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Mechanical Properties Modeling for Accelerated Certification of Additive Manufactured Components

Robert Tryon, Animesh Dey - VEXTEC, Brentwood, TN

Dan Matejczyk - Aerojet Rocketdyne, Canoga Park, CA

Abstract

Additive Manufactured (AM) metal properties are affected by many factors. Use in critical applications requires understanding of processing and properties, and requires process control. Development and certification are multi-stage, requiring time and resources. Use of validated models has the potential to enable higher-confidence design properties development, and high-confidence process-control-witness-sample evaluation.

Factors affecting high cycle fatigue (HCF) of Laser Powder Bed Fusion alloy 625 were examined in detail, including AM surface topography. An HCF model was constructed within the framework of VEXTEC's simulation tool VPS-MICRO®. Quality of the simulation was assessed by examining a number of alloy 625 variants. Model inputs were developed for each variant, and simulation results were compared to experimental HCF data.

Results show that the simulation is able to calculate HCF lives, predict differences in lives among the sample groups, and inform concerning the most important microstructural and topography features affecting HCF life. Potential time savings for an accelerated certification process are estimated and compared to current typical timelines for complying with NASA-STD-6030.