Structural Engineering Seminar Series

CEE 595 S

Thermodynamics-based Data-driven Computing and N-adaptivity: A Machine Learning Enhanced Computational Mechanics

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Abstract:

After several decades of development in computational methods such as the Finite Element Method and Meshfree Method, several classes of engineering and scientific problems remain challenging, for instance, generalizable material models for complex material systems, problems with moving strong and weak discontinuities, model order reduction for nonlinear systems, to name a few. The fast-growing research and development in data science, machine learning and artificial intelligence offer new opportunities for the development of new paradigms in scientific computing. This talk presents a few recent advances in achieving this objective: 1) manifold learning, model order reduction, and thermodynamics-based "model-free" data-driven computing for nonlinear materials, and 2) neural network enhancement of Galerkin solution for weak and strong discontinuities, and adaptivity with a fixed discretization, called n-adaptivity. These unique combinations of machine learning techniques and advanced computational methods have expanded the horizon of computational mechanics and scientific computing well beyond what the conventional computational methods can offer. Applications to plasticity, localization, fracture, thermal fatigue, and digital twins will be presented to demonstrate the effectiveness of these new developments for computational mechanics.

Bio:

J. S. Chen is the William Prager Chair Professor and Distinguished Professor of Structural Engineering Department, Mechanical & Aerospace Engineering Department, and the Founding Director of Center for Extreme Events Research at UC San Diego. Before joining UCSD in 2013, he was the Chancellor's Professor of UCLA Civil & Environmental Engineering Department, Mechanical & Aerospace Engineering Department, and Mathematics Department, where he served as the Department Chair of Civil & Environmental Engineering during 2007-2012. J. S. Chen's research is in computational mechanics and multiscale materials modeling with specialization in the development of meshfree methods. He is the Past President of US Association for Computational Mechanics (USACM) and the Past President of ASCE Engineering Mechanics Institute (EMI).

He has received numerous awards, including the Computational Mechanics Award from International Association for Computational Mechanics (IACM), the Grand Prize from Japan Society for Computational Engineering and Science (JSCES), the Ted Belytschko Applied Mechanics Award from ASME Applied Mechanics Division, the Belytschko Medal from U.S. Association for Computational Mechanics (USACM), the Computational Mechanics Award from Japan Association for Computational Mechanics (JACM), the ICACM Award from International Chinese Association for Computational Mechanics (ICACM), among others. He is the Fellow of USACM, IACM, ASME, EMI, SES, ICACM, and ICCEES. He received BS (Civil Engineering) from National Central University, Taiwan, and MS and PhD (Theoretical & Applied Mechanics) from Northwestern University.

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1310 Yeh Student Center