



ICTS Biophysics Seminar

Title : Learning Under Constraints: From Loopy Vascular Networks to Continual Learning Machines

Speaker : Purba Chatterjee (University of Pennsylvania, USA)

Date : Monday, 09 March 2026

Time : 2:00 PM (IST)

Abstract : This talk presents two examples of how learning outcomes in natural and artificial systems are actively shaped by physical, energetic, and material constraints, as well as by interacting dynamical timescales. First, I show that in periodically driven elastic flow networks (e.g., animal vasculature), the coupling between short-term pulsatile dynamics and long-term structural adaptation stabilizes a spectrum of looped architectures under realistic material and metabolic costs. Unlike standard adaptation models, this explains both the ubiquity of loops in biological networks and pathologies that emerge when flow pulsatility is disrupted. Second, I show that constrained local learning rules—restricting updates to parameters experiencing strong transient training signals—allow tunable physical networks to learn new tasks continually without loss of previously learned functions. This framework for overcoming catastrophic forgetting moreover reduces noise sensitivity and the energetic cost of training, making it potentially more biologically plausible than standard strategies in artificial neural networks.

Venue : Chern Lecture Hall

Zoom Link: <https://icts-res-in.zoom.us/j/97686356894?pwd=RaAJA8NljQ4LgbWAn4annMHOZs1sj9.1>

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