Digital Twin – basis for adaptable automation systems (Code: 34f5q)

in honor of Professor Peter Luh

Goal:

Industry 4.0 and digital twin technology have been widely discussed for over a decade. In future factories, digital twins can be used for the direct control of the machines from the distance and the interaction with the factory's twin. Yet, broad implementations throughout the life cycle and roll-outs enabling future factories still face various challenges.

The concept of digital twins was shaped by the terms Industry 4.0 and the Internet of Things. Digital twins are virtual instances of a physical component that includes all information necessary for start-up, operation, and maintenance. Digital twins are desired to enable bi-directional information flow between the physical and virtual worlds to be realized automatically and optimally following real-time requirements. They should provide a complete information model for an asset, available and enriched over the system's entire life cycle. With all engineering information available, enriched by operation data, digital twins can be used as the basis for learning to avoid learning from scratch and benefit from engineering data[1]. All information and models need to be systematically managed to enable a smarter and more adaptive system.

However, due to different component manufacturers, different data exchange formats, inconsistent or incomplete information sources, and the lack of labeled and contextualized data, the digital twin technology still faces major challenges. Subsequently, numerous questions arise:

- How do I map/assign the process of data appropriately from operational and design data over to transforming data to knowledge?
- How do I enrich and combine existing engineering models?
- How is the information organized and exchanged?
- How do I ensure data and model consistency?
- How to benefit from small data / rare events?
- How can digital twins evolve?
- Are there real applications and implementations of the digital twin of a future factory?

This special session will focus more specifically on digital twins in industrial automation, planning, engineering, manufacturing, and logistics. The emphasis lies on current advances in digital twins in academia and industry. In addition to the digital twins of the plant, also the representation of required resources and involved humans are to be addressed. The software/hardware foundations, system architecture, and implementation possibilities are essential to implementing digital twins. The track chairs also invite practitioners and lecturers from academia and industry to present new concepts, demonstrators, and real applications of digital twins of future factories, while getting into exchange discussing current challenges and open issues.

Topics

- Digital twins for planning and control of processes in manufacturing, logistics and supply networks
- Human digital twins and digital twins of resources
- Foundations, architecture, and implementations of digital twins
- Hardware requirements to enable digital twins
- Real-time and safety aspects of digital twins
- Digital assets, inconsistency management, and standardization of data models for digital twins
- Information management and data exchange formats (e.g., knowledge base, ontology, asset administration shell AAS, AML, XML)
- Asset life cycle management, bi-directional information flow between engineering and operational data, enrichment and merging of models, and evolution/update of digital twins
- Decision making in Industry 4.0 era and the virtualization and simulation techniques
- Digital twin visualizations (e.g., computer vision systems, real-time graphics collaboration platforms)
- Digital twins for quality monitoring, diagnosis and prognostics in manufacturing processes
- Real applications of digital twins for future factories, current challenges and open issues

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