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Digital twin-driven quality assessment approach in a pharmaceutical assembly line

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The transition from batch to continuous manufacturing in the pharmaceutical industry is well underway, leading to the investigation of new technologies. Digital Twin (DT) is one of the topics promising to optimize processes and increase product quality by integrating the sensor data and simulation models.
In this presentation, we report on the main steps for implementing the DT for a particular cell, part of manufacturing assembly pilot line. We describe the most important aspects of the digital twin, such as the physical system, data collection and transfer layer, visualization, models, as well as more advanced DT services such as fault detection.
The physical system includes a snap-fit process carried out by a linear motor and measurement. To collect and store the data, a transfer layer, Apache Kafka, is implemented and continuously collects and maintains the data. Moreover, to visualize different measurements such as applied force, torque and displacement, an event-based data dashboard, has been established. The simulation model for the snapping process has been developed to investigate the effect of assembly and geometrical variation and find the optimum settings. Furthermore, this simulation model is able to generate synthetic samples to assist future data-driven models. Eventually, an interpretable fault detection model is developed to detect the potential deviations from the normal situation.
In conclusion, DT technology shows great promise in enabling real-time monitoring and optimization of continuous manufacturing. This study is an example of how DT technology can be used to build a fault detection system and optimize a snap-fit process by implementing a data transfer layer, a dashboard, and a simulation model. This presentation proves the potential of DT, which adds to the overall understanding of the process, reduces abnormal situations, and therefore improves product quality.

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