Structural Engineering Seminar Series

CEE 595 S

Scarce data approaches to transfer knowledge across disparate domains: a study in extrapolation via machine learning

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Abstract:

Rising sea levels, extreme weather events, and shifting ecosystems threaten the very fabric of our cities and infrastructure. The built environment—our homes, bridges, roads, etc.—stands vulnerable, demanding innovative solutions. This in turn, necessitates innovative approaches to assess and enhance infrastructure resilience. This presentation is specifically motivated by the need to combat the ever-increasing demands on the built environment due to climate change and global warming via advanced data-driven approaches that can be used for extrapolation. Historically, data-driven approaches, or machine learning/artificial intelligence (ML/AI) are considerably robust and reliable for interpolation or in-sample prediction, especially when there is sufficient data available. However, when trying to estimate the impact of never-before-seen loads (such as those due to climate change and global warming) or new materials/designs, where we have little-to-no available data, we need these approaches to be robust and reliable for extrapolation or out-of-sample prediction. The ability to accurately predict infrastructure performance for novel materials and under climate change impacts will empower stakeholders, including infrastructure owners, operators, and policymakers, to prioritize resources, mitigate risks, and ensure the long-term sustainability and resilience of critical infrastructure systems. The work presented will contribute to the development of climate-resilient infrastructure, safeguarding public safety, minimizing economic losses, and promoting environmental stewardship.

Bio:

Dr. Paal is the Williams Brothers Construction Company Associate Professor in the Zachry Department of Civil and Environmental Engineering at Texas A&M University. Dr. Paal joined the faculty at Texas A&M in the Fall of 2016 after completing a post-doctoral fellowship at the Ecole Polytechnique Federale de Lausanne (EPFL) in Switzerland. She received her Master's and Doctoral degrees in Civil Engineering from the Georgia Institute of Technology in 2011 and 2013, respectively. Additionally, she received a B.S. in Architectural Engineering from the University of Texas at Austin in 2009. Dr. Paal has extensive background knowledge and expertise in machine learning and machine vision and applications of these technologies in infrastructure and structural condition assessments and other infrastructure-related practices. Her research focus is on mitigating the effects of natural disasters on our built infrastructure by integrating traditional civil engineering practices with emerging techniques and technologies. Her current research interests are towards hybrid artificial intelligence-physics-based approaches, understanding the impact of integrating artificial intelligence models and methodologies in civil engineering design, analysis, and evaluation operations, and developing advanced modeling approaches grounded in real-world data for extreme scenarios. This requires the development of advanced data-driven techniques to handle extrapolation rather than interpolation, scarce data scenarios, and extreme values or outliers. Her research has been supported by numerous state and federal agencies such as the National Cooperative Highway Research Program, Texas Department of Transportation, the National Association of Home Builders, the American Concrete Institute, the Department of Energy, and the National Science Foundation. In 2020, she was granted an NSF Early CAREER award for her research towards enhancing our understanding of our infrastructures performance under natural hazards by leveraging available experimental data and artificial intelligence. She has also focused considerable efforts on integrating data-driven science into undergraduate and graduate courses at Texas A&M University and has multiple National Science Foundation grants to support these efforts.

Monday, October 6, 2025 4:00 – 5:00 p.m.

1310 Yeh Student Center