Adaptive and deployable lightweight civil infrastructure

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Abstract:

Current infrastructure is designed and built such that it must simultaneously comply with all possible loads. This leads to overdesigned structures that are inefficient in terms of energy and cost. A structure that can self-identify damage, adapt, and learn for future events addresses the emerging field of intelligent infrastructure and structural health monitoring through inspiration from biology. To achieve this type of structure requires balance of structural engineering, architecture, mechanical engineering, computer science, and robotics. Deployable active structures that change shape either autonomously or remotely to accommodate challenging environments are rare. Tensegrity structures are geometrically non-linear, they are ideal candidates for studying deployable structures (http://youtu.be/FeXxjerleZE). Through actuation, origami-inspired structures can also be repeatedly deployed for ease of transportation and installation. The grand challenge of this work is addressing uncertainties between modeling and experimental testing for large-scale shape changing structures. To address this challenge, SMARTI lab employs optical tracking and computer vision for high-definition measurement and additive manufacturing for optimized connections. This seminar will present work on adaptive and deployable structures using sustainable materials and control algorithms for resilient infrastructure.

Bio:

Ann Sychterz (SICK-tesh) is an assistant professor in the Department of Civil & Environmental Engineering at the University of Illinois Urbana-Champaign. With her team at SMARTI lab, they harness geometrically nonlinear systems, such as tensegrity structures and origami, for adaptive civil infrastructure. She obtained her PhD in 2018 from the Swiss Federal Institute of Technology Lausanne (EPFL) addressing the novel use of control algorithms, statistical diagnostic tools, and real-time feedback on a full-scale tensegrity structure to enable smooth deployability, damage detection, adaptation, and learning. She completed her masters and bachelors of science at the University of Waterloo, Canada. Dr. Sychterz completed a postdoctoral position at the University of Michigan on actuator optimization of adaptive origami structures.