FAKULTA ústav mechaniky
STROJNÍHO těles, mechatroniky
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Pozvánka na přednášku, kterou pořádá

Ústav mechaniky těles, mechatroniky a biomechaniky, Fakulta strojního inženýrství, Vysoké učení technické v Brně ve spolupráci s Českou společností pro mechaniku, pobočka Brno

která se bude konat

v pondělí 21. 3. 2022 od 10:00 do 11:40 v učebně A2/617 (Technická 2, Brno)

a kterou přednese

Dr. Fuh-Gwo Yuan

na téma

Machine learning for structural health monitoring: Closing the gap between research and industrial applications

Abstrakt

A physics-based approach to structural health monitoring (SHM) has practical shortcomings which restrict its suitability to simple structures under well controlled environments. With the advances in information and sensing technology (sensors and sensor networks), it has become feasible to monitor large/diverse number of parameters in complex real-world structures either continuously or intermittently by employing large in-situ (wireless) sensor networks. The availability of this historical data has engendered a lot of interest in a data-driven approach as a natural and more viable option for realizing the goal of SHM in such structures. However, the lack of sensor data corresponding to different damage scenarios continues to remain a challenge. Most of the supervised machine-learning/deep-learning techniques, when trained using this inherently limited data, lack robustness and generalizability.

Physics-informed learning, which involves the integration of domain knowledge into the learning process, is presented here as a potential remedy to this challenge. The concept of physics-informed neural networks (PINNs) will be presented using two kinds of problems: (1) Forward problem: scattered wavefield reconstruction in complex aerospace structures from sparse sensor data. It is shown that honoring the underlying physics and/or domain knowledge during the training process of ANNs leads to improved robustness and better generalization. By doing so, diffraction limit can be transcended thereby achieving super resolution imaging. (2) Inverse problem: detailed damage characterization of complex composite structures using deep learning. Lastly, a recent vision-based SHM system using the digital image correlation (DIC) to capture scattered ultrasonic wavefield for image the damage was developed. Leveraging the physics-informed learning with the vision-based SHM is in progress toward damage characterization.

Životopisná data

Dr. Yuan působí na Department of Mechanical and Aerospace Engineering, North Carolina State University v Raleigh jako profesor a současně jako Distinguished Samuel P. Langley Professor v National Institute of Aerospace od roku 2011. Kromě dalšího univerzitního působení na ČVUT v Praze (2022), SouthEast University (2006–2009), University of Oxford (2008) nebo University of Illinois at Urbana-Champaign (1986–1989), kde získal titul Ph.D. má i praktické zkušenosti z Wright-Patterson AFB (1991–1992), NASA Langley Research Center (1990) či Boeing Co. (1985). Je členem několika společností jako International Society for Optics and Photonics nebo American Society of Mechanical Engineering. Získal mnohá ocenění, především za významné publikace, kterých je autorem či spoluautorem v souhrnu více než 300 na téma pokročilých kompozitních materiálů a struktur, nedestruktivního testování či chytrých snímačů. Je rovněž editorem či členem redakční rady v časopisech jako Structural Health Monitoring nebo Journal of Energy Engineering.

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