

Digitizing Manufacturing Systems through Digital Twin Driven Virtual Platform

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Abstract

Manufacturing industries are rapidly evolving through digitalization, data analytics, and cyber-physical systems associated with Industry 4.0. Among these technologies, the Digital Twin (DT) enables real-time monitoring, simulation, and optimization of production processes, improving productivity, enabling predictive maintenance, and reducing operational downtime. However, many manufacturing environments still struggle to integrate physical systems with digital models due to challenges such as real-time data synchronization, large scale data management, and practical implementation for operational training. This research proposes a DT driven virtual manufacturing platform that integrates a physical manufacturing testbed with a virtual model developed using Emulate3D. The platform enables simulation, virtual commissioning, and operational monitoring while allowing users to analyze system performance and detect potential failures before implementation. The system has been used to train over 100 undergraduate engineering students, proving its value as both an educational and operational tool for future smart manufacturing systems.

Keywords

Digitizing, Manufacturing Systems, Virtual Platform