Structural Engineering Seminar Series

CEE 595 S

Structures as Sensors: From trains, to people, to pigs

Hae Young Noh

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Abstract:

'Smart structures' sense, understand, and respond to structure itself, the humans within, and the surrounding environment. Traditional monitoring approaches using dedicated sensors often result in dense sensing systems that are difficult to install and maintain in large-scale structures. In this talk, I introduce "Structures as Sensors" approach that utilizes the structure itself as a sensing medium to indirectly infer multiple types of information (e.g., occupant activity, surrounding infrastructure states) through their influence on the physical response of the structure. Challenges lie in creating robust inference models for analyzing noisy structural response data. To this end, we developed physics-guided data analytics approaches combining statistical signal processing and machine learning with physical principles. I will present two projects as examples of this approach: 1) Vehicles as Sensors: indirect infrastructure health monitoring through vehicle responses; and 2) Buildings as Sensors: occupant tracking and characterization through footstep-induced building vibrations. We developed new learning methods incorporating structural dynamics, wave propagation, and human activity models; and we evaluated our methods with real-world experiments, including our multi-year railway, eldercare center, and pig farm deployments.

Bio:

Hae Young Noh is an Associate Professor in the Department of Civil and Environmental Engineering at Stanford University. Her research focuses on indirect sensing and physics-guided data analytics to enable low-cost non-intrusive monitoring of cyber-physical-human systems. She is particularly interested in developing structures to be self-, user-, and surrounding-aware to improve users' quality of life and provide safe and sustainable built environment. The results of her work have been deployed in a number of real-world applications from trains, to the Amish community, to eldercare centers, to pig farms. Before joining Stanford, she was a faculty member at Carnegie Mellon University. She received her Ph.D. and M.S. degrees in Civil and Environmental Engineering and the second M.S. degree in Electrical Engineering at Stanford University. She earned her B.S. degree in Mechanical and Aerospace Engineering at Cornell University. She received several awards, including the Google Faculty Research Awards (2013, 2016), the Dean's Early Career Fellowship (2018), the NSF CAREER Award (2017), and various Best Paper Awards from ASCE, ASME, ACM, IEEE, and SEM conferences.

Monday, October 7, 2024 4:00 – 5:20 p.m.

1310 Yeh Student Center