Contribution ID: **5** Type: **not specified**

Design of genetic control systems: Theory and Implementation

Thursday 9 November 2023 09:00 (45 minutes)

Adaptation is a recurring theme in biology, offering vital survival mechanisms in dynamic environments through precise regulation of physiological variables. This talk dives into the intriguing concept of robust perfect adaptation (RPA), a phenomenon where a system maintains a specific variable at a setpoint despite persistent perturbations. The objective of this talk is to explore the fundamental problem of achieving maximal RPA, focusing on a designated output variable and its robustness to perturbations across almost all network parameters. I will elucidate how RPA imposes critical structural constraints on underlying networks, characterized by simple linear algebraic conditions. These conditions provide insights into the diverse ways biomolecular integral feedback mechanisms can be realized. Building on these insights, I will introduce a novel internal model principle (IMP) tailored for biomolecular networks, akin to celebrated IMP in control theory. Throughout the presentation, I will relate these theoretical developments to practical implementation of RPA-achieving controllers and their applications. Specifically, I will discuss the implementation of genetically engineered synthetic integral feedback controllers within living cells and showcase their tunability and adaptation properties. Furthermore, I will highlight the relevance of these genetic control systems in the context of cell-based therapies.

Presenter: Prof. KHAMMASH, Mustafa (ETH Zurich)

Session Classification: Session 4