Fri. Oct 17, 2025

Invited | Timing & Time Perception

Fri. Oct 17, 2025 11:00 AM - 12:00 PM JST | Fri. Oct 17, 2025 2:00 AM - 3:00 AM UTC Room 1(Mathematical Science Building)

[K1] Keynote : Kalanit Grill-Spector

Chair:Domenica Bueti(International School for Advanced Studies (SISSA))

11:00 AM - 12:00 PM JST | 2:00 AM - 3:00 AM UTC

[K1-01]

Understanding cognitive processing in the human visual system using spatiotemporal population receptive fields

*Kalanit Grill-Spector[1] (1. Stanford University (United States of America))

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))

Sun. Oct 19, 2025

Invited | Other

Sun. Oct 19, 2025 4:15 PM - 5:15 PM JST | Sun. Oct 19, 2025 7:15 AM - 8:15 AM UTC Room 2(West B1)

[K3] Keynote : Masaki Tanaka

Chair:Hugo Merchant(Universidad Nacional Autónoma de México)

4:15 PM - 5:15 PM JST | 7:15 AM - 8:15 AM UTC

[K-01]

Decoding subcortical mechanisms of temporal prediction of periodic events

*Masaki Tanaka[1] (1. Hokkaido University (Japan))

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[K1] Keynote : Kalanit Grill-Spector

Chair:Domenica Bueti(International School for Advanced Studies (SISSA))

A key goal of cognitive neuroscience is to generate an understanding of the functional neuroanatomy of cortical systems. fMRI and computational modeling have transformed our understanding of the human brain. In the visual system, modeling population receptive fields (pRF) led to discoveries of multiple maps of pRF eccentricity, polar angle, and size as well as explained cognitive phenomena like spatial attention and the face inversion effect. However, due to the low temporal resolution of fMRI and the low spatial resolution of EEG/MEG it is unknown what is the nature of spatiotemporal computations in the human brain
Using computational encoding models and the visual system as a model system, I will describe recent empirical and computational innovations that have advanced understanding of key cognitive neuroscience questions. Specifically, I will describe a new empirical and computational framework for estimating from fMRI data the spatiotemporal population receptive field (st-pRF) of each voxel in the visual system in units of visual degrees and milliseconds. I will start by showing how we tested and validated the sp-pRF framework vs. ground truth data. Then, we use this framework to elucidate the spatiotemporal computations across the human visual system for the first time, finding that spatial and temporal windows as well as compressive nonlinearities increases systematically across the visual hierarchy. With this understanding in hand, we then assess how simple, bottom-up computations by st-pRFs may affect visual capacity and explain elusive phenomena like why neural responses are suppressed when multiple visual stimuli are presented at once compared to one after the other in sequence. I will end by the discussing the relevance of this powerful spatiotemporal pRF framework for understanding other sensory and cognitive systems in the brain.

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Keywords: Computational Modeling, Human Visual System, Spatiotemporal Population Receptive Fields

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)

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.

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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Keywords: Bayesian frameworks

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[K3] Keynote : Masaki Tanaka

Chair:Hugo Merchant(Universidad Nacional Autónoma de México)

Periodic events evoke rhythm perception, which entails predicting stimulus timing, focusing attention on the moment, and preparing synchronized motor responses. Although both the cerebellum and basal ganglia are implicated in rhythm processing, their distinct roles remain poorly understood. In monkeys performing rhythmic tasks, we found periodic neuronal activity in the cerebellar dentate nucleus and striatal caudate nucleus. Cerebellar neurons encoded the spatial properties of sensory stimuli, while caudate neurons represented the direction and type of intended movements. These results suggest a functional dissociation: the cerebellum is involved in sensory prediction, whereas the striatum contributes to periodic motor preparation. Consistent with this view, optogenetic suppression of dentate activity impaired the detection of subtle changes in isochronous stimulus timing. Furthermore, Purkinje cells in the cerebellar crus lobules, which project to the dentate nucleus, showed periodic modulation in both simple and complex spikes, suggesting that synaptic plasticity in the cerebellar cortex may contribute to the formation of an internal model for rhythmic sensory input.

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Keywords: temporal prediction, cerebellum