Department of Biostatistics and Medical Informatics Seminar

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Friday, March 06, 2026
12:00-1:00 pm
Morgridge Hall Seminar Room 7650

Zoom Meeting: 966 3372 9112
https://uwmadison.zoom.us/j/96633729112?pwd=tHFc9i1dAAgmXe05uWtw8wXBIQZxGB.1
Passcode: 621125

Causality through Lagrangian Dynamics

Abstract: Most causal models in statistics and machine learning define causality through regression and conditional dependence on directed acyclic graphs (DAGs). While effective for estimating local directional effects, these frameworks are ill suited to systems dominated by feedback, recurrence, and higher-order cyclic organization, where cycles are typically treated as violations rather than intrinsic causal mechanisms. Such assumptions are misaligned with many real-world dynamical systems, including biological and neural systems, in which cyclic and recurrent interactions are fundamental.

We propose reframing causality within Lagrangian mechanics. In this new framework, causal organization is defined globally through an action functional over all admissible causal paths, and causality emerges as a topological steady state corresponding to a minimum-energy configuration. This perspective provides a physically interpretable and mathematically principled alternative to DAG-based models, naturally accommodating feedback-dominated and recurrent systems while extending causal inference beyond acyclic paradigms.

Bio: Chung is a Professor in the Department of Biostatistics and Medical Informatics at the University of Wisconsin–Madison. His research develops neuroimaging methodologies to quantify and compare functional, anatomical, and network variations in healthy and clinical populations using geometry and topology. His recent work focuses on brain network dynamics and topological data analysis (TDA). Over the past decade, TDA has evolved from a primarily exploratory, feature-based framework into a powerful operator-based approach for analyzing complex, dynamic biomedical systems. The talk will highlight advances enabled by topology that extend beyond the reach of conventional methods.

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