Sat. Oct 18, 2025

Invited | Other

Sat. Oct 18, 2025 3:15 PM - 4:15 PM JST | Sat. Oct 18, 2025 6:15 AM - 7:15 AM UTC Room 2(West B1)

[K2] ECR Keynote: Devika Narain

Chair:Martin Wiener(George Mason University)

3:15 PM - 4:15 PM JST | 6:15 AM - 7:15 AM UTC

[K2-01]

Prior beliefs for timing movements: from neurons to manifolds

*Devika Narain[1] (1. Erasmus Medical Center (Netherlands))

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Timing and motor control are inextricably linked, giving rise to the remarkable feats of motor precision observed across the animal kingdom. Laboratory assessments of movement timing, however, often reveal significant variability and systematic biases, presenting a seemingly contradictory picture. Previous research has attempted to reconcile this discrepancy through Bayesian frameworks, which describe how prior beliefs about temporal variables guide precise actions in the face of environmental uncertainty. While these models successfully account for a wide range of behaviors across different domains, the neural mechanisms responsible for forming and utilizing such prior beliefs remain poorly understood. In this work, we propose a role for cerebellar circuits in the acquisition of prior knowledge that shapes basic predictive motor behaviors, specifically, the conditioned eyelid response observed in Pavlovian eyeblink conditioning. We present evidence suggesting that cerebellar Purkinje cells encode probability distributions of sensory stimuli and propose a mechanism by which this encoding influences motor output kinematics. At the population level, we demonstrate that cerebellar cortical activity exhibits a topological organization characterized by curved manifolds, with prior knowledge encoded along the curvature of these structures, consistent with previous work in monkeys. In the second part of the talk, we introduce methodological advances aimed at identifying and embedding neural manifolds formed by the dynamics underlying these tasks within their intrinsic dimensions, enabling the decoding of task-relevant information. Using this approach, we test the hypothesis that the curvature of neural manifolds reflects the encoding of prior knowledge in sensorimotor timing tasks. Overall, we propose a neural mechanism through which prior beliefs governing the temporal control of movement are acquired at the cellular level and subsequently represented in the topological structure of neural populations, consistent with normative theories that explain the emergence of precise timing behavior.

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Keywords: Bayesian frameworks