A Digital Engineering Approach for Additive Manufacturing

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One of the major challenges for the widespread use of additive manufacturing (AM) in engineering applications is the lack of strategy and tools to standardize the AM design, manufacturing, and qualification processes. This talk addresses this deficiency by placing it in the general context of an overarching digital engineering (DE) approach that needs to be established to allow material, design, processing, and post-processing, as well as modeling and testing aspects of AM to be linked in ways that allow data synchronization and information flow. The talk uses a recently published standardization roadmap for AM to explore one of the current gaps identified that corresponds to the lack of validated procedures to investigate the "effect-of-defect" issue in AM. This issue is at the heart of current qualification and certification approaches in which the type, size and number of printed artifacts needs to be determined to perform verification and validation, as well as to enable knowledge transfer ways from test coupon to actual production parts. As a representative example, the case of laser powder bed fusion metal AM method is shown for a widely used aluminum alloy. The role of feedstock power selection, geometry design and optimization, thermomechanical process simulations, on- and off-axis in situ monitoring, post-processing, as well as microstructure and surface characterization in the as-printed state is explained. Furthermore, additional insights that can be gained from the use of artificial intelligence methods in further analyzing data from all aspects of the AM process are discussed in view of future DE efforts that could be established to allow for cross-material, machine, and manufacturing method correlations and quality assessments.