Modeling and Optimal Control in Systems Biology: Applications from Immunology and Chronotherapy

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Abstract:
Mathematical modeling and optimal control can be exploited in biological applications focusing on the analysis of regulations and the target-oriented manipulation of self-organized dynamics. There is increasing interest in modeling, simulation and control analysis of dynamical phenomena in cell biology and physiology. In the first part of the talk, we apply spatiotemporal modeling to experimentally observed exotic metabolic wave phenomena associated with mutually phase-coupled temporal oscillations in human immune cells in order to analyze the potential origin of metabolic oscillations and waves and their biochemical regulation. In the second part, we compute for a circadian oscillator model mixed-integer optimal control functions that allow the design of chronomodulated pulse-stimuli schemes achieving circadian rhythm manipulation.