systems.

To this end we propose

1) To use microfluidic devices for physically restricted cellular networks;
2) To implement circuits with mixed but physiologically isolated cells (without wires) with different computation capabilities.
In addition, we will extend these studies to obtain highly reprogrammable circuits. The combination of such approaches should demonstrate that biological computation is scalable, allows constructing arbitrary cell-based computing machines and breaks all current limitations concerning circuit complexity.