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TATA INSTITUTE OF FUNDAMENTAL RESEARCH

ICTS CALIBRE Seminar

Title : From pixels to phase space and beyond by maximizing predictability

Speaker : Tosif Ahamed (Indian Institute of Science, Bengaluru)

Date : Tuesday , 08 September 2026

Time : 11:30 AM (IST)

Abstract : Modern experiments provide increasingly detailed observations of living systems, yet these measurements offer only partial and noisy glimpses of the underlying dynamics that generate them. Inferring those dynamics is a fundamental inverse problem, made challenging by the scale and dimensionality of modern biological data. In this talk, I will explore this question with two related problems in animal behavior. First, what generates behavioral variability? Using videos of the nematode *C. elegans*, we reconstruct a predictive state space and estimate its full Lyapunov spectrum. These analyses reveal that stereotyped locomotion and variability can emerge together from low-dimensional chaotic dynamics, offering an alternative to longstanding models based on stochastic switching between metastable states. Second, behavior is organized across timescales, from rapid neuromechanical dynamics to foraging behaviors spanning minutes. Using data-driven transfer operators, we systematically coarse-grain this reconstructed phase space and find that longer-timescale behaviors emerge as dominant slow modes of the operator. I will conclude with preliminary results on applications in neuroscience and developmental biology, illustrating how these approaches can construct effective dynamical theories from high-dimensional biological data.

Venue : Emmy Noether Seminar Room

Zoom Meeting:

<https://icts-res-in.zoom.us/j/95966165692?pwd=GbgD0vpLPSCLOWrEZ1agyphJBpHOGx.1>

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