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The Future of Build Preparation and Parameter Development for LPBF: How Can Model-Based Engineering Boost Part Quality?

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Laser Powder Bed Fusion (LPBF) is making strong progress, with ongoing advancements in build preparation and parameter development paving the way for continuation in greater scalability and broader industrial adoption. This work presents a structured model-based engineering (MBE) approach aimed at improving part quality, process efficiency, and robustness, ultimately enabling fully optimized LPBF production.

At the core of the MBE framework is the systematic use of high-quality process data, including thermal behavior and material response. By transitioning from empirical trial-and-error methods to predictive modeling, MBE provides a deeper understanding of process–structure–property relationships and enables more reliable process design.

The integration of high-fidelity data with MBE unlocks multiple application areas within LPBF. It supports faster and more targeted development of material parameters, enabling greater customization while significantly reducing development cycles and time-to-market. In addition, MBE can be applied to advanced data preparation and build job conditioning, with the objective of homogenizing part quality across complex geometries and build platforms.

A key element of this approach is a feedforward control strategy. By predicting part characteristics evolution and proactively adjusting input parameter, the method stabilizes the job conditions throughout the build process. This predictive control minimizes defects and enhances process consistency.

Overall, MBE provides a powerful pathway to boost NSLM machine performance, higher part quality, and more scalable additive manufacturing, supporting the transition toward industrialized LPBF production.

AUTHOR'S STATEMENT
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