Physics- and Data-driven Modelling techniques for Digital Twins

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ABSTRACT

Despite being conceptualized almost two decades ago, digital twins have only risen to prominence in the last few years and are currently seeing an explosion of use cases in many disciplines from manufacturing and construction [1] to massive-scale digital twins of the entire planet [2]. This recent resurgence is in part driven by advances in the technologies used to create and maintain digital twins, from internet of things (IoT) devices and machine learning to cloud and edge computing.

An important aspect of digital twins is that they are maintained throughout the lifetime of the physical twin. Digital twinning can thus be considered a driver for pushing isogeometric representations into industrial use, where the same representation can be used for multiple aspects of modelling, including design, physics-based simulation and advanced material representation for additive manufacturing [3, 4]. In digital twins, there is also a trend towards performing simulations on as-built models, as opposed to as-designed models, thus taking any deviations in the manufacturing process into account at the simulation stage. This requires methods for capturing the deviations in the process, but also methods for processing the acquired data into a form suitable for representation in the digital twin. Data-driven approaches that can model both physical processes and the knowledge of process experts are a key technology here [5]. Hybrid analytics, which combines machine learning with analytical models, and reduced order modelling, which enables simulations to be performed more efficiently, are also key enablers for digital twinning.

In this Minisymposium, we will discuss recent advances in technologies that are used to model digital twins, including physics-based and data-driven modelling, as well as hybrid approaches.

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