

Mathematical Sciences Department

Harold J Gay Lecture Series



Friday, October 30th, 2026

2:00PM at Salisbury Lab SL115

Prof. George Karniadakis

Charles Pitts Robinson and John Palmer Barstow Professor of Applied Mathematics,
Brown University; Also @MIT & PNNL.

Agentic Scientific Machine Learning

Scientific Machine Learning (SciML) integrates data-driven inference with physical modeling to solve complex problems in science and engineering. However, the design of SciML architectures, loss formulations, and training strategies remains an expert-driven research process, requiring extensive experimentation and problem-specific insights. We introduce **ATHENA**, a collaborative multi-agent system in which about 20 specialized AI agents collaborate to propose, critique, and refine SciML solutions through structured reasoning and iterative evolution. The framework integrates structured debate, retrieval-augmented method memory, and ensemble-guided evolutionary search, enabling the agents to generate and assess new hypotheses about architectures and optimization procedures. Across physics-informed learning and operator learning tasks, the framework discovers solution methods that outperform single-agent and human-designed baselines by orders of magnitude in error reduction. The agents produce novel strategies -- including adaptive mixture-of-expert architectures, decomposition-based PINNs, and physics-informed operator learning models -- that do not appear explicitly in the curated knowledge base. They also prove error estimates, universal approximation theorems, and discover singularities in PDEs. These results show that collaborative reasoning among AI agents can yield *emergent* methodological innovation, suggesting a path toward scalable, transparent, and autonomous discovery in scientific computing.



William Benter Prize (2026)

G.I. Taylor Medal, Society of Engineering Science (2024)

National Academy of Engineering (NAE) (2022)

SIAM/ACM Prize in Computational Science and Engineering (2021)

Ralph Kleinman Prize, SIAM (2015)

J. Tinsley Oden Medal, US Assoc. Comput. Mechanics (2013)

SIAM Fellow (2010)

Comput. Fluid Dynamics Award, US Assoc. Comput. Mechanics (2007)

American Physical Soc. (APS) Fellow (2004)

American Soc. Mech. Eng. (ASME) Fellow (2003)

Among others...

**His h-index is 171 (highest in Applied Mathematics).
He has been cited over 188,000 times.**

TITLE	ARTICLES of AMAZING IMPACT, SUCH AS	CITED BY	YEAR
Physics-informed neural networks: A deep learning framework for solving forward and inverse problems involving nonlinear partial differential equations	M Raissi, P Perdikaris, GE Karniadakis Journal of Computational physics 378, 686-707	27799	2019