



THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON STATISTICS

Disentanglement and Quantification of Complexity in High-Dimensional Noisy Data

By

Prof. Valeriy A. Makarov

Department of Applied Mathematics and Mathematical Analysis
Complutense University of Madrid

Abstract

Modern biomedical recordings, including EEG, MEG, and local field potentials (LFPs), provide high-dimensional time series that capture complex neuronal dynamics. However, their high dimensionality, nonstationarity, and intrinsic noise pose fundamental challenges for quantifying dynamical complexity. The correlation dimension (CD) is a powerful nonlinear measure of complexity, but conventional estimation methods require prohibitively large datasets as the system dimension increases. Here, we present a novel framework that combines linear decomposition of multivariate time series with nonlinear CD estimation to quantify the dynamical complexity and noise level of time series. The method decomposes multichannel recordings into statistically independent components, thereby mitigating the curse of dimensionality and reducing the data requirements for reliable CD estimation by orders of magnitude. We provide a mathematical justification for the use of alternative kernels in the evaluation of the correlation integral and develop an automated parameter-optimization procedure. Validation on synthetic data shows improved accuracy and stability compared with conventional approaches, while application to hippocampal LFPs demonstrates feasibility for complex biological signals.

Bio : Professor Valeriy A. Makarov is a Full Professor of Applied Mathematics at the School of Mathematics of the Complutense University of Madrid (UCM). He earned a degree in Physics in 1992 and a PhD in Mathematical and Physical Sciences in 1997 from Nizhny Novgorod State University. His research focuses on nonlinear dynamics, computational neuroscience, brain-inspired cognition, and autonomous navigation. He has published more than 120 scientific articles and three monographs. His work has received over 2,400 citations in the Web of Science. He has held academic and research positions at UCM and served as Head of the Department of Mathematical Analysis and Applied Mathematics from 2022 to 2026. He is an Associate Editor of Communications in Nonlinear Science and Numerical Simulation.

Date : 19 November 2026 (Thursday)

Time : 4:00p.m.-5:00p.m.

Venue : Room 3598 (near Lift 27/28)

All are welcome!