Structural Engineering Seminar Series

CEE 595 S

Machine learning applications to support planning and emergency response management for storm surge risk

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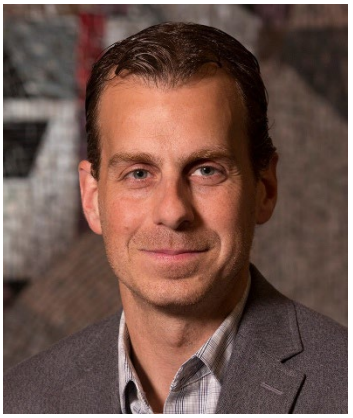
Abstract:
Prediction of storm-surge hazard and impacts within planning (pre-disaster), emergency management and post-disaster settings has emerged as a key priority in natural hazard risk mitigation efforts. Migration towards coasts as well as concerns related to the future effects of climate change, further stress the importance of research efforts that attempt to address this priority. Numerical advances in storm surge prediction is one of the more important such efforts. These advances have produced high-fidelity simulation models that permit a detailed representation of hydrodynamic processes and therefore support high-accuracy forecasting. Unfortunately, the computational burden of such numerical models is large, requiring thousands of CPU hours for each simulation, something that limits their applicability for hurricane risk assessment. This prohibits their broader use in regional planning or emergency response management efforts. This seminar will examine how machine learning advances have been recently promoted to address this challenge, and how the integration of such techniques can be established to better serve the needs of the relevant decision makers (planners, emergency managers).

Emphasis will be placed on technical aspects for integrating surrogate modeling techniques to provide surge predictions using a database of high-fidelity, synthetic storms, with the goal of maintaining the accuracy of the numerical model utilized to produce this database, while providing greatly enhanced computational efficiency. This ultimately supports great versatility in leveraging high-fidelity modeling to support regional flood studies (supported by FEMA or Army Corps of Engineers) and real-time emergency response management (supported by NOAA). The integration of graph neural networks and multi-fidelity approaches is discussed in this context. The presentation also examines how these developments and the advantages they can offer need to be promoted in order to gain acceptance by the community they intend to serve (aforementioned agencies and also planner and emergency response managers), corresponding in this case to non-technical end-users with respect to the underlying computational statistics methods.

Bio:
Dr. Alexandros Taflanidis is Professor in the Department of Civil and Environmental Engineering and Earth Sciences at the University of Notre Dame. He holds a concurrent position at the Department of Aerospace and Mechanical Engineering. He received his Bachelors (2002) and Masters (2003) in Civil Engineering from Aristotle University of Thessaloniki, Greece. He got his PhD in Civil Engineering with minor in Control and Dynamical Systems from the California Institute of Technology (2008). His research focuses on uncertainty quantification and uncertainty-conscious analysis/design, with applications to dynamical system design, natural hazard risk mitigation and sustainability/resilience of civil infrastructure systems. A special area of interest for his group is the integration of computational statistics techniques in risk assessment/design and real-time emergency response management. His awards/distinctions include the 2021 Walter L. Huber Civil Engineering Research Prize for applications of machine learning and computational statistics in the domain of natural hazards engineering, the 2014/2019 Joyce C.S.C Awards for Excellence in Undergraduate Teaching and the 2014 NCEEES Award for best undergraduate project linking undergraduates to the professional practice.



Monday, November 9, 2026 4:00 – 5:00 p.m.

1310 Yeh Student Center