From Process Simulation to Quality-Aware Digital Twins in the Age of AI

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The vision of a quality-aware digital twin framework linking materials discovery, product development, certification, production control and optimization, and even in-service management is no longer a dream. This is thanks to AI methods which are promising a supercharging of prior digitalization advances in composites processing and manufacturing. These methods include ML surrogate and inverse models, formal uncertainty quantification and propagation methods, and the underlying data science methods for managing and aggregating large and disparate data sets from both simulation and experiment. A quality-aware digital framework can then be rolled up into much broader digital thrusts such as Model-Based Systems Engineering (MBSE). This will enable a step-change in our use of digital tools for composites processing and manufacturing in the near future, reducing risk, timelines, and cost.