Department Of Mathematics

Applied Mathematics Seminar

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Title: **A Modeling Study to Characterize Microtubule Mechanisms of Dynamic Instability: Connecting Micro-level Tip Structures to Macro-level Phases**

Abstract:

A cytoplasmic biopolymer system called microtubules (MTs) offer a real-world example of dynamic instability (DI), a non-equilibrium steady-state characterized by catastrophe and rescue events that drastically change the biopolymer's length on the macro-level between growth and shortening phases. Little is known about the mechanisms that lead to DI phases changes, so to this end, a detailed 2-protofilament continuous-time Markov chain model is presented as the simplest case that considers the lateral bond as part in order to focus on the tip structure, where most of the micro-level MT dynamics occur. Additionally, an automated method of approximating, classifying, and analyzing the MT length history that represents DI behavior is presented as a means for improving the identification of DI phases and the quantification their properties. The unsupervised learning component of this approach reveals a previously overlooked intermediate phase that we call "stutters", which represents periods of slower changes to MT length that commonly occur at the onset of catastrophe events. Finally, a supervised machine learning approach is presented for predicting different DI phases and forecasting their transitions from only the tip structure features observed in simulated data generated from the simplified MT model. The overarching approach outlines a study for better understanding the mechanisms involved with DI phase transitions.

About the speaker:

Shant Mahserejian was first exposed to interdisciplinary research as a graduate student in the Dept. of Mathematics at the California State University Northridge under the advisement of Prof. Rabia Djellouli, where he combined a mathematical modeling approach with *in vivo* experiments to study the effects of low current electrical pulses on reducing fibrous tissue growth around biomedical implants. His passion for using mathematical and computational skills in the arena of biology led him to pursue a doctoral degree at the University of Notre Dame in the Dept. of Applied and Computational Mathematics and Statistics. There, he worked under the advisement of Prof. Mark Alber to accumulate a unique skill set outside the common realm of mathematics such as microscopy and 3D printing, which enhanced his research experiences in various biological applications, including bacteriology and ovarian cancer. His curriculum in computational statistics further expanded his ability to study and compare data sets generated from real-world laboratory experiments and computational simulations. This culminated in his dissertation project studying dynamic instability phase changes of the cytoplasmic biopolymer system of microtubules, which relied on modern machine learning and data mining techniques. Since his completion of his PhD program, Dr. Mahserejian has been a research scientists at the Pacific Northwest National Laboratory, where interdisciplinary problems dealing with national security challenge him to find computational solutions using deep learning applications and other state-of-the-art technologies.

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11:00 – 12:00pm

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