



Centre for Biosystems Science and Engineering

SEMINAR

at 4:00 PM on April 25, 2017

MRDG Seminar Hall

Systems approaches for elucidating and engineering information processing at multiple levels in cellular systems

Prof. Krishnan

Chemical Engineering, Imperial College London

Cellular processes are regulated and orchestrated by complex and sophisticated biomolecular networks. Dissecting information processing through these networks is central to both understanding cellular processes (systems biology) and engineering them (through synthetic biology and other means). The fact that biomolecular networks are at the core of information processing in cells and tissues presents a number of serious systems challenges. In this talk, I will discuss three topics within this broad umbrella. In the first part, I will focus on adaptation in signalling and cellular information processing. This is encountered in a range of cellular contexts including sensory transduction, chemotaxis, and is related to homeostasis. I will discuss how networks giving adaptive responses function in dynamic environments and in response to dynamic stimuli. Biochemical modules such as switches (monostable and bistable), adaptive modules, oscillators, and simple covalent modification cycles can be regarded as basic building blocks of complex networks. Yet these modules are studied in isolation, with very little consideration of the network of which they are a part. In the second part of my talk, I will discuss a systems framework to bridge the gap between understanding the behaviour of a module in isolation and as part of a network. While the study of biochemical networks is routine in a whole range of contexts in systems biology, very little consideration has been given to the spatial organization and regulation of the relevant pathways, even though it is abundantly clear that it is present. Spatial organization and compartmentalization is emerging as an important tool in synthetic biology as well. I will discuss a multipronged approach to dissect the effect of spatial regulation on biochemical pathways, from basic building blocks to the spatial organization of concrete cellular systems. In all cases I will discuss the systems challenges as well as the relevance to both natural and engineered biology.

About the speaker:

Dr Krishnan is a Senior Lecturer in Chemical Engineering, and the Centre of Process Systems Engineering at Imperial College, and is part of the Institute of Systems and Synthetic Biology and the Centre for Bioinformatics. He obtained his undergraduate degree in IIT-Madras and PhD in Princeton University (in Chemical Engineering) and was an Associate Research Scientist in Electrical Engineering at the Johns Hopkins University. His research focusses on elucidating and engineering information processing in cells and tissues. This is done through a combination of mathematical modelling, theoretical work, systems approaches, and collaboration with experimentalists in cell biology/biomedicine/synthetic biology.