SIAM MPE Community Meetings: Colloquium

Prof. Pedram Hassanzadeh

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The AI Revolution in Weather/Climate Modeling and the Challenges with Interpretability and Predicting Gray Swan Weather Extremes

Abstract: In recent years, there has been substantial interest in using deep neural networks (NNs) to improve the modeling and prediction of Earth's climate, a complex, nonlinear, multi-scale dynamical system. For 1 to 10-day weather forecasting, fully data-driven NN-based models have already transformed the state-of-the-art and are on their way to becoming operational. Promising results on building NN-based models for longer time-scale, and even emulators to study climate change are emerging. Significant progress has been also made in developing data-informed subgrid-scale parameterizations (closures) for hybrid weather and climate modeling. However, challenges with understanding the learning process of these models and concerns about their ability to provide early warning or statistics of the rarest, most impactful extreme weather events (the so-called gray swans) slow down progress and widespread adaptation of AI-based models. I will discuss examples of successes and failures of AI weather and climate models, and present ideas around using tools from math and physics, e.g., conducting Fourier analysis of NNs and leveraging rare-event sampling methods, to address them.

Biography: Prof. Pedram Hassanzadeh leads the University of Chicago's Climate Extreme Theory and Data Group and is an Associate Professor at the Department of Geophysical Sciences, Committee on Computational and Applied Math, and the Data Science Institute (DSI). He also leads the DSI's new AI for Climate Initiative (AICE). He received his MA (in applied math) and PhD (working on geophysical turbulence) from UC Berkeley in 2013. He was a Ziff Environmental Fellow at Harvard University before joining Rice University in 2016 and moving to the University of Chicago in 2024. His research is at the intersection of scientific machine learning, computational and applied math, climate change, extreme weather, and geophysical fluid dynamics. He has received an NSF CAREER Award, ONR Young Investigator Award, and Early Career Fellowship from the National Academies Gulf Research Program.

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11:00 AM EDT

Zoom link: siam.zoom.us/j/85142274147

Hosts:
Julie Bessac and Pierre Lermusiaux
http://mseas.mit.edu