DEPARTMENT OF CIVIL ENGINEERING

SEMINAR

AI-powered Digital Twin for Structural Health Monitoring

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Date: July 30, 2025 (Wednesday)
Time: 2:00 p.m. – 3:00 p.m.
Venue: Room 612B, 6/F Haking Wong Building, The University of Hong Kong
Zoom: https://hku.zoom.us/j/974 9065 0148

Abstract
Digital twin is a hot topic these days, especially in the field of structural health monitoring. It is referred to as a cyber counterpart of a physical structure, continuously updated with sensor data to represent the changes in the real world. However, several challenges exist in the journey of digital twin development, such as modelling complexity for digital twin, big mismatch between physical and digital twin, and large delay of interactions. In this talk, we will discuss how artificial intelligence can help to address the above challenges, further empowering digital twin technologies. Four main strategies will be discussed, including: 1) AI-based surrogate model to build lightweight digital twins of buildings and infrastructure, which is further used for damage detection and displacement estimation, 2) Transfer-AE for model updating to fill the inevitable gap between physical and digital twin, which is further used for impact detection and localization in complex and nonlinear structures, 3) CV-based model updating to reflect the crack geometry and assess its impact on RC structures, which is further used to evaluate tunnel segment linings, and 4) Live digital twin framework to streamline data flow to mimic dynamic behavior of physical structures in real-time, which is used for seismic building condition assessment in timely manner. These strategies are demonstrated and evaluated in either lab or field tests, showing the power of artificial intelligence to release the potential of digital twin in structural health monitoring.

About the Speaker
Dr. Fu is an Assistant Professor and MSc (Civil) Director in the School of Civil and Environmental Engineering, Nanyang Technological University (NTU), Singapore. He is also president-elect of ASCE Singapore section. He received B.S. and M.S. in civil engineering from Tongji University in 2012 and 2014, respectively, and earned Ph.D. in civil engineering from the University of Illinois at Urbana-Champaign (UIUC) in 2019. Prior to joining NTU in 2021, he was a research scientist at Embedor Technologies to commercialize the IoT sensor developed in the Ph.D. study, funded by NSF-SBIR. He then became a postdoctoral research associate in the Resilient Extra-Terrestrial Habitats Institute at Purdue University, funded by NASA. His research interests include IoT sensing and digital twin modelling for structural health monitoring. He has published 50+ journal papers, hold/file 5 patents, and secured research grants of over two million SGD as PI or co-PI (with separate accounts) in Singapore. He acted as the key personnel for the development of *Xnode* and enabled wireless construction monitoring of Ain Dubai Ferris Wheel and many railroad bridges in North America. His NTU team is currently working on next-gen wireless SHM systems based on edge intelligence, aka, *LiftNode*, which is deployed in Bukit Panjang Railway tunnel for over one-year monitoring.

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