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FACULTY OF
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DATA SCIENCE AND
ANALYTICS
DEPARTMENT

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SEMINARS

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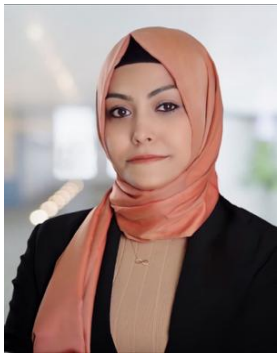

Dr. Sultan ZEYBEK

Physics-Informed Machine Learning for Additive Manufacturing under Small-Data Constraints

ABSTRACT: This seminar presents an ongoing research effort on physics-informed machine learning for additive manufacturing, focusing on learning under small-data and high-cost experimental settings. Advanced manufacturing processes such as Laser Powder Bed Fusion involve complex thermo-physical interactions and high-dimensional parameter spaces, where conventional data-driven models often struggle due to limited data availability and strong process constraints. To address this challenge, we propose a hybrid learning framework that integrates physics-based reasoning with data-driven modeling. In particular, the first phase of the study introduces a structured model discovery strategy, where candidate machine learning models are systematically evaluated under small-data conditions using an AutoML-inspired approach. Preliminary results demonstrate that combining domain knowledge with automated model selection can improve predictive performance and parameter estimation reliability. The study positions physics-informed surrogate modeling as a principled alternative to black-box approaches in data-scarce manufacturing settings.

SHORT BIO: Dr. Sultan Zeybek is an Assistant Professor at Istanbul University, Department of Artificial Intelligence and Data Engineering. She received her MSc from Istanbul Technical University and her PhD in Mathematical Engineering from Yıldız Technical University. During her PhD, she was a visiting researcher at the Autonomous Remanufacturing Lab, University of Birmingham, United Kingdom, supported by a TÜBİTAK 2214-A International Research Fellowship. She previously held academic positions at Fatih Sultan Mehmet Vakıf University. She serves as Co-Editor-in-Chief of D3AI - Journal of Data Analytics and Artificial Intelligence Applications, published by Istanbul University Press. Her research focuses on machine learning, optimization, and data-driven modeling for industrial systems, including additive manufacturing.