Programming cells: from models to data and back

Date: Wednesday 28 February 2024 Location: Aula Magna "A. Lepschy", Department of Information Engineering Time: 10:00-11:00



Abstract: The ability to program ad hoc cells and biological processes offers exciting opportunities in basic research, in the biotechnology industry and in the clinic. Computer-aided design can significantly accelerate design-build-test-learn cycles for cellular programming; however, the lack of established design tools which can cover biological functions across scales, and difficulties in engineering systems resilient to changes and perturbations, still represent major roadblocks. In this talk, I will present two complementary approaches to rationally and robustly program cell phenotypes. I will first discuss how computer-aided cell design can be supported by whole-cell models (WCMs), which are mathematical models aimed at capturing the function of all genes and multiscale processes within a cell. The design of minimal bacterial genomes will be used as a proof-of-concept; I will also show how machine learning can support WCMs' output interpretation and solve their computational burden challenge. The second approach leverages feedback control to engineer robust cellular phenotypes. I will show results obtained using intracellular, external or multicellular controllers in both bacterial and mammalian cells, and diverse applications of cybergenetics methodologies (e.g., control-based analysis of gene networks' dynamics, and drug combination therapy design). Our tools and results will assist the engineering of complex biological processes, bridging the gap between the design and the implementation of robust cellular phenotypes.



Biography: After completing her studies in Mathematics, Lucia started a PhD in Automatic Engineering, focused on the design of synthetic gene network (University of Naples, Italy, PhD award 2010). She then moved to the Centre for Genomic Regulation (Barcelona, Spain) where she was awarded an EMBO Long term fellowship to study gene expression dynamics in pluripotent stem cells.Lucia moved to Bristol in 2013, where she is currently an Associate Professor in Systems and Synthetic Biology, and an Engineering and Physical Sciences Research Council (EPSRC) Fellow. She co-directs the Bristol BioDesign Institute, a specialised research institute in Synthetic Biology.

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