Introduction to the Minitrack "Simulation Modeling and Digital Twins for Decision Making in the Age of Industry 4.0"

Tobias Reggelin
Otto von Guericke University Magdeburg
tobias.reggelin@ovgu.de

Stefan Galka
Ostbayerische Technische Hochschule Regensburg
stefan.galka@oth-regensburg.de

Steffen Strassburger
Technische Universität Ilmenau
steffen.strassburger@tu-ilmenau.de

Sebastian Lang
Fraunhofer Institute for Factory Operation and Automation IFF Magdeburg
sebastian.lang@iff.fraunhofer.de

Abstract

The minitrack contains contributions with a focus on simulation modeling and digital twins and decision making in the context of Industry 4.0. The use of simulation models and digital twins is manifold, from planning to virtual commission and real-time operational decision support. Cyber-physical systems integrate the real world and the virtual world to enable decision making in the age of Industry 4.0.

For example, customer decisions and supply disruptions which directly influence manufacturing and logistics systems require immediate decisions. Thus, models must have the capability to support decision making in manufacturing as well as in internal and external logistics in real-time.

Methods include discrete-event simulation, discrete-rate simulation, hybrid simulation, system dynamics simulation, the combination of simulation modeling with machine learning or optimization heuristics, prescriptive analytics, and adaptive systems. Furthermore, this minitrack addresses simulation education and simulation models used for education and training in manufacturing and logistics.

1. Hybridization of the Digital Twin - Overcoming Implementation Challenges

In the context of Industry 4.0 the concept of the Digital Twin (DT) has gained significant momentum in industry as well as academia. However, few real-world implementations are known. Therefore, this paper (Scheer et al., 2023) addresses the most pressing challenges inhibiting the concept's industrial application. It describes the process of the concept's hybridization to achieve a practical implementation strategy: the Hybrid Digital Twin. Subsequently, a prototype is implemented using a presently operational real-world manufacturing system to substantiate the viability of the methodology.

The Hybrid Digital Twin is a valuable approach to introduce the concept of the DT to previously inaccessible environments due to lower implementation efforts by reducing its implementation challenges.

2. Design and Implementation of Hierarchical Digital Twins in Industrial Production Environments

This paper (Finke et al., 2023) argues that real production environments with different machines require the development of hierarchical digital twins in order to develop cyber-physical systems for their monitoring, control and optimization. The paper presents a concept for a hierarchical digital twin based on a set of requirements (requirements catalog) and presents its prototype implementation.

3. Investigation of Material Supply Strategies to Increase Resilience in Matrix Production Systems

The authors of this paper (Schmidtke et al., 2023) argue that matrix production systems create the conditions for resilient production systems through their adaptability, robustness, and anticipation. They use a simulation study to investigate and derive material supply strategies to design resilient processes in matrix production systems. The simulation case study uses data and scenarios from the automotive industry.

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4. References

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