Department of the Navy SBIR/STTR Transition Program

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Topic # N151-012

Innovative Approach to Rapidly Qualify Ti-6Al-4V Metallic Aircraft Parts Manufactured by Additive Manufacturing (AM) Techniques

3DSIM LLC

WHO

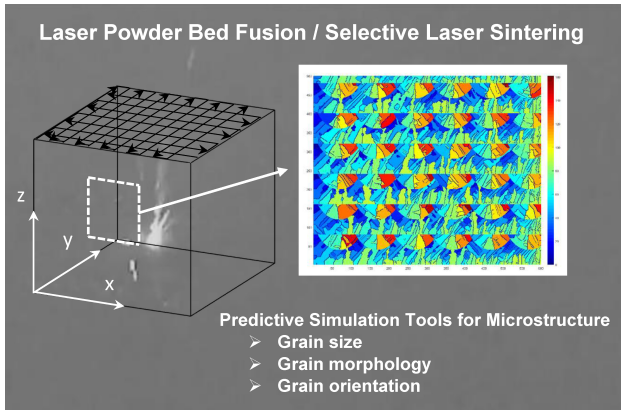
SYSCOM: NAVAIR

Sponsoring Program: PEO (A)

Transition Target: NAWCAD

TPOC:
(301)342-4078

Other transition opportunities: 3DSIM's predictive tools are applicable to any program, industry, government or entity engaging in the design and production of parts using laser powder bed fusion/laser sintering process.



Predictive Simulation Tools for Additive Manufactured Parts: Prediction of Part Microstructure

WHAT

Operational Need and Improvement: New methods and techniques are needed to improve the quality of metallic (e.g. Ti-6Al-4V) Additive Manufacturing (AM) aircraft parts. For AM to truly achieve its potential to rapidly produce qualified worthinesses parts, innovative design,manufacturing and analysis tools are needed to support the design/manufacturing of these parts, and reduce the cycle time for production and testing.

Specifications Required: The material properties of the parts manufactured using AM must be understood and must be repeatable if they are to be used in a safety critical aircraft environment. There is a need to understand how the AM material process variables (i.e. laser power, scanning speed, distance between scanning lines, thickness of deposited layers, energy density, build orientation, cooling rate, powder size and size distribution, laser beam width, etc.) impact the microstructure and hence the related mechanical properties of the alloy.

Technology Developed: 3DSIM is developing a set of user-friendly, cloud-delivered tools to help accelerate production and innovation in metal Additive Manufacturing (AM). Our tools can predict thermal history, phase & state changes, distortion, stress, and defect distributions within a part before it is built. These tools provide users early insight into potential outcomes, saving time and money associated with traditional trial and error experimental methods. Within this project we are expanding our tools to include the AM part's microstructure prediction capability.

Warfighter Value: Predictive simulation tools can dramatically shorten the traditional certification process, or new materials testing processes, allowing AM parts to be rapidly produced and certified for operational use. Additionally, simulation driven methods are aimed at providing a means to rapidly validate the reliability of metal AM part properties.

WHEN

Contract Number: N68335-17-C-0157 **Ending on:** February 7, 2019

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Development of initial algorithm for microstructure prediction	Med	Simulated results were validated with open source published work	3	August 2017
Design of experiment	Low	Successfully printing of 3D part	3	October 2017
Validation of microstructure result with real geometry	Med	Point to point correlation between simulated and experimental microstructure	7	February 2018
Testing of prediction tool in cloud environment	Med	Validation of simulated result with different geometries processed with various parameters	8	October 2018

HOW

Projected Business Model: 3DSIM's primary business model is direct sales (Software as a Service) of cloud-based subscriptions to industry service bureaus, machine OEMs, universities, and R&D organizations engaged building metal AM parts. We have a worldwide re-seller network in place for direct sales in Asia, Japan, UK, and the US. A second model involves developing a joint product with a strategic partner to enhance existing AM workflows. A joint product could bring these predictive simulation tools to market faster utilizing existing partner networks.

Company Objectives: 3DSIM's objective is to commercialize AM predictive modeling toolsets capable of predicting the complex thermal histories, residual stress, support structure design and part qualities such as porosity, surface finish, dimensional tolerance and distortion, etc., for metal AM processes. The predictive tools can save end users time and money by reducing trial and error iterations commonly associated with traditional metal AM. Specific to this program, 3DSIM is developing innovative approach to rapidly qualify Ti-6Al-4V metallic aircraft parts using these predictive tool sets.

Potential Commercial Applications: 3DSIM's predictive tools and innovative approaches to rapidly qualify Ti-6Al-4V metallic aircraft parts can be used to accelerate the FAA certification process as well as the NAVAIR process. Fast qualification will promote a wider acceptance of AM technology within both the military and commercial sector.

Contact: Jon S. Ginn, President
jon.ginn@3dsim.com 435 631 9206