LMS Seminar

29 February 2024 at 2:00 pm - Room Jean Mandel

Fusing physics-based and deep learning algorithms
for fault diagnostics and prognostics

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ABSTRACT

Deep learning algorithms need large amounts of representative data to learn relevant patterns. Although increasing amounts of condition monitoring data have been recently collected for complex systems, these data lack labels (in form of faults) and often also representativeness due to the high variability in operating conditions. Integrating physics and structural inductive bias helps to overcome some of the limitations of deep learning algorithms. It reduces the amount of required training data and adds interpretability in the algorithms. Furthermore, it helps to build trust in the algorithms by making the outputs interpretable to decision makers. The talk will give some insights into different approaches based on fusing physics-based and deep learning algorithms for fault diagnostics and prognostics. The focus will be in particular on calibration-based hybrid approaches, (physics-informed) graph neural networks and on transformer-based architectures combined with transfer learning. The applications will cover turbofan engines, batteries and bearings.

BIOGRAPHY

Olga Fink has been assistant professor of intelligent maintenance and operations systems at EPFL since March 2022. Olga is also a research affiliate at Massachusetts Institute of Technology. Olga's research focuses on Hybrid Algorithms Fusing Physics-Based Models and Deep Learning Algorithms, Hybrid Operational Digital Twins, Transfer Learning, Self-Supervised Learning, Deep Reinforcement Learning and Multi-Agent Systems for Intelligent Maintenance and Operations of Infrastructure and Complex Assets. Before joining EPFL faculty, Olga was assistant professor of intelligent maintenance systems at ETH Zurich from 2018 to 2022, being awarded the prestigious professorship grant of the Swiss National Science Foundation (SNSF). Between 2014 and 2018 she was heading the research group "Smart Maintenance" at the Zurich University of Applied Sciences (ZHAW). Olga received her Ph.D. degree from ETH Zurich with the thesis on "Failure and Degradation Prediction by Artificial Neural Networks: Applications to Railway Systems", and Diploma degree in industrial engineering from Hamburg University of Technology. She has gained valuable industrial experience as reliability engineer with Stadler Bussnang AG and as reliability and maintenance expert with Pöyry Switzerland Ltd. Olga has been a member of the BRIDGE Proof of Concept evaluation panel since 2023. Moreover, Olga is serving as an editorial board member of several prestigious journals, including Mechanical Systems and Signal Processing, Engineering Applications of Artificial Intelligence, Reliability Engineering and System Safety and IEEE Sensors Journal. In 2018, Olga was honored as one of the "Top 100 Women in Business, Switzerland". Additionally, in 2019, earned the distinction of being recognized as a young scientist of the World Economic Forum. In 2020 and 2021, she was honored as a young scientist of the World Laureate Forum. In 2023, she was distinguished as a fellow by the Prognostics and Health Management Society.