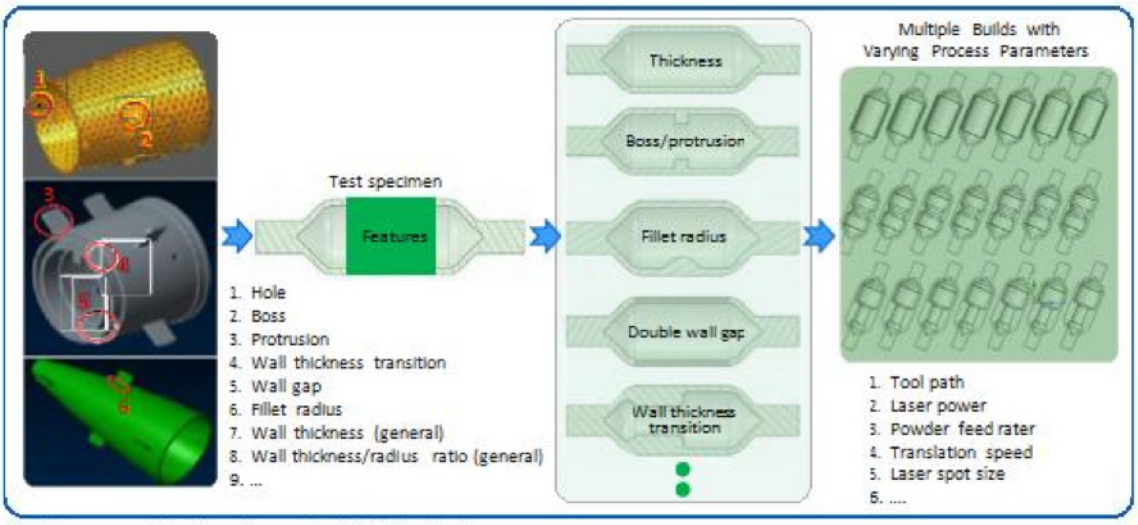
PROJECT SUMMARY 3011

MAMLS Feature-Based Qualification Method for Directed Energy Deposition Additive Manufacturing



An example of a feature-based qualification test process where multiple samples are printed in a single build with varying process parameters to capture different additively built characteristics and feature geometries.

PROBLEM

It can take several years to go from concept to production for components produced by additive manufacturing (AM). The flexibility of the AM process allows for build customization including build strategy, process conditions, etc. This leads to long iterative evaluation cycles—build strategy, printing parts, post processing, dimensional inspection, material performance, and functional performance—which greatly increases the time and cost of substantiating the process and component.

OBJECTIVE

The objective of this project is to improve the speed and confidence of directed energy deposition (DED) process qualification by identifying application space, process technology, and materials; developing and validating feature-based build qualifications (FBQ) by cataloging features, build process parameters, additive characteristics, and material property relationships; deploying the FBQ catalog for design engineering; and process qualification.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

VALUE CHAIN

ASTM PROCESS CATEGORY: Directed Energy Deposition

EQUIPMENT: RPM 557

MATERIAL: Ti-6Al-4V

TECHNICAL APPROACH

GE Global Research Center (GEGRC) is focusing on developing FBQ by first identifying part-based critical features (including engineering and performance requirements), testing protocols, and printing specimens, thus establishing additive characteristics and performance measurements. In addition, probabilistic modeling and efficient sampling are being developed for a performance catalog based on FBQ methodology.

GE Bayesian Hybrid Modeling framework (GEBHM) in conjunction with Intelligent Design Analysis of Computer Experiments (IDACE) is being used to build predictive models of each feature for the relationship between process parameters, additive build characteristics, and material performance. Implementation efforts include defining the application space, process technology and materials; generating hybrid probabilistic models relating feature performance to process; and deploying hybrid models to the engineering community. Training development and pilots are also planned.

PROJECT START / END DATE

June 2018 - June 2020

EXPECTED DELIVERABLES

- Detailed guidelines for general feature-based decomposition and validation for GE Aviation and Raytheon use cases
- Standard test geometry definition
- Process definition for RPM / Ti6-4 and samples for predictive model population
- Samples for feature-based qualification methodology validation
- Screening level data to EWI to guide process definition
- Detailed property and quality data to generate the predictive model
- A predictive model for Ti6-4 on RPM platform— capable of predicting feature performance as a function of feature type to assist with component design
- A predictive model for Ti6-4 on RPM platform— designed to guide process and part qualification work scope
- A concise deployable packet of training information that can be distributed to America Makes, USAF, and DoD supply chain partners
- Two hands on training sessions and two virtual training sessions

FUNDING

$3.7M total project budget
($2.5M public funding/$1.2M private funding)

PROJECT PARTICIPANTS

Project Principal:
GE Global Research Center

Project Participants:
Raytheon
EWI
Youngstown State University
GE Aviation

Public Participant:
U.S. Department of Defense

NCDMM Headquarters
486 Cornell Road
Blairsville, PA 15717
Phone: (724) 539-8811

Letterkenny Offices
4755 Innovation Way
Chambersburg, PA 17201
Phone: (717) 553-0068

America Makes Offices
236 West Boardman Street
Youngstown, OH 44503
Phone: (330) 622-4299

ncdmm.org

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