Alumni of the BRAIN and MIND Sciences Seminar Series

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ΕΓΚΕΦΑΛΟΣ και ΝΟΥΣ
που οδηγεί σε Μεταπτυχιακό Δίπλωμα Ειδίκευσης
INTERDISCIPLINARY GRADUATE PROGRAMME in the
BRAIN and MIND sciences
leading to Master's degree

From Object Recognition to Neural Manifolds: Population Geometry in Mouse Visual Cortex

Christos Paschalidis, MSc

PhD candidate,

Medical School of the University of Crete &

Institute of Molecular Biology and Biotechnology, FORTH

Thursday, June 18, 2026

14:00-15:00

Alumni of the BRAIN and MIND Sciences Seminar Series ZOOM LINK
Meeting ID: 898 1282 5746
Passcode: 703942

Info: Vassilis Raos, 4512, raos@uoc.gr

The speaker:

Christos Paschalidis

BSc in Mathematics, National and Kapodistrian University of Athens, 2018; MSc in Brain and Mind Sciences, School of Medicine, University of Crete, 2023; PhD Candidate, School of Medicine, University of Crete, 2023-present; Thesis: Understanding the organization and functioning of populations of neurons contributing to the visual description of objects using modern computational methods; Medical School University of Crete & Systems Neuroscience Lab Institute of Molecular Biology and Biotechnology (IMBB-FORTH); Supervisor: Dr Emmanouil Froudarakis.

My research interests focus on how neuronal population activity gives rise to our perception of the external world, particularly object perception. I investigate this question through the lens of geometry, studying how neural activity forms manifolds that link population-level responses with mathematical principles of representation and computation.

Summary of the presentation:

Object recognition is fundamental to visual perception: we depend on it thousands of times each day. Even a single object can produce countless retinal images as either we or the object move in space. A striking achievement of the visual system is its ability to transform this continuous flow of external information into stable, recognizable perceptions of objects. A long-standing hypothesis suggests that the visual system solves this problem by progressively transforming visual input along the cortical hierarchy, generating increasingly complex population representations whose structure reflects the computations required for perception. However, characterizing such representations across thousands of neurons remains a challenge.

We use mesoscopic two-photon calcium imaging to record simultaneously from hundreds of neurons in the mouse visual cortex while head-fixed mice viewed four objects undergoing transformations, including changes in size, position, and rotation. Recordings were obtained from primary visual cortex and higher-order visual areas. We examine the geometrical properties of these population responses across mice, visual areas, asking how object-related neural manifolds are organized and transformed across the visual hierarchy. The characterization of these manifolds, their dimension, radius, and separability, reveal how visual areas transform sensory inputs into stable, behaviorally useful representations. To probe how these representations are shaped, we first examine behavioral state as a natural modulation of cortical processing. We then compare biological data with in-silico mouse models to test which aspects of object-manifold geometry current models capture.

Our results support a geometric view of object coding, where stronger higher-area information is reflected in manifold geometry.