NextManufacturing
Carnegie Mellon University

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Scott Hall 6142

AM Process Monitoring and Control at Multiple Scales

Jack Beuth
Professor, Mechanical Engineering
Faculty Co-Director, NextManufacturing Center

Process monitoring and control is a highly active area of AM research. In such studies, process monitoring for documenting part quality is the first goal, followed by efforts to achieve robust in situ control. Both can be performed at a variety of levels of detail. This talk will describe process monitoring at part, layer and melt pool scales carried out at CMU. Part-level monitoring includes tracking top surface temperatures during builds, quantifying overall temperature changes as a function of part height. A new project exploiting machine learning involving acoustic monitoring during AM builds will also be described. Layer monitoring applies machine vision and machine learning approaches to address errors in powder spreading and powder fusion, with images of fused layers used to identify when and where melt pool splatter occurs. Multiple tools for melt pool monitoring will be detailed, each involving high speed imaging with a stationary camera. One approach involves the extraction of information directly from melt pool emissions. Another tool involves machine vision and machine learning methods to link melt pool characteristics to flaw formation. The status of using each of these methods for real time control will be summarized.

BIOGRAPHY

Prof. Beuth received his Ph.D. in Engineering Sciences from Harvard in 1992. He has been a member of the Carnegie Mellon faculty since that time. Beuth's research is in the areas of manufacturing, solid mechanics, and fracture mechanics, with over 75 publications across the areas of additive manufacturing, interfacial mechanics, and thin film mechanics.

Prof. Beuth's modeling research in additive manufacturing has led to the development of "process map" approaches for mapping out the role of principal process variables on process characteristics such as melt pool geometry, microstructure, and residual stress. By characterizing AM processes over their full process variable range, his research is allowing unique insights into process control, expansion of process operating ranges, and unique comparisons of AM processes operating in very different regions of processing space.