9th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMA2024)
June 3-7, 2024, Lisbon, Portugal

DIGITAL TWINS FOR PREDICTIVE DECISION-MAKING OF ENGINEERING SYSTEMS

TRACK NUMBER (700)

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Key words: Digital twins, Predictive maintenance, Machine learning, Structural health monitoring, Engineering systems.

ABSTRACT

A digital twin is a personalized virtualization of a physical asset or process that evolves in time. It relies upon a set of computational models that dynamically update to persistently mirror its physical counterpart, enabling informed decisions that realize value. The models and parameters comprising the digital twin are continually updated through the assimilation of real-world data, or sensor recordings. This enables diagnostic and predictive capabilities not achievable with static digital models. Up-to-date and comprehensive models are suitable to be exploited within dynamic decision-making frameworks, informing actions tailored to the physical setting of interest.

Computational models, in the form of physics-based simulators and data-driven models, and a synergistic coupling between the physical asset and its virtualization, are critical enablers for effective digital twins. Enhanced computational efficiency is also required to handle the continuous assimilation of noisy and big data, as well as to accommodate the quantification and propagation of uncertainties related to, e.g., environmental conditions, modeling assumptions, and operational variabilities.

This session aims to collect contributions highlighting the impact of physics-based and data-driven methodologies for digital twins of engineering systems and processes. Contributors are invited to discuss topics ranging from, but not limited to, structural health monitoring and

predictive maintenance of mechanical, aerospace, and civil engineering systems, simulation and reduced-order models for digital twins, process surveillance and decision-making through digital twins, data assimilation techniques for parameter and state estimation, digital twins for process optimization, multi-fidelity methods, and surrogate modeling strategies. Topics covering both methodology development and real-life applications in engineering and applied sciences are welcome.