Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2020-870

Topic # N162-087
Onsite Structural Restoration Methods for Aircraft Components
Product Innovation and Engineering L.L.C.

WHO

SYSCOM: NAVAIR

Sponsoring Program: PEO (A)

Transition Target: PMA-276, H-1 USMC Light/Attack Helicopters

TPOC:
(301)757-9639

Other transition opportunities:
Fleet Readiness Centers (FRC)
Primes – Boeing, Bell Helicopter, GKN, and Toyota

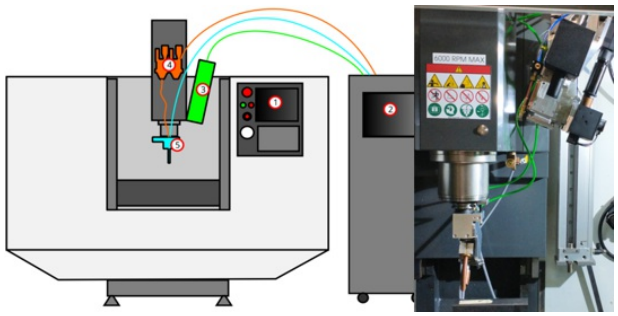

Photo Courtesy of Product Innovation and Engineering (PINE) An illustration showing the general layout of the major items in the repair system: 1. CNC; 2. Deposition Controller; 3. Optics assembly; 4. Powder feeders; 5. Powder tool with photo of items 3,

Notes:
CW – Continuous Wave
AM – Additive Manufacturing
PC – Personal Computer
CAM – Computer Aided Manufacturing
CNC – Computer Numerical Control
DED – Directed Energy Deposition
FPGA – Field Programmable Gate Array

WHAT

Operational Need and Improvement: Aircraft designed for today's Navy are being pressed into service beyond their design life resulting in an increase in failure rates of parts. There is a need for precise and effective methods for full dimensional and strength restoration of aircraft components to reduce the Total Life Cycle Cost and improve Operational Availability of Navy aircraft.

Specifications Required: The system is to repair metallic aircraft components. Repairs generally include blending away damage until the surface is smooth to reduce stress risers that may cause fatigue cracking. By blending, repaired components are left with a lower thickness in the repair location which reduces the ability for future repair capability. The restoration method should result in a component with the same strength capability as an original non-damaged component. In addition, the resulting restoration method should be environmentally friendly, not require the use of hazardous materials, and should not generate or require the disposal of hazardous wastes, such as chromate containing primers and coatings.

Technology Developed: The repair system consists of three primary subsystems:
1. The additive controller includes two powder feeders, a high power CW laser, a q-switched pulse laser, a FPGA for timing-critical control actions, and a PC for on-board CAM, simulation, and managing connectivity to external devices such as cameras or spectrometers;
2. A third party motion system to execute the part program and carry out investigatory probing;
3. An end effector for delivering the combined laser beams and powder stream at a fixed point in space.

AM repair software integrates inspection, CAM, and simulation.

Warfighter Value: The Repair System developed by PINE:
- Reduces Maintenance Costs
- Improves Operational Availability
- Extends Life Cycle Costs of Airframe
- Utilizes Additive Manufacturing

WHEN

Contract Number: N68335-18-C-0603

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Powder Feed Subsystem	Med	Powder delivered on demand at the requested rate.	TRL 6	May 2019
Integral AM CAM system	Low	Computation of AM CAM plan from within the AM controller.	TRL 6	August 2019
Powder Delivery Subsystem	Med	Powder and shield gas delivery to the work position at appropriate linear velocities.	TRL 4	October 2020
AM Controller Subsystem	Med	Control over all external equipment: CW laser, pulse laser, powder feeders, galvo, gas settings, and sensors	TRL 6	October 2020
CNC AM control macros	Low	Ability to express AM intent from within G-code.	TRL 4	February 2020
Repair Application software	Med	Successful demo repair	TRL 4	August 2020

HOW

Projected Business Model:
PINE is considering multiple paths to commercialize our product. Since we designed our repair system in a modular fashion there are multiple options for deployment.

We can sell the system as an entire unit.
We can sell the system to 3rd parties as modules for their custom integration.

We have used our proven additive controller on several internal projects as it provides a fast, flexible avenue for adding AM and/or laser processing abilities to our CNC machines or robots.

Company Objectives:
Depending on the route finally taken to commercialization, PINE has begun discussing spinning off a new manufacturing venture and licensing the technology to Prime vendors.

Potential Commercial Applications: In addition to the aircraft part repair application, the repair system would be applicable to heavy machinery and tooling repair. The submodules of the repair system have more market potential, such as DED production or laser cutting applications.

Contact: Todd Sparks, Principal Investigator
toddesparks@mopine.com (573)612-1352