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Review of Intelligence for Additive and Subtractive Manufacturing: Current Status and Future Prospects

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Abstract:

Additive manufacturing (AM), an enabler of Industry 4.0, recently opened limitless possibilities in various sectors covering personal, industrial, medical, aviation and even extra-terrestrial applications. Although significant research thrust is prevalent on this topic, a detailed review covering the impact, status, and prospects of artificial intelligence (AI) in the manufacturing sector has been ignored in the literature. Therefore, this review provides comprehensive information on smart mechanisms and systems emphasizing additive, subtractive and/or hybrid manufacturing processes in a collaborative, predictive, decisive, and intelligent environment. Relevant electronic

databases were searched, and 248 articles were selected for qualitative synthesis. Our review suggests that significant improvements are required in connectivity, data sensing, and collection to enhance both subtractive and additive technologies, though the pervasive use of AI by machines and software helps to automate processes. An intelligent system is highly recommended in both conventional and non-conventional subtractive manufacturing (SM) methods to monitor and inspect the workpiece conditions for defect detection and to control the machining strategies in response to instantaneous output. Similarly, AM product quality can be improved through the online monitoring of melt pool and defect formation using suitable sensing devices followed by process control using machine learning (ML) algorithms. Challenges in implementing intelligent additive and subtractive manufacturing systems are also discussed in the article. The challenges comprise difficulty in self-optimizing CNC systems considering real-time material property and tool condition, defect detections by in-situ AM process monitoring, issues of overfitting and underfitting data in ML models and expensive and complicated set-ups in hybrid manufacturing processes.

Keywords

Author Keywords: intelligent manufacturing; digital twin; feedback control; smart system; data analytics

Keywords Plus: POWDER BED FUSION; NEURAL-NETWORK; MACHINE-TOOLS; INDUSTRY 4.0; MECHANICAL-PROPERTIES; SURFACE-ROUGHNESS; ACOUSTIC-EMISSION; BIOMEDICAL APPLICATIONS; ELECTRICAL-DISCHARGE; CHATTER PREDICTION

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