Topic: N16A-T022

Senvol LLC

Using Machine Learning to Reduce Cost and Time to Qualify Additive Manufacturing Processes
Current methods used to qualify additive manufacturing (AM) materials and processes during manufacturing are expensive and time-consuming. Senvol is developing data-based machine learning software that supports the qualification of AM processes, machines and materials, rapidly optimizes process parameters, predicts material properties of components, supports quality assurance, and minimizes data generation costs. The software can be applied to any AM process or material and has been prototyped and functionality verified. Sustained competitive advantage is provided as this technology significantly decrease AM data generation costs such that qualification of AM components can be achieved faster and with fewer resources. Our goal is to integrate and transition this technology into government and prime contractor systems that enable the adoption and deployment of AM.

Technology Category Alignment:

Computational Research Engineering Acquisition Tools and Environment
Design and Integration
Manufacturing Technology for Affordability
Structures and Protection

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SYSCOM: ONR
Contract: N68335-18-C-0084

Booth: 405
Room: FST at AIAA Aviation 2020
Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-18-C-0084

Department of the Navy SBIR/STTR Transition Program

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ONR Approval #43-5915-19

Topic # N16A-T022

Integrated Computational Material Engineering Approach to Additive Manufacturing for Stainless Steel (316L)

Senvol LLC

WHO

SYSCOM: ONR

Sponsoring Program: ONR

Transition Target: NAVAIR

TPOC:
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Other transition opportunities:
Senvol's software is useful for the DoD and private sector in generating additive manufacturing (AM) data and qualifying additively manufactured parts more efficiently than current methods. To accelerate transition, Senvol is currently running an Alpha program whereby select organizations have been given access to the software's capabilities. Alpha participants span various industries, including DoD, aerospace, medical, AM machine manufacturer, AM material supplier, and automotive.

Notes: The three surfaces (red, yellow, purple) indicate what AM machine process parameters should be used in order to achieve a target material density. All points on the surface would allow the build to achieve the target material density. This image is from data analyzed for the U.S. Navy.
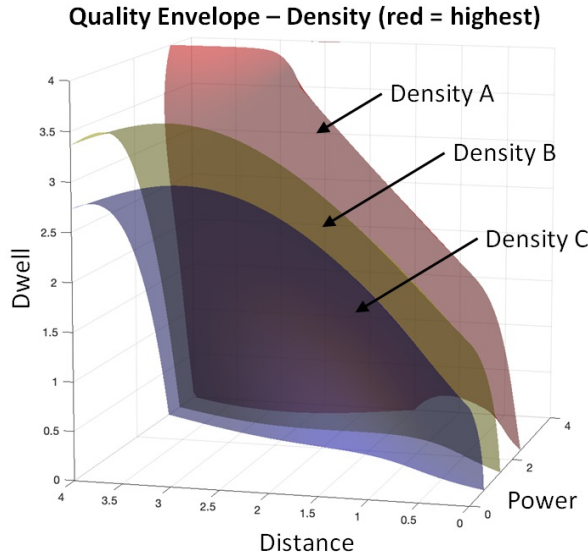

Quality Envelope – Density (red = highest)

Density A
Density B
Density C
Dwell
Distance
Power

Image courtesy of Senvol LLC, Copyright 2019

WHAT

Operational Need and Improvement: Parts no longer in production are expensive and time consuming to procure due to increased restart costs and low volume requirements. AM is one solution to this issue. Senvol's machine learning software (Senvol ML), which can be applied to any AM process or material, ties the processes that produce parts to their material properties to ensure the design of the right material for an application. This reduces the cost and time to qualify AM created parts over the current methods, further enhancing operational availability and decreasing total ownership cost.

Specifications Required: The software tool must model, simulate, and predict part quality and performance based on input process parameters including local composition, microstructure, residual stresses and/or distortion, and mechanical properties. The tool should be developed and validated to: predict production reliability; model accurately AM processes and part fabrication; quantify dimensional, microstructural, and mechanical property uncertainty; predict residual stress and distortion; predict number, percent, and location of defects; support optimal build strategy selection; predict resultant microstructure and resultant material properties; assess part functionality; provide rapid qualification probabilistic framework; establish output upper and lower limits for key process parameters to ensure quality in process controls during later fabrication.

Technology Developed: Senvol ML is machine learning software for AM that will be used to support qualification of any AM process, machine and material, rapidly optimize AM process parameters, predict material properties of AM components, support quality assurance, and minimize AM data generation costs. The software has been prototyped and functionality validated. Sustained competitive advantage is provided as this technology allows users to significantly decrease their AM data generation costs such that qualification of AM components can be achieved faster and with fewer resources.

Warfighter Value: The Navy's supply chain is a massive, complex undertaking – shipping material across the globe. Mission Capability rates are directly impacted by the accessibility to spares. AM is one method to provide out of stock or out of production parts in a timely manner. This technology further drives down the cost and time in procuring qualified parts – possibly allowing for production at any site with AM production capability. This technology further reduces AM qualification time and cost over current methods providing further incentive to increase adoption of AM as a logistic enabler of combat readiness.

WHEN

Contract Number: N68335-18-C-0084   **Ending on:** November 13, 2019

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Proof-of-concept demonstrated	N/A	Successful demonstration of capabilities on AM data	3	2nd QTR FY17
Developed advanced suite of additional capabilities	Low	Almost all capabilities have been demonstrated and validated; additional validation efforts ongoing	4	2nd QTR FY19
Testing of software with Alpha participants	Low	All Alpha participants have been onboarded and initial feedback from the software's analysis has been very positive; efforts ongoing.	5	3rd QTR FY19
Software fully developed and deployed	Med	Front-end developed and the software available for download	5	1st QTR FY20
If Option exercised, transfer learning capability developed and integrated into the software	Med	Validation of transfer learning capabilities on empirical AM data	6	1st QTR FY21

HOW

Projected Business Model: Senvol's software will be licensed directly (e.g. on a per seat basis) to customers within the DoD as well as the commercial sector.

Company Objectives: Senvol is the global leader in data for AM. Senvol has unique expertise in developing pedigreed AM data and in providing software tools to analyze such data. Customers/users include organizations within the DoD and the commercial sector. Senvol intends to continue to further develop this software and make improvements to meet customer requirements. For the FST event, Senvol would like to connect with interested transition partners in the DoD (i.e. who are using AM technology).

Potential Commercial Applications: The application of Senvol ML to the design of AM will help speed new materials and processes, where AM is appropriate, to reduce the time and cost of process/part qualification and certification. This applies not only to DoD entities, but to the commercial sector as well. Senvol's current Alpha users of the software, as well as other future potential commercial customers, include companies in aerospace, defense, oil & gas, consumer products, medical, and automotive industries, as well as AM machine manufacturers and AM material suppliers.

Senvol has received various letters of support from DoD organizations and aerospace and defense companies who see value in Senvol's machine learning software and are interested in participating in transition.

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