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沖縄科学技術大学院大学

VISITING PROGRAM

TSVP TALK

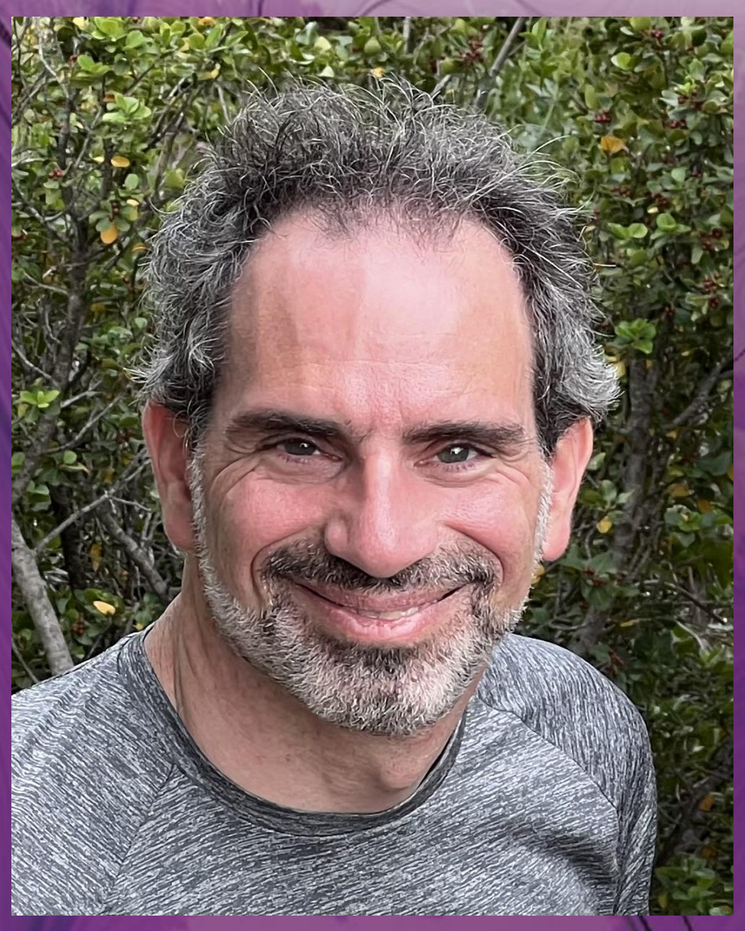
Asymptotics for Biological Data in Non-Smooth Spaces

2025 WED. Jul. 16

15:00–16:00

HYBRID L5D23, ZOOM

For zoom and other details scan QR code or visit oist.jp/visiting-program



Biological data are often complex and geometric. Each data object -- a 3D or 4D brain scan or a phylogenetic tree, for instance -- or the sample space parametrizing all possible data objects can be nonlinear and sometimes singular, meaning not smooth. Statistics in these kinds of situations requires new mathematical tools to integrate geometry with analysis. This talk tackles the central limit theorem (CLT) to understand asymptotic behavior of large-sample averages in singular settings. It starts with examples of nonlinear biological data, followed by a review of the usual linear CLT and its generalization to smooth manifolds, as seen through a lens that casts the singular CLT as a natural outgrowth. Milestones along the way include the introduction of appropriate classes of spaces and measures as well as analogues of Gaussian random variables. Joint work with Jonathan Mattingly and Do Tran.

Duke University

Ezra Miller

Ezra Miller holds a PhD in Mathematics from the University of California at Berkeley (2000) following undergraduate years at Brown University, where he earned a Bachelor of Science in Mathematics and a Bachelor of Arts in Music with a focus on theory and composition (1995). After his postdoc at MIT, and 6 years of faculty position at the University of Minnesota, he moved to Duke University in 2009. His research interests include geometry, algebra, topology, probability, statistics, algorithms, and combinatorics, with applications to biology and other sciences.

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THEORETICAL SCIENCES VISITING PROGRAM

TSVP TALK

Feedback Control and Variability in the Nervous System

2024
THU. **Jan. 25**

15:00–16:00

HYBRID L4E48, ZOOM

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We are living in an era when it is possible to measure and manipulate neural circuits in increasing detail. On one hand this promises to reveal circuit mechanisms that underlie brain function. On the other hand, data gathered from large populations of neurons and their synaptic connections remind us of the challenge of finding a systems-level understanding. We observe huge variability and fluidity in neural circuit properties despite efforts to extract precise measurements under controlled conditions. It can be tempting to conclude that much of what we see is messy, idiosyncratic biology. I believe that principles from engineering can help us make sense of the mess: nervous systems need to be robust, and to negotiate fundamental tradeoffs in speed, precision, and stability. Much of this is achieved by feedback control loops at every level of organisation, from molecular pathways to neural circuits. I will present examples of our recent and ongoing work that illustrates the diversity of feedback mechanisms in the nervous system, and how these may reconcile apparent messiness with coherent function.

University of Cambridge

Timothy O'Leary

Timothy O'Leary is Professor of Information Engineering and Neuroscience at the University of Cambridge. His research uses concepts and methods from systems theory and control engineering to understand the brain at the cellular and network level. He trained in pure mathematics and obtained his PhD in biophysics and physiology at the University of Edinburgh. He then worked with Eve Marder as Swartz Theoretical Neuroscience Fellow in Brandeis University before starting his group in Cambridge in 2016.

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