Department of the Navy SBIR/STTR Transition Program

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NAVAIR #2022-789

Topic # N162-083
Rapid, Low Cost, High-quality Component Qualification Using Multi-scale, Multi-physics Analytical Toolset for the Optimization of Metal Additive Manufacturing Process Parameters
Applied Optimization, Inc.

WHO

SYSCOM: NAVAIR

Sponsoring Program: NAVAIR

Transition Target: V-22, H-1, H-53

TPOC: (301) 342-9359

Other Transition Opportunities: PMA 275, PMA 276, PMA 261 for the Additive Manufacturing (AM) of structural parts subject to dynamic loading

3D printed metal part aboard a US Navy Carrier - Photo courtesy of the U.S. Navy. www.navy.mil

Notes: Additive Manufacturing Parameter Predictor (AMP2) is the multi-scale, multi-physics analytical toolset, developed by Applied Optimization, Inc. (AO). AMP2 predicts AM processing parameters to optimize the quality of AM material, with the purpose to attain lower cost and time to perform Integrated Computational Materials Engineering (ICME) for the qualification of AM structural parts. AMP2 brings together the analytical methods developed by AO with support from SBIR programs by NAVAIR, ONR, NASA and Air Force. Using the results generated by AMP2, AO has received five awards in open competitions sponsored by DARPA, NIST, Air Force, and America Makes. AO has used AMP2 to support our various commercial projects for the last ten years.

WHAT

Operational Need and Improvement: The Navy operational need is to enable rapid qualification of AM structural parts. The multi-scale, multi-physics analytical toolset is needed to reduce the cost and time needed for ICME to optimize the AM process, and produce high-quality, as-built materials for complex geometry structural parts. Widen the supplier base to AM structural parts.

Specifications Required: Demonstrate ICME models to support rapid qualification of AM structural parts produced using legacy alloys (e.g., Ti-6Al-4V) and new alloys (e.g., Scalmalloy).

Technology Developed: AO has demonstrated analytical toolset, simplifying and streamlining the procedures, to reduce the cost and time needed for ICME to produce a higher-quality Ti-6Al-4V AM structural part with no surface-connected defect indications and significantly reduced defects in the interior of the part. AMP2 demonstrated procedures to analyze the experimental data and determine the process corrections to be applied to enhance part quality. The current work is to apply the analytical toolset to produce a Scalmalloy AM structural part with higher mean and lower variance for its fatigue limit.

Warfighter Value: Ability to attain consistent, high fatigue properties for AM structural parts for the sustainment of existing Navy systems, and for the demonstration of new-generation of AM structural, complex parts of legacy and novel alloys.

WHEN

Contract Number: N68335-19-C-0299 **Ending on:** Nov 28, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Demonstrate higher quality AM structural part, produced using alloy Ti-6Al-4V	N/A	Completed	6	1st QTR FY21
Demonstrate higher quality AM structural part, produced using Scalmalloy	Low	In progress	5	1st QTR FY23
Demonstrate higher mean and lower variance for fatigue limit of the AM structural part produced using Scalmalloy	Medium	In progress	4	3rd QTR FY23

HOW

Projected Business Model: There are four elements to the business model: (1) Use Simulation to Optimize AM process and Estimate Fatigue Limit, (2) Demonstrate consistent and higher fatigue strength, prepare fatigue testing plan, (3) Demonstrate ability to reduce the testing required for AM part qualification, (4) Demonstrate ability to enlarge the supplier base to produce higher-quality AM parts

Company Objectives: Reduce the time and cost for the qualification of AM structural parts by a third using ICME to attain higher mean and lower variance for fatigue limit of AM structural parts.

Potential Commercial Applications: ICME to produce smaller, intricate structural parts, with a requirement for durability while subject to dynamic loading at elevated temperatures (e.g., parts in industrial machinery subject to vibratory loads)

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