Empowering Digital Twins by Conceding them an Architecture for Proactive Collaboration Behavior

Tim HÄUSSERMANN[1], Joel LEHMANN, Alessa RACHE, and
Julian REICHWALD
Mannheim University of Applied Sciences, Mannheim, Germanyof Industrial

Abstract. The concept of the Digital Twin (DT) serves a pivotal role in digital transformation as well as transdisciplinary engineering disciplines and offers great potential that has not yet been fully exploited. Bridging physical and digital space by DTs opens up entirely new possibilities for data processing and value creation in once physically isolated fields of application. The DTs currently used in industry and research are mostly limited to representational and passive functionalities. Therefore, the concession of a habitat for DTs that allows them to behave proactively, must be considered. Autonomous interactions based on semantic technologies are intended to provide a basis for collaboration and negotiation between the DTs in order to perform bidirectional adaptations on the corresponding physical twins. This paper elaborates on an architecture for active bidirectional communication between physical twins and DTs as well as autonomously collaborating DTs and shows the feasibility of the outlined approach by a prototypical implementation. The implementation utilizes the knowledge-based representation of the DTs to enable efficient collaboration and thus facilitates a rationalization of the underlying processes. Furthermore, it supports the distribution of the assignments that result from the collaboration of the DTs and thus provides essential services in the context of data management. A final proof of concept in the area of manufacturing substantiates the work.

Keywords. Digital Twin; Intelligent Digital Twin; Cyber-physical System; Knowledge-Graph; Manufacturing

---

[1] Corresponding Author, Mail: t.haeussermann@hs-mannheim.de