Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Seminar

Perfect Adaptation in Noisy Systems: Mathematics Meets Biology

Ankit Gupta

ETH Zürich, Switzerland

Biological cells function in inherently stochastic environments, where random molecular events shape gene expression, signalling, and other processes. Yet, cells display remarkable robustness, raising fundamental questions about how networks control or exploit noise. Stochastic reaction networks provide a rigorous framework to uncover constraints and design principles underlying such robustness. In this talk, I will introduce maximal Robust Perfect Adaptation (maxRPA), where systems maintain exact outputs despite fluctuations and perturbations. I will present a full mathematical characterisation of networks achieving maxRPA and demonstrate applications in synthetic biology. Through this lens, I will highlight how stochastic methods bridge theory and experiment in analysing and engineering biological control mechanisms.

Wednesday, Sep 17th 2025

14:00 Hrs (Tea / Coffee 13:45 Hrs)

Auditorium, TIFRH