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International Doctoral Program in Civil and Environmental Engineering

SEMINAR

Soft Sensing Technology for Fatigue Crack Discovery and Monitoring

Prof. Simon LAFLAMME

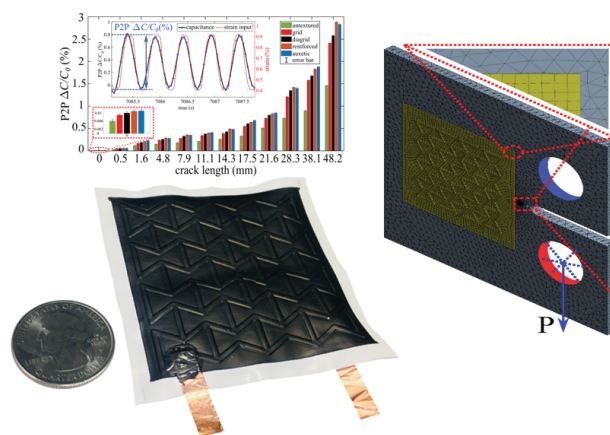
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UNIPG Campus of Engineering
Via G. Duranti, 93, Perugia, Italy
Aula 7

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Abstract

The timely discovery and monitoring of fatigue cracks in steel structures is an important task in order to ensure structural integrity. However, off-the-shelf strain sensors are small and their deployment is too spatially localized to successfully locate new crack formation or growth within acceptable confidence. A solution is the use of large-area electronics capable of covering large surfaces. Recent advances in hyper-elastic materials and self-sensing sensor designs have enabled the creation of dense compliant sensor networks for the cost-effective monitoring of large-scale geometries. In particular, we have previously developed at Iowa State University a sensing skin technology based on a soft elastomeric capacitor (SEC) that consists of a highly compliant, low-cost, and scalable strain gauge that transduces surface strain into a measurable change in capacitance. In this talk, we review recent research advances empowering field deployment of the SEC technology for discovering and monitoring fatigue cracks. This includes an auxetic structure-inspired design for improved sensing capabilities, signal processing strategies to fuse data into useful information, and latest data from a field investigation on a bridge located in Kansas, United States. We also highlight collaborative work with the University of Perugia that further enabled research advances on the SEC. Lastly, we discuss recent work on a modified version of the SEC that comprises a structural color film that allows for optical feedback and thus can assist visual inspections in discovering fatigue cracks.



Prof. Simon Laflamme is the Waldo. W. Wegner Professor in Civil Engineering in the Department of Civil, Construction, and Environmental Engineering at Iowa State University, and holds a Courtesy Appointment in the Department of Electrical and Computer Engineering. He received his Ph.D in Structures and Materials from the Massachusetts Institute of Technology in 2011, and was granted the Early Achievement in Research Award (2017) and the Mid-Career Achievement in Research Award (2022) by Iowa State University. Dr. Laflamme has amassed more than 9 million USD in research projects from various sources, including NSF, DOD, and USDOT. He is a member of various editorial boards including Mechanical Systems and Signal Processing, Measurement Science and Technology, and IOP SciNotes. His research yielded a textbook on Structural Motion Engineering, five U.S. patents, and more than 200 articles in the areas of Smart Structures and Systems, Structural Control, and Structural Health Monitoring.

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