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Spatial control of biochemical modification pathways and cascades

Krishnan

Imperial College London, UK

Biochemical modification pathways and cascades are the building blocks of signal transduction and are usually studied, analyzed and understood in temporal (lumped) terms. However it is becoming amply clear that in many cellular contexts, reactions occur at different locations and that the spatial aspects of signal transduction and biochemical pathways in general are especially important. This aspect is however poorly understood for multiple reasons. In this talk we focus on the effect of compartmentalization, which is ubiquitous in cellular systems. The effects of compartmentalization are important in understanding concrete pathways and cellular processes which involve compartmentalization, how this has been employed by evolution and also for designing microcompartments in synthetic biology. In this talk, I will discuss the effects of compartmentalization in a range of biochemical modification cascades/pathways: (1) Enzymatic cascades where the output at one stage is an enzyme for the next stage, (2) Pathways where the output at one stage is the substrate for the next stage, (3) Phosphorelays and (4) Open pathways. In each case, a systematic analysis of the effects of compartmentalization is made by comparing the spatially distributed system (modeled by PDEs) with the colocalized system (modeled by ODEs). Through this systematic analysis, we uncover a whole range of effects of compartmentalization of such pathways. We then discuss the relevance and implications of these results for engineering spatial compartmentalization.

Biography

Krishnan is a Senior Lecturer in Chemical Engineering and in the Centre for Process Systems Engineering and affiliated with the Institute of Systems and Synthetic Biology at Imperial College. He has completed his undergraduate studies at IIT-Madras, PhD at Princeton University (both in chemical engineering) and was an Associate Research Scientist in Electrical Engineering at the Johns Hopkins University.

j.krishnan@imperial.ac.uk

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