Active Project (2016 - 2017)

Empirical Optimization of Additive Manufacturing, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

In this Phase I STTR project, pursuant to the Materials Genome Initiative (MGI) and Integrated Computational Materials Engineering (ICME) interests, the proposed collaborative effort between WSU and Advratech will represent the first AM optimization framework of its kind, constructed entirely from experimental sensor data collected in-situ. Rather than using in-process data to inform limited "physics-based" FE models or detect single defects long after a build is complete, this framework will leverage correlations between in-situ data, input process parameters, and output AM build characteristics to construct a "physics-capturing" empirical black box that can be used to quantify AM process uncertainty, analyze sensitivities of AM component outputs to both input process parameters and in-process information, and ultimately, to optimize each layer of SLM builds in real-time. In essence, this project will provide a wrap-around software package and optimization tool that combines each mode of in-process data to inform real-time process parameter selection based on one or more desired physical property outputs. It will be designed on our SLM R&D test bed, be seamlessly applicable to any SLM system (e.g., Concept Laser LaserCUSING, etc.), and more generally applicable to any AM system (e.g., NASA's EBF3) used to construct aerospace components.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: SLM has been identified to manufacture multiple parts on NASA's Space Launch System engine, and our sensor suite is perfectly suited for use with not only any SLM system (e.g., Concept Laser GmbH), but also NASA's EBF3 system. Further, although Concept Laser systems have in-process monitoring capability that can detect and view the melt pool, these have been noted to be inadequate. The in-process data fusion optimization scheme

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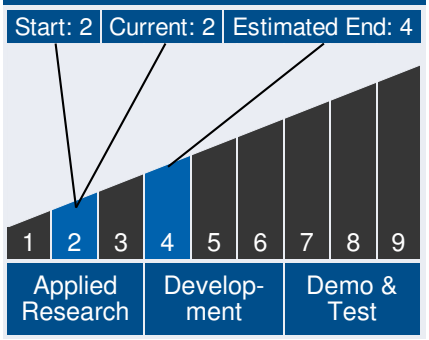
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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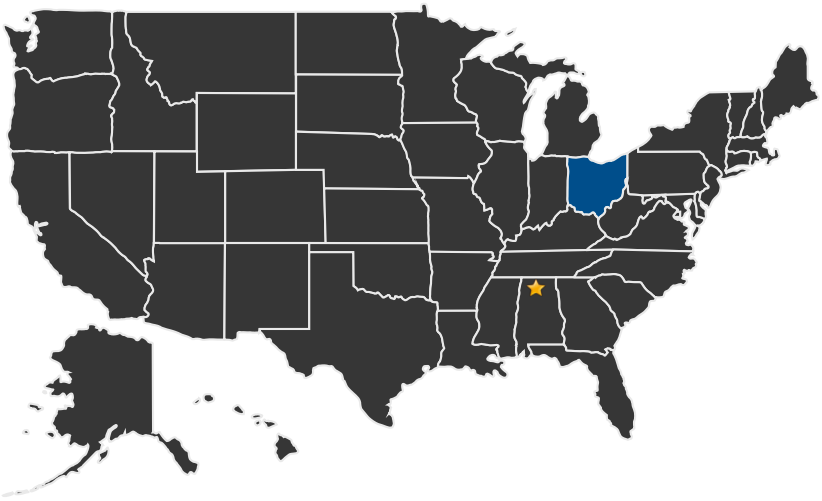
developed here, however, will useful for controlling and improving all AM processes, especially SLM and EBF3.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The correlation of process parameters to nondestructive sensor data and subsequently to build outputs effectively draws a black box around the link between microstructure and properties. Capturing these physics helps bridge this essential gap, effectively reducing the time-to-market required for new material systems. This outcome has far-reaching effects on all industrial applications.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Marshall Space Flight Center

Other Organizations Performing Work:

- Advratech LLC (Dayton, OH)
- Wright State University (Dayton, OH)

Management Team *(cont.)*

Principal Investigator:

- Joy Gockel

Technology Areas

Primary Technology Area:
Materials, Structures, Mechanical Systems and Manufacturing (TA 12)

- Manufacturing (TA 12.4)
  - Manufacturing Processes (TA 12.4.1)

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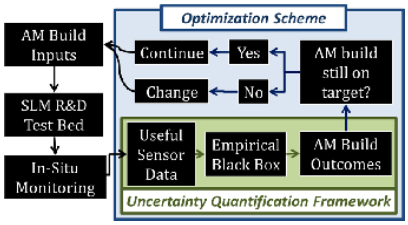
PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23608)

IMAGE GALLERY



Empirical Optimization of Additive Manufacturing, Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

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