



Ph.D. DISSERTATION DEFENSE

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Degree:	Doctor of Philosophy
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Date:	Wednesday, April 24 th , 2024
Time/Location:	10:00 a.m. to 11:30 a.m. / McLean, Room 114
Title:	Applications of machine learning for intelligent sensing and structural health monitoring
Chairperson:	Dr. Yi Bao, Department of Civil, Environmental and Ocean Engineering, School of Engineering and Science, Stevens Institute of Technology
Committee Members:	Dr. Weina Meng, Department of Civil, Environmental and Ocean Engineering, School of Engineering and Science, Stevens Institute of Technology Dr. Muhammad Hajj, Department of Civil, Environmental and Ocean Engineering, School of Engineering and Science, Stevens Institute of Technology Dr. Henry Du, Department of Chemical Engineering and Materials Science, School of Engineering and Science, Stevens Institute of Technology

ABSTRACT

Structural health monitoring is vital for the early detection of structural damage, enabling timely and cost-effective rehabilitation. Traditional structural health monitoring approaches suffer from limitations such as low accuracy, reliance on manual intervention, inefficient data analysis, and susceptibility to human error. This dissertation presents the development of novel machine learning-based sensing techniques to monitor both macroscopic and microscopic structural behaviors, thereby enhancing structural health monitoring capabilities and offering a pathway to intelligent infrastructure systems. The key contributions of this dissertation include: (1) develop low-cost ultra-wideband sensors to improve the accuracy of displacement measurements from tens of centimeters to sub-millimeter; (2) improve the accuracy and frequency of ultra-wideband sensors for dynamic displacement measurements; (3) intelligently detect, locate, quantify, and visualize cracks based on massive distributed fiber optic sensor data in real time; and (4) automatically detect, locate, and quantify corrosion and interactive corrosion and cracks based on spatiotemporal distributed fiber optic sensors data. This research will greatly improve the safety and sustainability of civil infrastructure through advancing the capabilities of structural health monitoring.