

Metrology to enable model-based qualification of additive manufacturing

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ABSTRACT

Models of additive manufacturing (AM) processes enable manufacturers to study and optimize their processes while minimizing costly empirical studies. Accurate process models of the entire production chain will enable model-based qualification and will significantly reduce the investment of time and money that is currently required to empirically qualify high-value critical components. Once model-based qualification becomes a reality, AM will be the tool that accelerates technological advancements in high-value manufacturing industries, such as aerospace and biomedical. However, before model-based qualification can be fully realized, these models must be validated against high-quality process measurements. Unfortunately, this is a significant challenge considering the complexity of the AM process and the high temporal rates and small spatial scales over which the most intense thermal-material interactions occur. Furthermore, the metrology tools necessary to investigate the relevant phenomena are, in some cases, not fully developed. Therefore, metrology techniques must be developed and the acquired process data must be broadly disseminated to the modeling community to ensure the successful development of these models to achieve model-based qualification.

The National Institute of Standards and Technology (NIST), the national metrology laboratory of the United States, is developing the metrology tools and techniques necessary to acquire the measurements to validate AM process models and the methods to adequately disseminate the acquired validation data. This talk presents an overview of these efforts; specifically, in efforts related to temperature metrology. First, the current limitations in the metrology tools and the challenge in adequately describing the experiments and results are discussed. Next, the metrology tools being developed and utilized at NIST are discussed. Finally, recently acquired measurement data and the associated dissemination is discussed, with a particular interest in acquiring feedback from the conference attendees regarding the appropriate metrics and approach.