Department of the Navy SBIR/STTR Transition Program
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NAVAIR 2023-0071

Topic # N202-117
Optimized Subtractive Manufacturing - Right Parts, Right Time, Every Time
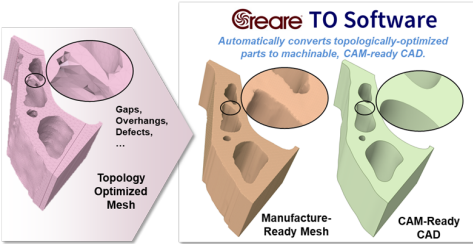Creare LLC

WHO

SYSCOM: NAVAIR

Sponsoring Program: NAVAIR

Transition Target: Automated Machining and Advanced Manufacturing

TPOC: (301) 342-8166

Other Transition Opportunities:

Notes:

Creare LLC 2022

WHAT

Operational Need and Improvement: Currently across the DoD and commercial sector, a part "optimized" for strength, stiffness, and weight is achieved using a tedious, multi-step process. Typically, optimization is conducted through a series of iterative design/engineering analyses, yet in some instances topology optimization is used. Existing FEA software lacks the ability to enforce constraints associated with subtractive manufacturing such as tool access and tool path. In addition, file outputs from topology optimization software is often highly tessellated and very difficult to modify and/or import into CAM software. Creare's Topological Optimization Software (TOS) package will interface with existing FEA software, enforce the necessary subtractive manufacturing constraints, and output CAM ready CAD files for CNC machining.

Specifications Required: Navy seeks the development of a software package that performs optimization for strength, stiffness, and weight as goals while using machinability as a constraint, with output from CAD in the form of a common platform independent file type. The output should be optimized for the chosen objective and be machinable by multi-axis mill and/or lathe.

Technology Developed: Our technology makes parts designed via Topology Optimization (TO) FEA machinable. While TO generates optimized part designs, it is rarely used because the generated parts cannot be physically machined using subtractive methods and the mesh files produced by the method do not integrate with existing machining software. Our software bridges this gap, making the use of TO designed parts practical.
Creare's software uses state-of-the-art level set algorithms to automatically identify areas of the models that violate subtractively manufactured constraints and then modifies the geometry to make the part machinable. We then combine level set algorithms with deep neural net machine learning for a robust, efficient, and automated solution for converting the corrected model to a CAM-ready CAD format.

Warfighter Value: Our innovation reimagines how parts are designed, enhancing the "user experience" as the tool will save time, money, and relieve user frustration.

WHEN

Contract Number: N68335-22-C-0212   **Ending on:** Apr 08, 2024

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Developed a Machinability Module to enforce machining constraints for 3-axis mills	Medium	Module validated	3	3rd QTR FY21
Developed Mesh-to-CAD Moduleto convert meshes to parametric CAD	Medium	Module validated	3	3rd QTR FY21
Conducted an end-to-end demonstration	Medium	Module validated	4	1st QTR FY22
Extend Machinability Module capabilities to 4- and 5-axis mills	Medium	Module validation	5	2nd QTR FY24
Mesh-to-CAD Module improved via Machine Learning to handle highly complex files	Medium	Module validation	5	2nd QTR FY24
User interface (UI) developed	Low	UI validation	5	2nd QTR FY24
Alpha version software testing by the Navy	Medium	Feature requests complete	6	4th QTR FY24
Beta version software testing by the Navy	Low	Set of feature requests and bug report	6	1st QTR FY25
Integrate into ANSYS ACT	Low	Available download	6	2nd QTR FY25

HOW

Projected Business Model: 1. Sell or license our software to Mechanical FEA software providers to integrate into a suite of customization toolkits. Software providers will take ownership of our software and make refinements for future releases. 2. Make the software available online as a pay-per-use basis. We will use the generated revenue to address bugs and make refinements.

Company Objectives: Overall Company Objective: To develop and transition technology to the warfighter and commercial market.

Project Specific Objective: Develop software with a streamlined user experience to produce topologically optimized (TO) geometry subject to subtractive machining constraints with a CAM-ready CAD output file.

Potential Commercial Applications: The global computer aided engineering market size was $8 billion in 2021, with a CAGR of 9.2% over ten years. This market includes FEA (ANSYS, Dassault Systems, Altair, etc.), CFD, multibody dynamics, and optimization software. Companies in this market are continually developing new software capabilities, and may have an interest in our software solution.

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