

CTMA TECHNOLOGY COMPETITION 2023

**Multifunctional
Automated Repair
System (MARS)
Takes Home
Top Prize
in 2021**

**2023 Finalists: Six
Technologies to
Change the Face of
Maintenance
and Sustainment**



The Commercial Technologies for Maintenance Activities (CTMA) Program is administered through the National Center for Manufacturing Sciences (NCMS). Founded in 1998, CTMA has grown into a direct service-funded program that finds solutions to DOD maintenance needs.

For the DOD maintenance and sustainment communities—we enable you to engage face-to-face with technology innovators.

NCMS

Technology Showcases

- Engage with solution providers
- Try out innovative technology
- Get answers to your pressing questions

Learn from solution providers how they can solve your M&S challenges.

At NCMS Technology Showcases, you request the M&S solutions most needed by your facility. Our industry and academic partners exhibit how their technologies can meet your needs. Give your maintainers an opportunity to interact firsthand with next-generation technology solutions.

To learn more about hosting a Technology Showcase at your facility, contact EventInquiry@ncms.org



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The CTMA Technology Competition: Discovering Next-Generation Sustainment Solutions

**Debbie Lilu, NCMS Vice President, Maintenance & Sustainment,
Business Development**

The 2023 CTMA Technology Competition has generated widespread interest, with 56 entries submitted by NCMS's collaborative network of government, academia, and industry experts. The competition supports the National Defense Strategy by highlighting innovative technologies that improve the readiness of the DOD's weapons systems and transport capabilities. All projects aim to make maintenance and sustainment operations more agile, effective, and affordable, contributing to the strength of America's fighting forces.

DOD sustainment planners keep a close eye on the CTMA Technology Competition because the technologies submitted in this competition have the potential to be adopted in industry and implemented across the DOD. When DOD sustainment planners need problems solved quickly and effectively, the CTMA Program is uniquely able to assist by providing access to NCMS's trusted network of industry and academic partners.



The 2021 CTMA Competition Overall Winner, the Multifunctional Automated Repair System (MARS), created by the Penn State University Applied Research Lab, is demonstrated during the Navy's Repair Technology Exercise (REPTX) event in 2022 aboard a Self Defense Test Ship off the coast of California. (Photo by Jhon Parsons.)

CTMA allows the DOD to evaluate, demonstrate, and validate innovative solutions to ensure they will be beneficial and cost-effective in sustainment operations before moving to wider usage.

Sustainment professionals will find the CTMA Program provides an opportunity for streamlined rapid execution technology demonstrations and validations. Objective outcomes include

durability, energy efficiency, lightweighting, maintenance avoidance, and improvements in life-cycle management, reliability, safety, and survivability. Since its founding, CTMA has executed 733 projects, received 17 awards for innovation, applied \$75 million in OSD and Congressional funds and \$1.5 billion in service-directed funds, contributed \$143 million to industry cost share, accomplished a 92%

technology transition rate since 2005, and is projected to save the DOD \$8 billion.

Entries in the CTMA Technology Competition will enjoy wide exposure to a large and interested audience of important decision-makers. For commercial partners, participating in the CTMA Technology Competition enables them to build relationships with NCMS's extensive collaborative network, which has served the technological needs of our government partners for over three decades. Additional advantages include reducing R&D costs, decreasing time between innovation and production, accessing opportunities for commercialization, solving specific industrial problems, and creating profitable new products and processes.

For DOD partners, the CTMA Technology Competition introduces them to not only new technologies, but also new providers that possess relevant technical expertise and cutting-edge capabilities. The competition offers the DOD a chance to bring new innovators into the CTMA pipeline, providing it with a well-honed project management process and a streamlined business process (60-90 days from cradle to execution).

"The CTMA Technology Competition is important because it raises awareness among government and industry partners about upcoming innovations

and capabilities," said Greg Kilchenstein, NCMS Chief Technologist. "Also, it shows that NCMS is investing \$100,000 to demonstrate those technologies for maintenance and sustainment operations."

This year's submissions to the competition have been judged by the principals of the Joint Technology Exchange Group (JTEG), a collaborative group formed by the DOD to improve coordination in the introduction of new or improved technology, new processes, or new equipment into DOD depot maintenance activities. (See pages 8–11 for more information about JTEG and its principals.) The entries range across all the CTMA technology focus areas: Advanced/Additive Manufacturing; Business IT and Decision Analytics; CBM+/Predictive Maintenance; Coatings and Corrosion Prevention; Energy, Environment, Health and Safety; Enhanced Inspection; Facilities and Industrial Process Modernization; Reliability Improvement; and Workforce Development and Visualization.

Finally, no matter who wins, this competition is providing exposure to each participant,



The 2021 CTMA Competition People's Choice Award Winner: Industrial Internet of Things Batteryless Energy-Harvesting Sensors, created by Everactive.

as the competition booklet you are viewing here has been made available to the public in print and on the NCMS website. Even greater exposure will go to the competition's six finalists (see pages 12–13 for a complete list), scheduled to present their innovative solutions at the 2023 CTMA Partners Meeting. During this event, an overall award winner and a People's Choice award winner will be announced, and each will be awarded \$50,000 in project funding. This funding will go toward a selected DOD demonstration activity, to the extent permitted under the existing CTMA cooperative agreement. The technologies submitted in this competition have the potential to be adopted in industry and implemented across the DOD, enabling the rapid transfer of knowledge, experience, and know-how to ensure the continued strength of America's industrial base.

Meet The Judges:

The Joint Technology Exchange Group Principals

The JTEG is a DOD-run collaborative group created to improve coordination and information exchange between the military services, military agencies, industry, and academia. It focuses on the introduction of new or improved technology, new processes, or new equipment into DOD maintenance activities. The group is overseen by a panel of representatives from each of the military services, the Defense Logistics Agency, the Joint Chiefs of Staff, and the Office of the Deputy Assistant Secretary of Defense for Materiel Readiness.

The JTEG seeks ways to better leverage technology improvements in maintenance through collaboration to support the higher DOD goals of improving effectiveness and efficiency. Its mission includes:

- Providing a forum for the exchange of information on new technology, processes, and equipment developments within the DOD maintenance community

- Collecting, analyzing, and disseminating DOD maintenance requirements for new technology, processes, and equipment
- Serving as an advocate for new technology or equipment with cross-service potential to increase efficiency

The JTEG community includes anyone in DOD or industry interested in exchanging information associated with DOD maintenance. The group is overseen by a panel of representatives from each of the military Services, the Defense Logistics Agency, the Joint Chiefs of Staff, and the Office of the Deputy Assistant Secretary of Defense for Materiel Readiness – (ODASD-MR).

The JTEG conducts virtual monthly technology forums that provide opportunities for the DOD maintenance community to exchange information and share ideas.



Stephen McKee
*Director, Enterprise
Maintenance Technology
ODASD (Materiel Readiness)*

Mr. Steve McKee is the Director of Enterprise Maintenance Technologies with the Deputy Assistant Secretary of Defense for Materiel Readiness. He comes to this role after 18 years working with the Navy sustainment organizations and 13 years in uniform as an Army engineer. No stranger to the NCMS community, Mr. McKee possesses an understanding of the challenges facing our sustainment communities and a keen desire to partner with all those who can help improve the readiness.

Bill Baker
*Lead Engineer, Maintenance
Management Center
Marine Corps Logistics
Command*

Bill Baker served as production engineer at the Marine Depot Maintenance Command for twenty-six years. He is currently assigned as the Lead Engineer for the Depot Maintenance Division, Marine Corps Logistics Command Albany, GA. He is responsible for providing engineering guidance, technical support, and technology insertion for all Marine Corps depot maintenance including workload executed at other through service depots and commercial sources.



Joseph Sparks
*Lead, Advanced Technology &
Innovation Commander Fleet
Readiness Centers (COMFRC)*

Mr. Joseph Sparks was selected as the Advanced Technology & Innovation (ATI) Lead for Commander Fleet Readiness Centers (COMFRC) in Oct 2017. As the national ATI lead, he coordinates technology development projects between the Industrial Fleet Readiness Centers. He has 20 years of work experience in Naval Aviation.



Janice Bryant
*Strategic Technology
Manager, Naval Sea Systems
Command (SEA 05T1) NAVSEA
JTEG Co-Principal*

Ms. Janice Bryant is currently the Sustainment Technology Manager for NAVSEA 05T and is a long term principal for the Joint Technology Exchange Group (JTEG). Janice began her career as an engineer in the Naval Shipyards, and has added extensive experience during the last 25+ years across NAVSEA sustainment. She directs a \$25M portfolio focused on rapid development and fielding to assess, maintain and repair our fleet. She is always ready to share, consider, guide, think and engage to #GETSHIPSDONE.

Sean Coghlan
*LDivision Chief, Engineering,
Technology, and Technical
Policy Directorate of
Logistics, Civil Engineering,
Force Protection, and Nuclear
Integration Air Force Materiel
Command, Wright-Patterson
AFB, USAF JTEG Principal*

Mr. Sean Coghlan is the newly assigned Engineering, Technology, and Technical Policy Division Chief with the Air Force Materiel Command's Logistics & Nuclear Integration Directorate. Prior experience adds up to 20 years across many Directorates in the Air Force Research Laboratory, including Branch Chief for Material State Awareness for aircraft and propulsion structures and coatings sustainment. Mr. Coghlan's current position collaborates across the full range of Air Force system and infrastructure sustainment, technology insertion, and policy to improve combat capability.



Edilia Correa
*Chief/Process Owner,
Technical & Quality Assurance,
J344 Defense Logistics Agency,
Organic Manufacturing, DLA
JTEG Principal*

Ms. Edilia Correa has been in DLA since 2002 and is the Chief of the Technical and Quality Assurance (TQ) Division and TQ Process Owner at the Defense Logistics Agency. Ms. Correa is responsible for establishing policy and procedures regarding the technical, engineering and quality assurance requirements for the parts the Agency procures, manages and delivers to DOD and other federal customers. She has over forty years of experience working with technology and innovation including assignments as test engineer, Senior Technology Marketing Representative, branch chief and division chief in the Engineering Directorate, DLA Aviation, and Chief, DLA HQ Technical Programs Branch.

Eric Linderman

Army Deputy Sustainment Technology Executive, Office of the Deputy Assistant Secretary of the Army, Acquisition Policy and Logistics, US Army JTEG Principal

Mr. Linderman's diverse experience includes serving as the Army's Deputy Corrosion Control and Prevention Executive in the Office of the Deputy Assistant Secretary of the Army for Sustainment, fulfilling the Army's statutory responsibilities of addressing corrosion. His service also includes prior positions with the Department of Defense Education Activity (DoDEA), the National Aeronautics and Space Administration (NASA), the National Geospatial-Intelligence Agency (NGA), the Joint Improvised Explosive Device Defeat Organization (JIEDDO), US Special Operations Command (SOCOM), and the United States Patent and Trademark Office (USPTO).



Debbie Lilu

Vice President, Maintenance and Sustainment, Business Development, and Commercial Technologies for Maintenance Activities (CTMA) Program Principal, National Center for Manufacturing Sciences (NCMS), Industry JTEG Principal

Ms. Lilu has over 35 years of experience in the automotive and aerospace industries and working with the Department of Defense. Ms. Lilu has extensive expertise in managing complex, collaborative technical projects and understands how to bring new technology to commercialization. She has identified and developed new funding sources, augmenting program resources and monitoring project performance through implementation and commercialization. She has a proven track record leading a team for securing over \$2B in funding across all of the armed services.

JTEG TECH FORUM

The JTEG Technology Forum is a monthly venue that's free and open to the public, which provide opportunities for the DOD maintenance community to exchange information and share ideas. The forums, hosted on the Zoom-Gov platform, feature a different maintenance topic each month. The following schedule lists the remaining JTEG Technology Forums for 2023:

Emerging Technologies
(Lower TRLs)
June 27, 2023, 1–3 p.m.

Automated Test Systems
July 25, 2023, 1–3 p.m.

MILSVC Forum (AFMC/AFRL)
August 29, 2023, 1–3 p.m.

Big Data Analytics
September 26, 2023, 1–3 p.m.

Facilities Maintenance
October 31, 2023, 1–3 p.m.

Advanced Wiring Inspection
Capabilities
November 28, 2023, 1–3 p.m.

Laser Coating Ablation
(Removing Paint with Lasers)
December 19, 2023, 1–3 p.m.

To join these upcoming Technology Forums, visit: jteg.ncms.org/events.

2023 Finalists

Advanced Sphere Brake (SB) Kits

Sphere Brake Defense Inc.

Sphere Brake Defense, Inc. has developed, integrated, and track-tested the bolt-on Sphere Brake (SB) Kit for the Stryker, the Family of Medium Tactical Vehicles (FMTV), and an amphibious combat vehicle. The SB Kit uses hydraulic pressure to compress hemispherical brake pads against a spherical brake surface, which requires a smaller brake effective diameter to generate the same force requirement. The kit is designed to bolt-on to existing ground tactical vehicle wheel-ends and doesn't require any tools or wheel removal to change the brake pads. It is scalable to numerous vehicle platforms and can integrate with antilock brake systems and central tire inflation systems.

See page 68 for complete submission.



Nano Hybrid Polyurethane (NHP®) Coating

ToughGuard HP Coatings, LLC

NHP® is an industrial coating designed to enhance, restore, and extend the service life of freshly coated and oxidized painted surfaces by 10 years. Unlike conventional coatings, NHP penetrates deep into the pores of newly painted or highly oxidized paints to dramatically improve corrosion resistance, scratch and chipping resistance, chemical and long-term UV resistance. NHP coatings are designed to be applied over conventional paints, are impervious to water and oxygen, and protect painted metal surfaces. It is manufactured using proprietary 3D nano-structured polymers producing extreme crosslink density. NHP is a one-component (1K), humidity cured, polyurethane / polyurea hybrid nano-coating that penetrates and forms a hard, protective, clear, topcoat surface.

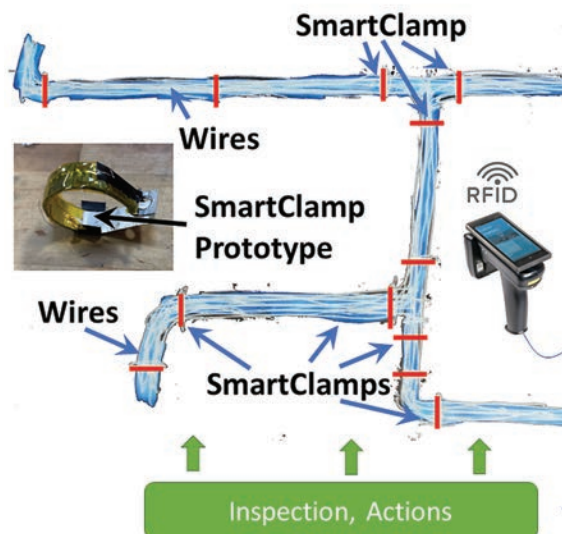
See page 36 for complete submission.

SmartClamp

Midé Technology Corp.

Midé Technology has developed a self-powered, radio frequency identification (RFID)-capable, user-programmable, patent-pending technology we call SmartClamp to combat electrical wiring interconnection system (EWIS) chafing issues. In addition to performing normal clamping functions, SmartClamp autonomously monitors, stores, and reports abnormal chafing/vibrations issues it detects during system use. To accomplish this, RFID scanning is completed periodically to transfer clamp information to the SmartClamp system, which notifies maintainers of the anomaly. The system's software allows users the ability to program clamp detection levels and customize software dashboards, system reports, and data analytic algorithms, giving users complete control of installation and system monitoring.

See page 32 for complete submission.





Tech Companion

Modest Tree

Tech Companion is an interactive solution that integrates emerging digital in-service technologies for equipment readiness. The stand-alone software modernizes the maintenance processes for complex assets, enabling technicians to access information on-the-go to support repairs and reduce maintenance backlogs. Technicians access the software on their PCs, tablets or mobile devices, providing them with data reporting and analytics capabilities that track their completion of maintenance tasks. They also gain immediate access to digital work orders, maintenance manuals, and other support documentation; remote expert video support with AR markup tools; and training in 3D formats to review operational steps.

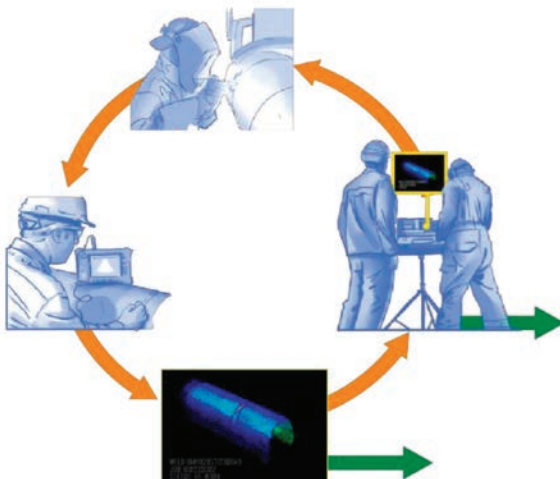
See page 76 for complete submission.

Ultrasonically Activated De-Paint (UADP) Technology

United States Air Force

The Air Force Life Cycle Management Center worked collaboratively with IBC Materials and Technologies and the University of Dayton Research Institute to develop an environmentally friendly, aqueous-based ultrasonically activated de-paint process (UADP) that completely removes top-coat and primer on aircraft components with complex geometries—without damaging underlying anodized coatings. The process removes paint coatings in sizable, easy to dispose pieces and only requires three steps: basic preclean/degrease, ultrasonic agitation, and final pressure wash. Use and disposal of hazardous chemicals and plastic media is eliminated, worker protective measures are minimal, and overall process time is competitive.

See page 51 for complete submission.

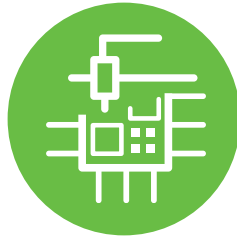


WeldScout™: Intelligent Welding Inspections for Critical Infrastructure

Cumulus Digital Systems

WeldScout™ is an image recognition technology that ensures quality for welding by using artificial intelligence to rapidly identify defects in weld inspection scans. Its primary purpose is inspecting weld integrity for the structural and piping connections that compose the world's most vital industrial infrastructure. The system uses a trained algorithm to evaluate phased array ultrasonic testing (PAUT) scans of welding and identify potential defects. WeldScout improves the speed and accuracy of welding inspectors by flagging potential defects and prioritizing those for closer study. It also enables scans to be reviewed by certified inspectors anywhere in the world.

See page 57 for complete submission.



ADDITIVE/ ADVANCED MANUFACTURING

Just as technology is rapidly changing the fundamental nature of manufacturing worldwide, corresponding changes are being brought to bear throughout the lifecycle of manufactured assets. Whether on the upstream, with digital model-based engineering design foundations, or on the downstream, with automation, robotics and artificial intelligence used in modern manufacturing processes, the tools and infrastructure continue to evolve. Advanced manufacturing is transforming the way products are brought to market and sustained over their lifecycles.

Likewise, additive manufacturing is changing the very nature of what can be manufactured and how the manufacturing process is executed. When effectively adopted and integrated into operations, these advanced manufacturing capabilities provide a path for US-based companies to cost-effectively “on-shore” manufacturing and sustainment operations. Likewise, the DOD is seeking ways to modernize sustainment operations using many of these same advanced and additive manufacturing technologies and processes.

All-in-One Robotic Maintenance Vehicle

necoTECH

The DOD has a massive footprint of asphalt and concrete that requires constant maintenance and repair. USAF bases alone contain over 2.2 billion square feet of asphalt. necoTECH is developing an All-in-One Robotic Maintenance Vehicle to provide a significantly improved alternative to the manpower and fossil fuel-based solutions in use at DOD installations around the globe. When developed, necoTECH's system will include a suite of interchangeable modules that provide full autonomy, or at least human-assisted automation, toward a wide array of maintenance and repair tasks.

Our current Robotic Crack Sealing Vehicle is at TRL 8 and can be used 24/7, at up to 2x the speed of a "trained" crew, while reducing the number of workers needed, and keeping those remaining workers out of harm's way. We are currently exploring the electrification and autonomation of this vehicle as part of our SBIR Phase II. For three weeks in January, this vehicle was stress-tested at Luke AFB in Arizona with their 56th CE Squadron.

We have received two STTR Phase I awards to develop additional use cases for this vehicle in pavement joint replacement and mobile 3-D concrete printing. Plus, we have submitted multiple other Phase I applications for future use cases and autonomy improvements. necoTECH has Cooperative Research and Development Agreements in place with the Air Force Civil Engineer Center and the US Army Engineer Research and Development Center.

This technology will allow DOD bases to conduct automated preventative maintenance year-round, catching small repairs before they become major overhauls, which will save time and money while maximizing infrastructure life.

Contact

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Problem Statement

- The DOD has a massive footprint of asphalt and concrete infrastructure that requires constant maintenance and repair. USAF bases alone contain over 2.2 billion square feet of asphalt.
- The solutions currently in use around the globe are manpower and fossil fuel-based, plus require task-specific equipment.
- DOD bases need to move towards conducting automated preventative maintenance year-round, catching small repairs before they become major overhauls.

Benefits

Save valuable warfighter time and money while maximizing infrastructure life and improving warfighter readiness and installation resilience.

Crack Sealing—Can be used 24/7, up to 2x the speed of a "trained" crew, reduces number of workers needed, and workers are no longer in harm's way.

Coming soon:

- Joint Replacement
- Pothole Filling
- Concrete Printing
- Etc.

Technology Solution

When developed, necoTECH's system will include a suite of interchangeable modules that provide full autonomy, or at least human-assisted automation, toward a wide array of infrastructure M&R tasks.

The first use case is our Robotic Asphalt Crack Sealing Vehicle which is at TRL 8, under a SBIR Phase II, and spent 3-weeks being stress-tested on an Air Force Base earlier this year.

- 2 Phase I awards to develop additional use cases
- CRADAs in place with Air Force Civil Engineer Center and the US Army Engineer R&D Center

ROBOTIC CRACK SEALING



Blue Laser Additive Manufacturing

NUBURU

NUBURU's industrial, high-power blue lasers unlock a path to new designs for both conventional laser-metal machining and 3D printing, which are not possible with today's infrared and green lasers.

NUBURU's patented blue laser technology takes advantage of the high absorption characteristics of all metals at the blue wavelength to dramatically reduce the energy required to melt and print metal materials, resulting in a significant increase in print speeds over an infrared laser. NUBURU's blue laser is the ideal source for remote depots because of its ability to process any metal material. NUBURU can provide this capability whether printing titanium, aluminum, stainless steel, steel, or even copper, and all of their alloys.

NUBURU integrated a 150-Watt blue laser into an EOS-M100 3D printing system to demonstrate the inherent advantages of the blue laser light over infrared light. Stainless steel parts were printed with both the infrared laser and the NUBURU blue laser. The result was a significant decrease in the

energy required to print the part and a 3x increase in printing speed. NUBURU repeated this same test with copper and discovered that the infrared laser was incapable of printing a copper part for the same power level as the blue laser. A higher power infrared laser is capable of printing copper parts, but the blue laser was 3x faster than an infrared laser with over 2x the power resulting in a 6x improvement in build speed. NUBURU has also tested titanium with results similar to stainless steel. The next step is to upgrade the EOS-M100 system with a 250-Watt blue laser and repeat the previous tests.

NUBURU has won an AFWERX SBIR Direct to Phase II for its 3D printing technology and a NAVSEA task order contract.

Contact

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Problem Statement

Current 3D printers are incapable of producing unique spare parts for maintenance and sustainment efficiently, quickly, and at a low price-per-piece.

Not only are they slow to produce parts, but small variations in each machine can result in small variations in produced parts, which, in turn, means they are not necessarily sufficiently strong and fail quickly.

If the component is critical, then the entire system in which it is used could be compromised at a vital moment in operation.

Technology Solution

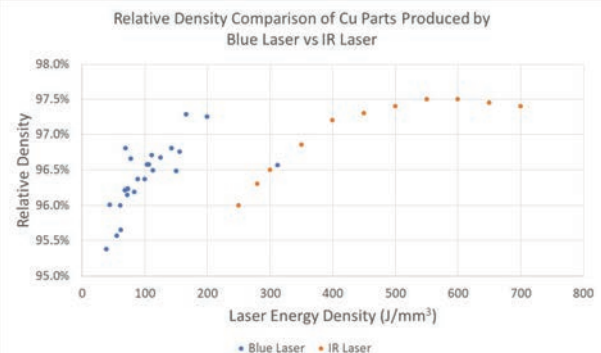
Blue laser printing provides enhanced absorption ranging from 1.3x to 66x for various metals over infrared.

Blue lasers' high absorption enables a much higher energy transfer to the powder bed, resulting in less energy being required to melt and fuse the powder (graph). The net result is a dramatic improvement in the blue laser's printing speed.

NUBURU developed a blue laser system that was integrated into an EOS M-100 laser printer, demonstrating speed and print density advantages.

Benefits

- NUBURU's unique blue laser 3D printing technology dramatically increases build speeds for materials including titanium, aluminum, stainless steel, copper and their alloys.
- The ability to print parts with high resolution and high speeds enables critical replacement parts for aircraft, which are obsolete or difficult to source, to be readily produced at depots, dramatically improving fleet readiness.
- The blue laser provides material agnostic printing capabilities, meaning that a single printer can print repair parts for virtually any military vehicle.



Complete End-to-End Additively Manufactured Electronics System for DOD Sustainment and Readiness

ChemCubed, LLC (C3)

The DOD currently relies on traditional methods for printed circuit board (PCB) design and manufacturing. Despite the incredible advances in all weapons systems, their foundation on PCBs limits or slows additional development. An additive manufacturing method that can build PCBs with high accuracy has yet to be developed, but is needed to manufacture the multilayer PCBs. ChemCubed proposes to put together the first end-to-end AME (additively manufactured electronics) system.

In addition to developing the best conducting ink available, C3 has also developed a system of products to use inkjet technology to print PCBs. This system has been branded ElectroJet and includes materials, printing equipment, and process capabilities that lay the foundation for this proposal. This proposed effort will merge the current printing technology of C3's Electrojet with a fully compatible pick-n-place SMT for component mounting, as well as software integration/camera alignment systems.

This combined system and technology integration and enhancement will result in a complete system that fully produces an additively manufactured electronic device (circuit boards, IoT devices, and other more efficiently produced electronic circuits).

The current Electrojet printing system is at TRL 8. It has been commercialized, but needs software and camera systems for automation purposes in an end-to-end system. The system has been tested as a proof of concept in numerous electronics applications. Repeatability testing has yielded less than 1% deviation from targeted electronic testing in passive circuitry and PCB board applications.

Contact

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Problem Statement

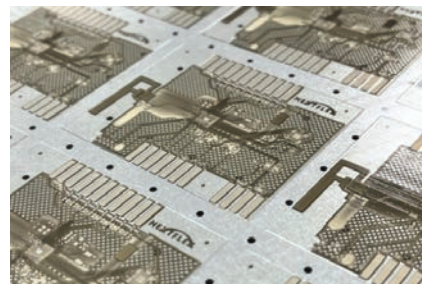
The DOD currently relies on traditional methods for PCB design and manufacturing. PCBs are manufactured in a slow, expensive, hands-on way that undermines flexibility and turn-around speed. Current PCB production methods raise costs and increase time required for suppliers to meet the DOD's needs. There is currently no complete end-to-end manufacturing system to additively produce PCBs. Such a system would save the DOD time and money, and enable new design and production capabilities.

Benefits

The proposed solution will provide benefits of decreased lead-time, faster turnaround through capabilities of in-house design, development, prototyping, and manufacturing scale-up. Internal processes vs. outsourcing may save weeks to months, as well as enable protection of sensitive intellectual property. The advanced process is flexible in capabilities, enabling engineers to be more innovative with ability to explore multiple iterations and testing due to a digital process and time savings. The proposed E2E AME system also has tremendous non-defense commercial potential.

Technology Solution

The proposed technology is to be incorporated as an upgrade to C3's pre-existing ElectroJet solutions printer, and a capability extension to the product line in functional capabilities as a full end-to-end additive manufacturing process for printed electronic circuit boards and related devices. We have demonstrated proof of concept of the ink-jetted electronics additive manufacturing system. Next steps are incorporating additions to the printer and make a small production run using a commercialized pick-and-place system with the ElectroJet printing system.



Data-Driven Part Qualification for Additive Manufacturing

3Degrees

The challenge of maintaining a fleet of aging aircraft, vehicles and equipment is immense across the Department of Defense. According to Air Force Lt General Warren Berry, “an internal review showed 80% of all demand for aircraft parts is satisfied by a repair instead of a replacement...of those part repairs, 92% can only be performed by a single supplier.” This situation presents not only a challenging, time-consuming process for identifying part suppliers but leaves billions of dollars of equipment sitting on the sidelines. The DOD has already identified one solution to fixing this problem: the use of Additive Manufacturing (also known as 3D printing) as an alternate manufacturing pathway.

In order to realize the benefits of this technology, technical data packages and manufacturing operations need to be validated and qualified. This is essential to ensure the manufacturing information is transferred and implemented correctly, and that all steps of product life cycle are documented and traceable. Failure to properly qualify parts has a high price: potential malfunction of

key equipment, damage to government property, and loss of life.

3Degrees’ TraceAM system allows AM users to track all their critical information, organizes it for multi-purpose use, and most importantly enables users to share a streamlined data set with internal and external partners. The successful implementation of the TraceAM software would accelerate DOD capabilities to generate accurate, timely, and consistent data packages for existing and future components that could be 3D printed locally or in the theater of war. Our team has been engaged in several DOD led efforts including a Phase II SBIR with the Air Force (AFRL/MX @Eglin AFB) as well as five funded projects with America Makes.

Contact

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Problem Statement

Additive Manufacturing (AM) has been demonstrated as a viable means of manufacturing maintenance and sustainment parts but critical gaps remain. AM qualification is slow (>18 months) and expensive (\$1.5 million) per part per material per parameter set. This process is inefficient and negates many of AM’s benefits. If current approaches continue, it would take over 600 engineering months and >\$80 million to validate just a single family of three commercial printers using only the basic commercially available materials.

Benefits

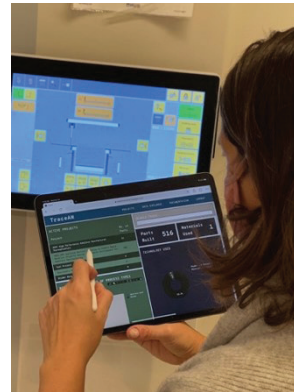
3Degrees’ TRACEAM can reduce these cost and time hurdles by 70% and successfully doing so would increase aircraft availability, decrease depot labor time, and expand the Make capability outside of just the DOD depots. This will shorten supply lines and decrease theater dependence.

If the process to qualify additive manufacturing materials and processes is prohibitively expensive, the ability to push the capability down the supply chain is significantly limited.

Technology Solution

3Degrees’ TRACEAM software is a streamlined platform designed to effectively organize, analyze, and deploy critical technical data packages related to Additive Manufactured parts. It is a secure and customizable interface ideal for use in development and sustainment operations, enabling rapid and qualified part solutions across DoD and its supply base.

Traction: We are engaged with several commercial customers and have been part of five funded America Makes (National Center for AM). projects. We have also recently been awarded a Phase II SBIR with the Air Force (AFRL/MX at Eglin AFB)



Development of Resistive Film Coating and Complete Manufacturing System for Resistive Film Coating

ChemCubed, LLC (C3)

Printed electronics allow for efficient, inexpensive, quick and easy production of complex, multilayer circuitry without etching copper and numerous hands-on multi-lamination steps. While conductive inks are usually metal for increased conductivity, conductive carbon-based ink can also be a good choice.

However, the application or additive process matters. Much is printed using screen printing, which is messy/difficult to control. A digitally controlled method of printing using inkjet technology is being explored. For inkjet printing, submicron particle sizes of carbon are needed. The goal is to establish a complete digital printing system for resistive coatings. It will digitally print resistive coatings on polyester (PET) and Kapton (DuPont trademark) films of up to 5 feet wide.

ChemCubed can currently print wide format conductive and dielectric inks on a specially modified commercial wide format printer. This system will be evaluated for consistent quality and low variability

and showing capability in making numerous resistive coating layers so multiple sheet resistances can be obtained. We will develop the final formulation of a resistive ink for a solvent-based wide format ink jet printing system using the best carbon raw materials such as carbon nanotubes (CNTs), conductive carbon pigment, hybrid metal/carbon, conductive resins, or some combination of to use to obtain the best printability for the purpose of a resistive coating on a film. The two films to be used are: a PET and Kapton, to show substrate versatility. We are creating a manner to dial in sheet resistance by varying print resolution and layering capabilities by printing with multiple printing channels and printheads at one time.

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Problem Statement

Rapid development of printed electronics technology promoted the development of conductive inks. Printed electronics allow for efficient, inexpensive, quick and easy production of complex, multilayer circuitry without etching copper and numerous hands-on multi-lamination steps. Conductive inks used are usually metal for increased conductivity. But, there are applications where conductive carbon based is a good choice such as wearables. The conductive fillers of carbon-based conductive inks had characteristics of wide source, low price and good stability, and had great application value.

Benefits

The proposed material will be 3x more conductive than current screen printing resistive inks. Additional Benefits: (1) use of secure, abundant, domestic coal feedstocks (2) increased ink formulation wettability & transferability (3) ability to achieve higher solids loading in ink formulation suspensions, carbon black and graphene (4) exhibited low surface resistance/resistivities (5) significantly lower particle density relative to silver (6) lower curing temperatures than silver and potentially a wider range of compatible substrates (7) significantly lower cost than silver pigments.

Technology Solution

ChemCubed will develop a new carbon-based resistive ink that will be 3 times more conductive than current screen printing resistive inks. The proposed project is more economically efficient than currently available options, and utilizes a secure, abundant, domestic coal feedstock. The digital printing aspect of this material will allow greater accuracy and flexibility in design, savings in energy and the ability to quickly replace damaged parts on the grid alleviating supply chain issues.



Digital 3D Patterns and Molds for Maintenance

Intrepid Automation

Intrepid Automation's patented solution enables a "closed loop" of contemporaneous feedback/print-run optimization during vat-based photopolymer print builds. Closed-loop operation results in vastly improved print quality: higher structural integrity of builds, fidelity to desired surface finishes, and better accuracy from print to print and printer to printer, etc.

Combined with Intrepid's patented Multiple Image Projection technology, closed-loop technology improves build efficiency, reduces total system costs, and optimizes maintenance and serviceability schedules for high-volume production runs of patterns, molds, tools, cores, and end-use parts. closed loop and multiple image technology, used together, significantly improve build times for both small- and large-format builds.

Presently, most investment-cast metal parts use a wax casting process. Carbon fiber components are also problematic. Intrepid solves both challenges. Custom molds and tooling have prohibitively high costs for small production runs and is unable to

produce custom/complex geometries. Intrepid's technology is scalable for custom molds and tooling. It has been commercially successful for thermoforming applications.

Target Performance and Next Steps:

- Enable both property and performance improvements by lightweighting equipment up to 20%: This calculation is based on the use of topology optimization software for part-mass reduction, standard applications engineering best practices in DfAM, and comparable projects.
- Enable lower-cost prototyping by reducing file-to-part time up to 30%: This is based on standard print/casting times of Intrepid's systems vs. legacy production methods.

Contact

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Problem Statement

Legacy manufacturing methods like tooling, molding, and machining are time-consuming and costly, involving the repetition of multiple steps to produce a single part.

Specialized equipment and skilled labor are required, driving up production costs and hindering in-house production for maintenance and sustainment.

Existing 3D print processes sometimes can fill the gap for low-volume production or prototype runs of complex/custom parts, but present technology is expensive, inaccurate, and difficult to scale.

Benefits

Intrepid's technology produces a cumulative effect or upward spiral of efficient and sustainable production for replacement parts and maintenance:

- Parts produced can be lighter, use less material, and be tested and produced with a lower carbon footprint.
- Local suppliers, supported by Intrepid's hardware, then reduce transportation distances and reduce the energy used in the manufacturing process.
- AM and Intrepid's hardware solution enable "greener" manufacturing of machinery designed to catapult both manufacturing and sustainment.

Technology Solution

Intrepid's patented modular DLP print process combined with closed-loop and automation technology and proprietary materials work together to produce parts, molds, tools, and patterns up to 10x faster compared to legacy 3D processes.

Intrepid's technology also enables larger builds at faster speeds - all without sacrificing print-to-print consistency. This process is ideal for production of parts with complex or highly custom geometries, legacy/obsoleted parts, lightweight parts, and single-crystal and/or superalloy required parts.



Geometric Deep Learning Technology for Supply Chain

Physna

COVID-19 and other global events have put the supply chain at increased risk. One of the recent major supply chain breakdowns comes in the form of part and component supply. To effectively manufacture and operate essential equipment and tools, suppliers need to ensure a reliable stream of parts and components. According to a McKinsey report, the lack of transparency in the supply chain significantly limits the ability for full products to be completed and delivered to consumers. These issues have elucidated the need for a method or tool that can create a more transparent supply chain and illuminate more attainable supply sources when needed. One method used to solve this issue is additive manufacturing (AM). By printing parts to replace gaps in the supply chain, the needs of manufacturers can be met, rapidly. The current method for identifying and analyzing AM candidate parts is a manual, time-consuming process, performed by engineers and AM subject matter experts. Physna has found this to be a common problem faced across many companies

and sectors, encompassing aerospace, electronics, automotive, and global appliance manufacturing.

Physna's geometric data processing and machine learning can complement dimensional, structural, material, and other technical data used to describe candidate components for AM. These attributes will deliver a learning recommendation engine that will address the AM question of "can it be printed?" The proposed solution will improve logistics effectiveness and readiness through increased usage of AM across product support life cycle management. It will also reduce manual processes, and therefore improve the user's cost margins, schedule of execution, and general product performance throughout its life cycle.

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Problem Statement

- To manufacture equipment suppliers need to ensure reliable streams of components. The lack of transparency in the supply chain limits the ability for products to be delivered demonstrating the need for a tool that can create a more transparent supply chain and attainable supply sources.
- Manufacturers remain dependent on 2D technical drawings, nomenclatures, and part numbers that prevent transparency of data necessary. With model-based design, there is a gap generated between the 2D and 3D worlds that Physna will close.

Benefits

The Physna platform contains patented geometric deep-learning capabilities that open many use cases across sectors:

- Data cleanup and deduplication
- Geometric classification
- Geometric smart tagging and labeling
- Geometric search/ reuse
- Geometric data comparison and analysis

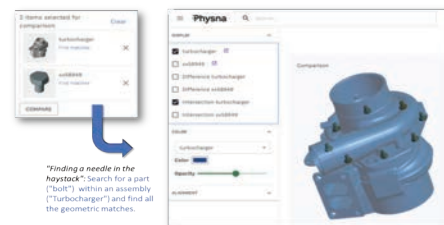
Physna will improve logistics effectiveness and readiness. It will also reduce manual processes, and improve the user's cost margins and schedule of execution.

Technology Solution

Physna developed a true 3D geometric search engine and deep learning platform unlocking:

- 3D search by geometry
- Automated labeling of digital assets based on shape
- Retrieval of 3D models with 2D images/photographs
- Model-to-model comparative analysis of parts

Physna's geometric data processing and ML complement dimensional, structural, material, and other technical data used to describe candidate components for AM.



HX5: Advanced Reinforced Polymer System

Alpine Advanced Materials

Alpine Advanced Materials offers a turnkey solution for manufacturing purpose-built parts by using HX5, an advanced thermoplastic nanocomposite that replaces heavy, legacy aluminum parts at 93% of the strength, but only half the weight, across a variety of industries. HX5 is lightweight, affordable, and delivers excellent mechanical properties, thermal stability, environmental durability, and superior manufacturing processability over its alternatives. Moreover, HX5's high-rate production methods significantly accelerate product schedules compared to machined aluminum or conventional composite parts. The material has been successfully overmolded with continuous fiber parts to create a lower-cost, high-performance structural component with complex geometry and scalable manufacturing through injection molding. HX5 was formulated with a very high surface energy, allowing it to bond with CFRPs and create a unified, high-strength structural component.


Replacing aluminum components with HX5 offers significant benefits to the aerospace and automotive industries. Weight reduction is critical for these

sectors, and HX5's lightweight, environmentally durable nature can lead to economic and environmental advantages. Overmolding also eliminates additional assembly processes and components, resulting in significant cost and time savings.

HX5 has already undergone successful testing and simulation. Next steps are to expand testing and optimization for novel applications in the aerospace, automotive, and other industries. HX5 will enable more efficient and effective maintenance practices by reducing maintenance costs, improving safety, reducing cycle time, and increasing readiness. For example, Alpine has delivered a missile bracket that outperformed a machined aluminum version by 15% in a critical load condition and is 30% lighter.

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<p>Problem Statement</p> <p>Current aerospace manufacturing relies on expensive, heavy aluminum components that corrode and fail prematurely. Attempts to replace them with injection-molded polymers have been successful for 6000-series aluminum, specifically with HX5, but not for 7000-series, which has 75% higher yield strength. This is due to the non-continuous fibers required for 7000-series mechanical properties. Moreover, manufacturing operations for continuous fiber (CFRP) parts are time-consuming and costly, limiting scalability. This is especially problematic for aerospace, defense, and space, where 7000-series is used extensively.</p>	<p>Benefits</p> <ul style="list-style-type: none"> • Process significantly reduces manufacturing time, operating costs, and power consumption • Rapid production leads to reduced power requirements and significant reductions in emissions. In the aerospace industry, operational cost savings range from \$300-\$1500/lb of weight decrease, with potential savings of \$300,000 per aircraft by replacing 1000lbs. • HX5 components have significantly shorter lead times • Case study: Aluminum brackets needed maintenance/replacement every 6 months due to corrosion from saltwater, whereas HX5 component has been active for years without any replacements.
<p>Technology Solution</p> <p>By using a simplified, flat piece of CFRP, Alpine has been able to form aerospace-grade panels into these complex shapes and overmold HX5. This allows the functional properties and scalability of molding HX5 to combine with the increased strength capability of CFRP to create a lower-cost, high-performance structural component to compete with or exceed the strongest aluminum 7000-series alloys.</p> <p>This is particularly critical for the aerospace and automotive sectors, where weight reduction is economically and environmentally important.</p>	

Polimotor-Epoxy Thermoset Advanced Materials

Cosine Additive Inc.

Cosine Additive has developed a groundbreaking method of manufacturing parts by combining two innovative technologies — 3D printing and thermoset epoxy pellets. Unlike traditional 3D printing thermoplastic technology, thermoset pellets exhibit isotropic properties and very low residual stress, resulting in easy-to-print, strong, and cost-competitive parts with reduced lead times. The material behavior, processing parameters, and results are well-known, and the thermoset pellet material is readily available in bulk quantities with a short, two-week lead time.

Thermoset materials can unlock incredible print speeds. Cosine uses a chemical bonding process rather than heat to iron down layers so print speed is not limited by layer bonding. Printing happens as fast as the machine will move. Cosine's advanced linear motor motion system increases print speed over 1000mm/s and allows AM technology to be made more efficient and increase cost effectiveness.

Material testing has been performed in two printers at Cosine's facilities and Cosine will use their

learnings to make software and hardware improvements to enhance their 3D printer's capabilities and enable operators to use the process more proficiently. Cosine Additive seeks to manufacture real-world parts for the military to determine the technology's capabilities. Once exhibited, the military can deploy the technology to forward operating bases to produce high-demand, short-lead-time parts. The cross-service applicability of this technology makes it potentially beneficial to all service branches.

In summary, the proposed technology's innovative characteristics along with Cosine's expertise make the thermoset pellets an ideal solution for reducing reliance on costly and time-consuming traditional manufacturing methods and suppliers.

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Problem Statement

- Traditional manufacturing methods for producing maintenance and sustainment parts are costly, time-consuming, and sometimes result in lower-quality parts that do not meet the rigorous standards required for military applications.
- There is a lack of affordable, innovative manufacturing methods which creates delays in maintenance and sustainment activities and impact readiness and operational effectiveness on the battlefield.
- Unmet need for technologies that can produce custom parts on-demand with complex geometries, limiting the ability to innovate.

Benefits

- Cosine Additive's novel approach to 3D printing allows the production of high-strength, durable parts that meet the requirements of military applications.
- Cosine's expertise in equipment and material development enables the efficient production of custom parts on demand, reducing the reliance on costly and time-consuming traditional manufacturing methods and suppliers.
- The simplified production process proposed by Cosine can increase military readiness and operational effectiveness on the battlefield, resulting in greater efficiency in maintenance and sustainment.

Technology Solution

- Cosine Additive pre-mixed and frozen Polimotor—epoxy thermoset pellets/granules. These thermoset pellets/granules produce strong, isotropic parts with low residual stress, simplifying the printing process.
- The printing capabilities, software and hardware as well as the epoxy thermoset material are mature and ready for implementation and production needs. These epoxy thermoset materials are used in the automotive industry for over a decade.
- Cosine is able to feed thermoset pellets into Cosine's existing 3D printing extrusion equipment to produce parts.



Predictive Maintenance to Enable Additive Manufacturing Repair of Critical Components

The Applied Research Laboratory at Penn State University

To address the DOD logistic challenges and high sustainment costs, ARL Penn State has developed an innovative concept of combining advanced machine learning-based predictive analytics with additive manufacturing (AM) repair technology to provide a new sustainment approach for DOD assets. This approach is particularly well-suited to critical dynamic load-bearing components (ex. gears, journal bearings, splines, etc.) in ground vehicles, helicopters, ships, and submarines. We are currently applying these technologies to legacy ground combat vehicles for parts that are no longer produced, or where it is difficult and expensive to obtain replacement parts.

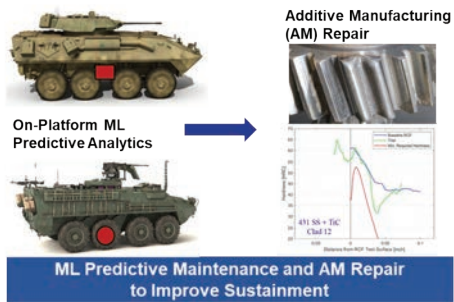
AM can repair damaged parts with low thermal distortion and superior mechanical properties. But to maximize the benefit for critical load-bearing components, the repair must be applied while the extent of the damage is low. ARL Penn State has developed machine learning-based on-platform predictive

analytics that can detect low lubrication levels and early indications of faults of loading bearing components using a single low-cost MEMS vibration sensor (~\$25/sensor). This provides the ability to identify and remove the critical parts from service with limited damage to ensure the best and longest-lasting repair. It should be noted that any DoD platform that has an existing predictive maintenance capability can be a candidate for the AM repair approach.

We have recently conducted technology development using US Marine Corps amphibious combat vehicles and US Army ground vehicles. The failure prediction capability has been shown effective for drive train components and many other applications.

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<p>Problem Statement</p> <ul style="list-style-type: none"> • DOD assets, such as ground vehicles, helicopters, ships, and submarines, employ gears, splines, and bearings that become damaged and degrade until catastrophic failure. • Remanufacturing of such high-value components is expensive and time-consuming. • Supply-chain issues involving these critical dynamic load bearing components degrade warfighter readiness. • DOD Depots are acquiring AM technology capability but with limited application solutions. 	<p>Benefits</p> <ul style="list-style-type: none"> • The marriage of advanced prognostics and additive manufacturing (AM) repair technologies will give the logistics and sustainment community an ability to cost-effectively repair critical parts that are difficult and expensive to remanufacture. • Application of this technology for critical load bearing components will eliminate the high cost and long lead time to manufacture new parts, improving warfighter readiness. • A CBA indicates a 20% savings from this process could save \$57M for the fleet of USMC LAV and USA Strykers.
<p>Technology Solution</p> <ul style="list-style-type: none"> • ARL Penn State has developed an innovative concept that combines advanced machine learning (ML) based predictive analytics with additive manufacturing (AM) repair technology. • Advanced on-platform machine learning based predictive analytics provides an early indication of the component fault that facilitates the ability to cost effectively conduct repairs with the AM technology. • ARL Penn State has two decades of experience implementing and evaluating predictive analytics on DOD weapon systems, and more than three decades of experience in developing and transitioning laser-based repairs for the DOD. 	 <p>The diagram illustrates the integration of On-Platform ML Predictive Analytics and Additive Manufacturing (AM) Repair. It features a military vehicle on the left, a graph of vibration data in the center, and a 3D model of a repaired part on the right. The graph shows a peak in vibration, indicating a fault. The 3D model shows a part with a red area indicating the repair. The text 'On-Platform ML Predictive Analytics' is next to the vehicle, and 'Additive Manufacturing (AM) Repair' is next to the 3D model. A blue arrow points from the vehicle to the 3D model. Below the graph, the text 'ML Predictive Maintenance and AM Repair to Improve Sustainment' is displayed.</p>

Universal Portable Adaptive Controls for Additive Manufacturing

ARiA

Under sponsorship from NAVSEA 05T, ARiA has developed the Universal Portable Adaptive Control (UPAC) system to expand the utility of additive manufacturing (AM) in expeditionary environments. UPAC provides bolt-on, modular control systems that: mitigate harmful effects of shock and vibration; provide local temperature and humidity control; filter out harmful polymer aerosol emissions; and mitigate local electromagnetic interference (EMI) and noise sources. UPAC minimizes health hazards to operators, enables mobile 3D printing, improves build quality, and reduces the time required to optimize AM machine settings for harsh environments.

UPAC's modular, bolt-on subsystems are polymer AM machine-agnostic and are tailorable to operational needs. Fully 90% of UPAC's components are commercial-off-the-shelf (COTS), many of which are already rated to MIL standards.

Based on high-fidelity computational fluid dynamics (CFD) simulations with Lagrangian particle transport, UPAC's evacuation system has a filtration efficiency

of 90% for particles deemed most hazardous by the EPA with robustness to changing operational environments. It achieves this by removing polymer filament aerosol emissions at the source and traps them in a control region the size of a postage stamp. Depending on the features chosen, UPAC's evacuation system can service up to two AM machines simultaneously while staying in a compact footprint as small as 0.5 cubic ft. Based on 48 high-fidelity build simulations, UPAC's shock and vibration isolation improves average surface roughness of finished parts by up to 93% when exposed to MIL-rated vibration sources. The next steps in developing the UPAC system include prototype fabrication and MIL standard validation testing.

Contact

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Problem Statement

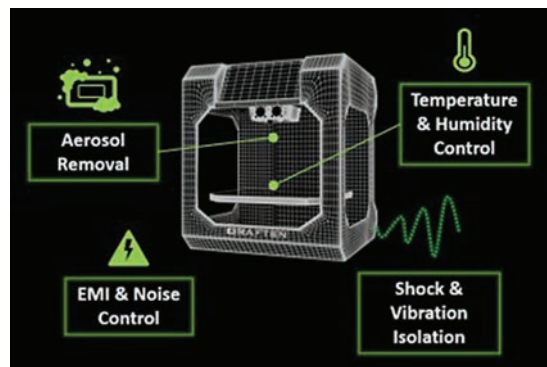
- Additive manufacturing (AM) has the potential to significantly reduce supply-chain issues in expeditionary environments by creating replacement parts on-demand at the point-of-need.
- AM machines are not designed to operate in harsh, non-laboratory environments.
- Modular control systems are needed to mitigate harmful environmental effects on AM machines as well as mitigate the harmful effects that AM machines have on their environment.

Benefits

- Universal: UPAC bolts onto any polymer AM machine you want to use.
- Breathe Easy: UPAC removes 90% of harmful polymer aerosol emissions at the source, allowing operators to safely use 3D printers in confined spaces.
- Mobile 3D Printing: UPAC improves average surface roughness of finished parts by up to 93% when exposed to MIL-rated vibration sources, enabling mobile 3D printing.
- Compact: UPAC's compact footprint is ideal for AM machines used in tight spaces.

Technology Solution

- The Universal Portable Adaptive Control (UPAC) system provides bolt-on, modular controls that retrofit existing AM machines for use in expeditionary environments.
- UPAC's modular subsystems contain interchangeable components that are tailorable to the operating environment.
- UPAC provides bolt-on: active & passive vibration isolation, local temperature & humidity control, local EMI and noise isolation, and an ultra-high efficiency filtration system.





BUSINESS IT AND ANALYTICS

Sustainment leaders and maintenance managers make a multitude of decisions every day, such as which component should be inducted to maximize production at the lowest cost. Other decisions center on which tools to invest in and processes to improve to maximize the effectiveness and efficiency of maintenance and sustainment operations. The world is experiencing an information revolution with the advent of new IT capabilities that can absorb and integrate disparate data types and present information more effectively to provide decision makers with

greater insight. The Internet of Things (IoT), machine learning, natural language processing, artificial intelligence, and ever-expanding internet bandwidth and speed are enabling business IT and decision analytic capabilities that were only dreamt of a few short years ago. These expanded capabilities are radically changing the very nature of when and how maintenance is executed. The result is a sustainment community that is maximizing weapon system readiness and reliability per maintenance dollar spent.

Fortis for Supply Chain and Sustainment

VeriTX Corp

Fortis is a transformative supply-chain data assurity platform enabling trusted operations in a Logistics Under Attack (LUA) Framework. The main focus of the solution is to protect against “bad data.” Fortis will prevent intruders from secretly corrupting the data being transmitted between the DOD stakeholders. It is highly relevant to DOD maintenance because it is capable of protecting intricate supply chains including the vast logistical footprint of the defense OEMs. This will allow creating the supply chain optionality and redundancy which in turn will lower the lead time and increase mission capable rates. The platform tracks provenance, provides data verifiability, and enforces least privileged access via a combination of blockchain and communication agents safeguarding the data throughout its lifecycle.


In the wake of the regional crisis sparked by Russia and in anticipation of the global challenge posed by China, our supply chains must be protected. The enemy will confront digital infrastructure with the same vigor it will attack physical supply

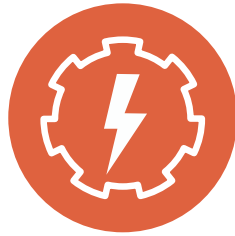
chains. It is not enough to have cybersecurity in place that is preventing bad actors only from “looking” at the data. An enemy could go a step further and corrupt critical data in a way undetectable to the end-user. Subtle alterations in the design documents, logistics numbers, or location coordinates could potentially have devastating consequences in the rapidly changing environment of a conflict. The impact of the solution includes saved lives, increased readiness of assets, and preserved initiative in the fight.

VeriTX is a team of military veterans with significant knowledge of the end-users and their problems. Fortis is at TRL 8 and is being piloted at OC-ALC (Oklahoma City Air Logistics Complex) currently.

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<p>Problem Statement</p> <ul style="list-style-type: none"> • National Security is at risk when our adversaries can intercept the data (e.g., part design data required for 3D printing), make unnoticeable yet fatal changes, and let it reach the recipient. • When data is transferred between systems, unless a connection back to the authoritative source is made (original source of truth), there is no means of knowing if the data has been tampered with. 	<p>Benefits</p> <p>The proposed solution addresses a critical need for the military, as the readiness posture of the United States is heavily reliant on a robust and dependable supply chain. By providing increased transparency, lower supplier risk, and expanded optionality, any division that leverages this solution will enable the following benefits:</p> <ul style="list-style-type: none"> • Higher readiness and lethality of the US weapon systems • Increased optionality and flexibility of the supply sources • Higher supply chain resilience • Protection of intellectual property
<p>Technology Solution</p> <ul style="list-style-type: none"> • Fortis tracks provenance, provides data verifiability and enforces least privileged access via a combination of blockchain and communication agents to ensure trusted operations in a Logistics Under Attached (LUA) framework in a zero-trust environment. • VeriTX has developed and tested the prototype over the course of 10+ commercial pilots and SBIRs. Current TRL is 8 as the solution was part of the AFSC Zero Trust Data Fabric Initiative. • Solution includes three components, namely a supply chain dashboard, a methodology to utilize relevant data, and a data assurity system. 	



CBM+/ PREDICTIVE MAINTENANCE

Across the DOD, maintenance has largely been conducted with the same approach as General Washington's Continental Army had established; unscheduled maintenance is prevalent, and when a system breaks, maintainers react by troubleshooting and correcting the problem. This legacy maintenance strategy is the leading driver of weapon system non-availability and exorbitant sustainment cost. However, with rapid advances in sensing technologies as well as artificial intelligence and data science, predictive maintenance is now within reach. The DOD recently completely revamped condition-based maintenance-plus (CBM+) policy to accelerate the adoption, integration and use of these transformative capabilities and shift from largely

reactive maintenance to proactive and predictive maintenance. Service leadership is staunchly committed to implementing and executing CBM+ across their vast sea-going, aviation and ground system enterprises. Legacy platforms like the KC-135 and new systems like the Littoral Combat ship are proving that predictive maintenance will become the new normal across DOD in the years to come. Through implementation of proactive and preventive maintenance methods, maintainers in the field and in depots are beginning to have the weapon system material condition insight necessary to pinpoint maintenance requirements and ensure they have the right parts, right tools, and the right skills to quickly and efficiently return equipment to operations.

Beacon for Predictive Maintenance

Murano Corporation

Using ideas and feedback from NAVAIR, NAVSEA, and Army, Murano Corporation has developed and demonstrated a secure mobile technology called Beacon that was funded by a NAVSEA SBIR. Beacon is a hardware/software platform that can be used to securely communicate, predict future supply and maintenance needs, and access technical maintenance documentation and enterprise data. There are two versions: Beacon Delta and Beacon Omega.

Both Delta and Omega automatically collect data from industrial, manufacturing, and mobility equipment like CNC machines, 3D printers, diesel engines, trucks, and automobiles. Beacons use data collected from assets to create digital twins. The built-in AI makes predictions that are used for predictive maintenance and improving demand planning and supply chains.


Beacon Delta is a tablet style device powered by NVIDIA's Xavier NX. Delta includes environmental sensors and 2D&3D cameras. Beacon Omega is a smartphone style device powered by Google's Coral

AI processor with an integrated tensor processing unit (TPU) and made slimmer and lighter by our own custom circuit board. Both Beacon products' processors support computer vision use cases on the edge, including corrosion detection, human activity detection, facial recognition, and more.

In May 2022, one of the early Beacon prototypes was installed on Pearl Harbor Naval Shipyard's Innovation Lab's TRAK 5-Axle CNC machine. This Beacon successfully demonstrated health monitoring and a digital twin of the TRAK CNC Machine. Since 2022, Murano Corporation has been on a rapid iterative journey to develop a slimmer, lighter device with an intuitive and interactive user interface.

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<p>Problem Statement</p> <ul style="list-style-type: none">• The DoD currently relies on analog processes and legacy systems that do not interact, rely on unreliable human entered data, and do not have the ability to remotely monitor assets or utilize predictive maintenance.• What's needed is a secure mobile platform that can act as a one-stop-shop for maintenance by fusing data from disparate systems and assets.	<p>Benefits</p> <ul style="list-style-type: none">• Built to DOD security standards, all components are sourced in the US and devices can be "bricked" when out of set range.• Systems of system design allowing for connectivity to legacy systems and a one-stop-shop for users.• High processing power allows for AI on the edge and ability to run in disconnected environments.• Ability to connect to multiple assets and legacy systems.• Intuitive and interactive user interface.• Configurable for different branches and all levels of maintenance.
<p>Technology Solution</p> <p>Beacon is a mobile hardware/software platform that acts as a systems of system by automatically fusing machine data and information from disparate legacy systems, providing a one-stop-shop for users.</p> <p>Beacon uses the data collected from assets to create digital twins, and the built-in AI makes predictions that are used for predictive maintenance and improving demand planning and supply chains.</p> <p>Beacon is a mobile solution that accurately collects data at the source.</p>	

A CBM+ Predictive Maintenance System Based on Past Service Records

Franz Inc.

The DOD lacks reliable predictive capabilities for the maintenance of complex systems. With thousands of interdependent mechanical, electronic, and software components, malfunctioning of one component can severely impact warfighter readiness.

Current predictive maintenance practices rely on sensors embedded within the system, from which data is collected to calculate the remaining life of the components. However, sensor-based predictive maintenance effectiveness depends on the coverage and quality of the sensors used, the accuracy of the data collected, other data sources, and algorithms used to analyze the data. Sensors may fail to catch impending problems due to process complexity.

Historic service records can serve as predictors of equipment failures. Predictive machine learning can detect forthcoming problems based on past service difficulties, but key insights of most service records cannot be input into ML algorithms easily.

Franz has developed a rule-based natural language processing (NLP) tool to transform text data into computable semantic data. The NLP process entails text reduction and normalization, entity identification/disambiguation, and semantic data extraction via pattern rules. In conjunction with data mapping of the service database, an ML neural network model can provide more specific problem prediction.

The data mapping is fully developed, and the rule-based NLP system is being used in prototype testing with the FAA service difficulty report (SDR) dataset. The current algorithm has shown strong predictive results; the rules for the NLP is currently manual.

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Problem Statement

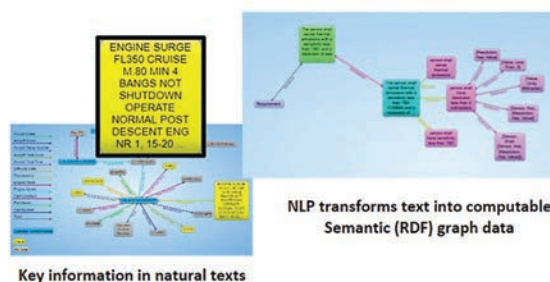
- The DoD lacks a reliable predicative capability for maintenance of complex systems, such as aircrafts and warships, resulting in preventable system or component failure impacting costs and readiness.
- Embedded sensors and routine maintenance are the primary approaches to prevent failure for these systems but are inadequate due to the complexity of the systems, or up to date with alternative predictive techniques.
- The systems the military relies on will get more complex over time and requires more reliable predictive maintenance approaches.

Benefits

- With proper maintenance, fewer failures occur, increasing battle readiness and reducing the down-time of critical systems.
- The lifecycle of large systems is increased with preventative maintenance. Time and money are saved.
- Systems can continue to increase in complexity and preventative maintenance will be built in.
- Humans will not need to work through historic service records to develop an adequate ML model. The level of detail built into the NLP would not be possible otherwise.

Technology Solution

- Predictive Machine Learning (ML) models trained with historic service records can detect forthcoming problems from past equipment failures.
- Franz has developed a Natural Language Processing (NLP) tool to decode and transform text data into computable semantic data. The NLP process entails text sentence reduction and normalization, entity identification and disambiguation, and semantic data extraction via pattern rules.
- In conjunction with semantic data mapping of service database, an ML neural network model can provide problem prediction to enhance predictive maintenance.



Data Collection System for Military Vehicle Operations

Cybernet Systems Corporation

The Data Collection System (DCS) is an innovative, on-vehicle solution utilizing artificial intelligence to monitor and analyze vehicle telemetry data, identifying normal and anomalous behaviors. This innovative system enables continuous assessment of equipment and vehicle readiness during active operations, minimizing downtime and mission risk through proactive maintenance alerts.

By reducing vehicle downtime and supporting both legacy and next-generation military vehicles, the DCS enhances fleet readiness and empowers commanders to make data-driven, risk-based decisions during operations. Seamlessly integrating with legacy systems, it offers real-time monitoring, anomaly detection, and maintenance recommendations for a wide range of military vehicles, including land-based combat vehicles, tactical wheeled vehicles, aircraft, naval vessels, and unmanned systems.

A key feature of the DCS is its ability to learn normal behavior over time, adapting to detect anomalous behavior, enabling commanders to make informed

decisions to ensure safe and effective operations. The DCS software records vehicle data, prepares it into a common format, runs AI analysis, and provides a reporting portal for easy access to crucial information. It also ensures smooth data flow and high security across sites and fleets through centralized reporting.

Proven effective through a SBIR Phase II demonstration for the Army, the DCS has potential for adoption by the Department of Defense (DOD) to address critical maintenance needs and optimize performance. In summary, the Data Collection System is a promising addition to the military's arsenal, revolutionizing vehicle maintenance and fleet management, and enhancing overall mission success.

Contact

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<p>Problem Statement</p> <ul style="list-style-type: none">• Timely maintenance of combat vehicles will provide a significant operational advantage for US Armed Forces.• The current health of vehicle components is currently gauged with subjective checks and preventative maintenance.• Inconsistent checks and inadequate maintenance drive up fleet costs for the military.• Overall, there is a critical need to know that all vehicles are going to be able to complete the mission.• A significant challenge is ensuring data flows smoothly from components to data analysis systems for maximum security and reliability with a low level of latency.	<p>Benefits</p> <ul style="list-style-type: none">• Reduces mission risk: continuous assessment of equipment and vehicle readiness and active operations• Minimizes down time: proactive alerts to imminent failure based on vehicle historical data• Supports legacy and next-generation vehicles• Learns normal behavior over time, and learns to detect anomalous behavior• Delivers continuous assessment of equipment and vehicle readiness and active operations• Enables data-based, risk driven mission decisions to ensure safe and effective operations
<p>Technology Solution</p> <p>An on-vehicle intelligent agent that collects vehicle data, learns normative behavior, detects anomalous behaviors, and recommends known solutions. Comprises a hardware platform for integrating with legacy systems, and software that:</p> <ul style="list-style-type: none">• Records vehicle telemetry data• Prepares the data into a common format• Runs Artificial Intelligence analysis engines• Has a reporting system portal• Transfers data for centralized reporting across sites and fleets• Identifies normative and anomalous behaviors	<pre>graph LR; A[Data Logger Module] --> B[Data Log]; B --> C[Transfer Client Module]; C --> D[Compression Module]; D --> E[Compressed data]; F[Data Monitor Module] --- B; B -.-> Log is ready! C;</pre> <p>The diagram illustrates the data flow from the Data Logger Module to the Data Log, then to the Transfer Client Module, followed by the Compression Module, resulting in Compressed data. A Data Monitor Module is connected to the Data Log. A photograph of the hardware unit is shown below the diagram.</p>

SmartClamp

Midé Technology Corporation



To combat the billion-dollar costs associated with electrical wiring interconnection system (EWIS) chafing issues as reported by the Joint Intermittent Testing Team Working Group (JIT WG), Midé Technology Corporation has developed a self-powered, radio frequency identification (RFID)-capable, user-programmable, patent-pending technology we call SmartClamp. This unit is designed to be a preferred Defense Logistics Agency (DLA) replacement spare part for legacy EWIS and hardline fuel and hydraulic (dumb) MIL21919 Adel clamps. In addition to performing normal clamping functions, SmartClamp autonomously monitors, stores, and reports abnormal chafing/vibrations issues it detects during system use to maintainers, allowing for assessment and repair of the detected issue before a costly and potentially dangerous system failure occurs. RFID scanning is completed periodically to transfer clamp information to the SmartClamp, which notifies maintainers of the anomaly.

No other technology of this kind exists to wirelessly detect chafe/vibration anomalies. SmartClamp

technology will reduce inspection and repair maintenance man-hours and maintenance costs, and improve system safety. Data collected with this technology can be used to support DOD's ongoing Condition Based Maintenance (CBM) efforts. Midé's user-friendly software allows programming of clamp detection levels and customizing of software dashboards, system reports, and data analytic algorithms. The unit is built with the TRL-9 core technologies based on Midé's enDAQ sensor line (formerly Slam-Stick), Midé's CBM data analysis algorithms, and commercial off the shelf (COTS) RFID equipment. Midé's SmartClamp technology is currently at TRL-5. The unit has been successfully prototyped and tested as accurate on Midé's laboratory EWIS test bed.

Contact

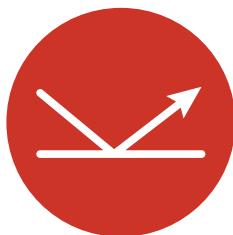
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<p>Problem Statement</p> <ul style="list-style-type: none"> Electrical wiring interconnect system (EWIS) and hydraulic/fuel/hard-line chafing issues are a multi-billion-dollar issue for the DOD and Original Equipment Manufacturers (OEMs) Currently there is no technology available that provides a reliable, self-powered, easily retrofittable, low cost, data analytics driven, Condition Based Maintenance (CBM) compatible solution to combat this issue 	<p>Benefits</p> <ul style="list-style-type: none"> No wires/power required during installation CBM approach vastly improves system safety and readiness, fix it before failure Greatly reduces cycle time and necessary manpower numbers by reducing/eliminating routine inspections and related repair maintenance man-hours Increases time on wing by detecting preventable failures Installed as preferred MIL21919 part, no installation ECP required reducing cost Detects vibration hot spots, systemic, one-off installation issues, and system design issues
<p>Technology Solution</p> <ul style="list-style-type: none"> SmartClamp is self-powered (no batteries), wireless, user programmable, and CBM compatible Maintainers scan for anomalies with RFID handheld device for upload to SmartClamp system software Notifies maintainers if an abnormal clamp vibration is detected providing clamp location Preferred replacement part for MIL MIL21919ADEL/ hydraulic/fuel/hard-line clamps and requires no engineering change proposal (ECP) to retrofit No other capability for this detection exists in the world Allows for remote monitoring in difficult locations TRL-5 has been demonstrated in our laboratory 	



COATING AND CORROSION PREVENTION

Recently, the DOD issued a report to Congress citing corrosion as a leading weapon system readiness driver, costing the department and the taxpayers in excess of \$20B annually. The DOD has as a result established the Corrosion Prevention and Control team, and each military service has appointed a corrosion executive in their expanded efforts to combat corrosion and its effects on readiness and cost. These authoritative and collaborative bodies seek to fundamentally change the way the DOD has battled corrosion by developing and implementing a multi-faceted solution set, which

includes novel primers and coatings, cold-sprayed protective layers, improved substrate material formulae, advanced washes and application methods, innovative non-destructive inspection tools, artificial intelligence-based algorithms, CBM+ focused sensors, and robotic solutions to name a few. Neil Young aptly observed that “rust never sleeps,” but through the application of advanced coatings and corrosion prevention and control technologies and processes, the DOD can significantly reduce corrosion’s cost and effects on weapon system availability and reliability.

Advanced Coatings on Missile Launcher Rail Components to Reduce Life Limiting Wear

US Air Force – Group I

Missile Launchers LAU-128/129 used on F-15 and F-16 aircraft had a life limiting wear condition due to the use of legacy anodizing coating that resulted in the launchers failing. The failed rail bodies had to be replaced every 3 to 5 years, costing the USAF roughly \$10M per year. These launchers carry and fire, AIM-9M, AIM-9X (Sidewinder), and AIM-120 (AMRAAM) including their captive carry variants. In an effort to mitigate the high cost of replacing the rail bodies and the difficulty in manufacturing, the Armament Sustainment Division has worked with IBC Materials & Technologies, LLC, to develop novel coatings for the 7075 AL rail body and the steel missile hangers that increase hardness, wear and corrosion resistance. These coatings coupled with a more robust design of launcher dampeners has significantly mitigated the life limiting wear condition in the LAU-128 and LAU-129 launchers. After 9 years of testing in flight, rail bodies coated with IBC's PEO (plasma electrolytic oxidation) coating partnered with missile hangers coated in

IBC's DLC (diamond like carbon) coating have no measurable wear detected and continue in service. It is now standard for all new LAU-128 and 129 launchers to be coated with PEO and DLC coatings for enhanced wear resistance. This technology has lowered maintenance costs, lowered the new production needed to alleviate DMSMS issues and eliminated the need for solid film lubricant, as the combination of PEO and DLC has less friction.

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Problem Statement

Accelerated wear of LAU-12X (AMRAAM/Sidewinder) Missile Launcher Rails

- Typical wear-out in 3-5 years
- \$10M annual replacement cost + supply shortages
- Drives extra maintenance:
 - Checking for wear
 - Apply SFL to body
 - Repair nose erosion
- Legacy anodize coatings unable to withstand modern ops tempo

Benefits

- Environmentally friendly process—no acids or harsh chemicals.
- Corrosion resistance outperforms all Anodization Types.
- Eliminates application of Solid Film Lube (SFL) in field.
- Cost savings from reduced frequency of inspection.
- Cost savings from reduced component replacement rate.
- PEO coating technology solution demonstrated successfully on defense and commercial applications.

Technology Solution

Plasma Electrolytic Oxidation (PEO) and Diamond Like Carbon (DLC) coatings

- Applied to LAU-12X rail and associated components
- PEO and DLC processes fully qualified and matured to TRL 9 / MRL 9
- Operational testing began 2014, full production began 2019
- PEO & DLC coatings applied on over 1800 Missile Rails
- Zero measured wear on PEO coated rails over 9 years
- PEO & DLC Coating is saving \$8M+ annually for USAF fighter fleets



Complete Spot Repair UAS for Elevated Steel Structures

Apellix

Large steel structures often develop small areas of premature paint failure or corrosion requiring some level of repair, even though 99% of the structure retains a fully intact protective coating. Over the lifetime of the coating, the cost of multiple minor repairs may exceed the price of the entire coating, with the bulk of the expense relating to asset downtime and the cost of worker access to the elevated area.

Apellix is developing a system to allow the repair of small, elevated areas based on our patented software-controlled Spray Painting Drone. Using an autonomous unmanned aircraft system (UAS), this system performs cleaning, removal (blasting) of paint and corrosion to an ISO 8501 Sa1 brush-off abrasive blast standard (i.e., NACE No.4/SSPC SP7), and application of primer/base-coat/top-coat or protective rust inhibitor such as Corrocoat. The Apellix computer-controlled unmanned aerial vehicle (UAV) platform performs all tasks. This technology can reduce project time and expense by over 95% while keeping the asset in service.

The Apellix system can currently control the precision flight of a heavy-lift (140 lb. thrust) industrial UAV to within a few centimeters, allowing the accurate application of a 3000 psi pressure washing, a blast system, and the application of protective coating. Apellix has commercialized a pressure washing drone using 3,000 psi ground-based pumps and 230vac power (connected via tether). A UAV has also been developed (through pilot stage) for making contact with elevated structures to obtain steel wall thickness or paint thickness measurements under complete computer control (e.g., autonomous flight). In conjunction with AkzoNobel, Apellix has developed (but not commercialized) the ability to apply coatings with its computer-controlled UAV with a precision exceeding traditional painters.

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Problem Statement

Minor defects in the protective coatings protecting large steel structures (including vessels) are common and must be repaired to retain asset integrity and avoid more serious structural failure. The repairs are dangerous to workers and expensive in terms of the required time and number of personnel. More critically, the repairs often require total asset downtime to allow scaffolding, crane positioning, or rigging for rope access and the actual work.

Benefits

- Revolutionary increase in maintenance efficiency
- Eliminated downtime and lower overall cost
- Increased safety with all workers safely on the ground
- Reduced reliance on staffing
- Increased readiness, faster cycle time
- Integration of existing technology already in various stages of commercialization
- Applicable across-service to all branches, easy to transition for use by the DOD
- Creates a complete, auditable digital data record

Technology Solution

The Apellix Spot Repair UAV provides an easy-to-operate, fully portable computer-controlled drone platform where complete surface preparation and application of the remedial protective coating can occur with a single UAV. The easy-to-transport drone can be configured for different coatings, blasting compounds, and levels of surface preparation. The system is designed to operate in GPS-compromised outdoor environments. Autonomous flights can be configured based on individual repair requirements.



Nano Hybrid Polyurethane (NHP®)—The End of Corrosion



ToughGuard HP Coatings, LLC

NHP® is the only industrial coating in the global marketplace to enhance, restore, and extend the service life of freshly coated and oxidized painted surfaces by 10 years. NHP sets new benchmarks by extending the potential service lifetime of assets and reducing the costs associated with maintaining assets in a state of repair, thus improving the ROI for their operation.

Unlike conventional coatings, NHP Coatings penetrate deep into the pores of newly painted or highly oxidized paints to dramatically improve corrosion resistance, scratch and chipping resistance, chemical and long-term UV resistance. NHP Coatings are designed to be applied over conventional paints, are impervious to water and oxygen, and protect painted metal surfaces. This technology reduces maintenance frequency, recoating cycles, chemical costs (mixing, repair, cleaning), the length and frequency of repair and maintenance downtime, and the volume of coating material shipped/stored/applied to project surfaces. Customized "first-to-market" functional additives have also been developed that enhance the multi-functional attributes of NHP to record-setting

levels of performance.

ToughGuard NHP is manufactured using proprietary 3D nano-structured polymers producing extreme crosslink density. NHP is a one-component (1K), humidity cured, polyurethane / polyurea hybrid nano-coating that penetrates and forms a hard, protective, clear, topcoat surface.

NHP protects against corrosion, restores existing color and gloss, and resists UV degradation, extreme weathering, and chemical attack, as well as abrasion, chipping, marring, gouging, impact and scratching. It also features repellency properties for oil and dirt, water and ice, brake dust, algae and other environmental and biological contaminants.

Contact

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Problem Statement

- The annual cost of corrosion to our US military is estimated at \$25 billion.
- Continual corrosion maintenance keeps high value assets out of operational service.
- At a time of leaner military budgets coupled with every increasing potential adversarial interaction, the US military would benefit to find ways to reduce the out-of-service time of its high value assets to have at the ready to be deployed when and where needed.

Benefits

- The use of NHP Coatings will significantly reduce the ever-increasing monetary cost of corrosion to the US military.
- The use of NHP Coatings will increase the number of critically important military assets ready for deployment or deployed where they need to be rather than in maintenance facilities.
- The use of NHP Coatings will have a positive health impact on maintenance personnel due to the reduction of re-paints and all of the health issues that arise from the removal and stripping of old paints and the reapplication of new paints.

Technology Solution

- The innovation of NHP® Coatings are designed to tackle these issues head on by significantly preventing the problems of corrosion and by reducing the costs associated with ongoing maintenance programs.
- NHP Coatings work with existing coating systems.
- NHP Coatings reduce the amount of paint coatings needed thereby reducing costs and weights associated with paint.
- NHP Coatings dramatically increase the service life of paint coatings thereby reducing maintenance cycles due to corrosion.



Snakebite Blast Nozzles

BlastOne

“Snakebite” is a revolutionary family of blast nozzles that offer unparalleled performance and safety benefits. Developed by acoustical engineers at the University of Queensland’s Center of Hypersonics, this patented nozzle design reduces noise up to 75% as well as reducing fatiguing back-thrust up to 45%.

Snakebite’s proprietary design increases blasting speed when used with garnet abrasive. This reduces overall asset downtime by completing DOD ship repairs sooner.

Less than 10% of the energy generated in a blasting environment is utilized for actual blasting. More than 90% of energy used in the compressed air and abrasive is wasted, producing screeching noise. Snakebite nozzles employ a redesigned internal geometry which produces a more stable jet stream of abrasive while reducing back-thrust and noise.

Compared to standard blast nozzles, Snakebites offer significant improvement in safety and productivity. The field-tested average of 16-19 decibels reduction in volume protects the hearing of the operator and

surrounding trades, as well as reducing overall noise pollution near any public space. The 45% reduction in the nozzle’s (back-thrust) force reduces blaster fatigue and mitigates falling dangers involved when blasting at heights on platforms or scaffolding.

Due to the reduced back-thrust, the SnakeBite Strike—a #10 (5/8” orifice) nozzle now allows blasters to manage a nozzle that large over full shifts, whereas before it was too powerful for practical use. Field testing showed the Strike provided a 25-35% increase in blast pattern width and a 54% increase in blasting speed. With the Strike, two blasters can now do the work of three blasters using #8 nozzles, or four blasters using #7 nozzles.

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Problem Statement

Industrial sandblasting is notoriously fatiguing and creates noise pollution ranging between 113dB-120dB. OSHA requires employers to implement protective hearing equipment when noise exposure reaches 85 decibels averaged over 8 working hours. However, as many blasting job sites are in public areas or work alongside other construction trades, standard blasting volumes are detrimental to anyone near the jobsite not wearing hearing protection.

Benefits

Snakebite Nozzles are up to 75% quieter than standard nozzles, protecting the hearing of operators and surrounding trades.

A 45% reduction in the nozzle’s back-thrust reduces blaster fatigue and mitigates falling dangers involved when blasting on platforms or scaffolding.

Due to its reduced back-thrust, the SnakeBite #10 (5/8”) nozzle now offers blasters the following benefits:

- 25-35% avg increase in blast pattern width per sweep
- 54% increase in blasting speed over the most common #8 high-production nozzle

Technology Solution

BlastOne contracted acoustical engineers at the University of Queensland’s (Australia) Center of Hypersonics to develop the technology.

The Snakebite’s newly designed internal geometry reduces noise up to 75% (16-19dB) compared with standard blast nozzles.

The re-engineered nozzle also results in a 45% average reduction in back-thrust; increasing productivity by decreasing operator fatigue.





ENERGY, ENVIRONMENTAL, & HEALTH AND SAFETY

In order for the DOD organic industrial base as well as field-level sustainment activities to remain ready, relevant and resilient, close attention must be paid to worker safety and health, environmental concerns and hazardous waste, and energy availability and its efficient use. One of the lessons learned during COVID-19 is that personal protective equipment (PPE) is critical to continued and extended maintenance operations, without which, weapon system readiness would suffer. Maintainer health and safety are at the heart of every process and procedure across the DOD's vast sustainment enterprise; but advances in PPE technology,

automation, eco-friendly chemicals, and process monitoring are rapidly changing the way industry and the DOD are taking care of their people. At the same time, greater efforts are aimed at improving process efficiencies and output, while reducing waste streams. Many emerging capabilities are significantly more energy efficient, drastically reducing maintenance activity energy usage footprint. These technologies protect our greatest maintenance assets, our people, and ensure that energy is available at the point of maintenance where it is used to maximum efficiency.

Battery Analytics for Autonomous and Electric Vehicles Platforms

Astrolabe Analytics, Inc.

The DOD has a need for low-cost, autonomous delivery vehicles for all missions and terrain, be it land, marine, or air. These various platforms include electric vertical takeoff and landing aircraft (EVTOLs) for the Air Force, ground autonomous vehicles for the Army, or unmanned underwater vehicles (UUVs) for the Navy. In each case Li-ion batteries will play a role as either a primary or auxiliary power source.

These are demanding applications where the battery will be pushed to its limits. Vehicle operators and maintenance organizations must know how much longer the battery will be able to perform, both for the current mission (i.e., battery state of charge) and for future sustainment (battery state of health).

Under a USAF SBIR Phase 2 award, Astrolabe has developed methods for forecasting battery health and performance in electric aircraft, which can in turn be applied to related platforms across the DOD. The benefits of this technology apply across the lifecycle of new vehicle platforms. In the design phase, we can help develop certification bases (e.g.

with the FAA) and standard operating procedures around battery systems safety and performance for autonomous and electric vehicles. Once deployed, Astrolabe can help monitor the performance of battery-powered assets in the field to help forecast end-of-life issues, thereby reducing maintenance costs and ensuring high system safety and uptime.

Astrolabe is interested in partnering with organizations across the DOD and its suppliers to help enable these new classes of vehicles. Having won a Phase 2 SBIR, Astrolabe is eligible to receive sole-source funding agreements through Phase III opportunities across the federal government. Astrolabe is also interested in additional R&D opportunities with Phase 2 or CRADA to further develop our capabilities.

Contact

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Problem Statement

- The DOD has a need for low-cost, autonomous delivery vehicles for all missions and terrain.
- Regardless of the application or platform (EVTOLs for the Air Force, ground vehicles for the Army, or UUVs for the Navy), Li-ion batteries will play a role as the primary or auxiliary power source. These are demanding applications where the battery will be pushed to its limits.
- Vehicle operators and maintenance organizations must know how much longer the battery will be able to perform, both for the current mission and for future sustainment.

Technology Solution

Our machine learning methods enable state-of-the-art lifetime prediction across different scenarios:

- Temperature ranges
- Load profiles
- Battery chemistries

We have patent-pending methods for online and offline health monitoring of EVTOL battery packs developed under a USAF SBIR Phase 2 contract.

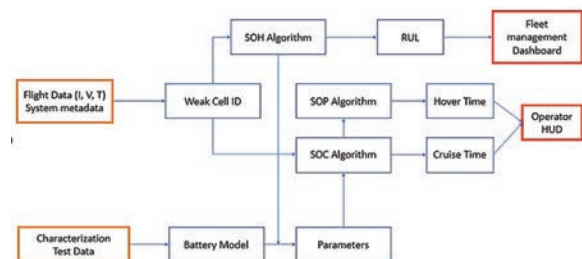
Battery forecasts can in turn be used across the product lifecycle to inform warranty design, quality control, field operations, and end-of-life retirement.

Benefits

Platform design phase: Develop certification bases and standard operating procedures around battery systems safety and performance for autonomous vehicles (including land, air and marine)

Operations phase: Analytics can be extended to help monitor performance of other battery-powered systems to improve key metrics like:

- Reducing maintenance hours
- Reducing battery replacement costs
- Ensuring system safety and uptime



Schematic for EVTOL battery analytics inputs (orange) and outputs (red)

Close Fit Respirators Resolve Issues of Neck Injuries (Who Would Have Thought)

GVS-RPB

The Elipse Tight-fitting Half-mask Range from GVS-RPB offers a form-fitting design that is NIOSH approved and provide a more secure and comfortable seal to the user's face. This unique design offers several benefits, including less interference with other PPE.

It is a known issue that welders often experience neck injuries due to extended welding shields, which are required to accommodate bulky respirators. This form fitting mask allows for a close-fitting welding mask, doubly reducing the weight of the PPE on the user's neck, thus decreasing the risk of neck injury.

Based on conversations with prime contractors, other benefits of the the Elipse's form-fitting design include:

- It fits securely, removing the feeling of sloppy cartridge attachment.
- It is much more lightweight, weighing less than 6 ounces.
- An unobstructed field of vision, increasing safety and convenience for the user.

The secure fit of the Elipse half-mask, combined with the pre-installed filter cartridges, means that the respirator is ready to use right out of the box. The Elipse Range includes models with protection from exposures including dust (particulates), fumes, organic and inorganic vapors, and chemical and ammonia based gases.

Overall, the Elipse Range of tight-fitting half-masks from GVS-RPB offer a reliable and comfortable solution for respiratory protection in hazardous environments. These products are available as a commercially available off-the-shelf (COTS) product.

Contact

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Problem Statement

The protrusion of tight-fitting respirators in industrial settings causes interference with other PPE, reducing compliance and increasing injury risk. Workers who wear welding shields are particularly affected by the large filter cartridges that require larger welding shields, making it difficult to fit into tight spaces and causing neck pain.

Therefore, finding a solution to reduce the protrusion of respirators while maintaining their effectiveness is crucial to enhance workplace safety and health in industrial settings.

Technology Solution

The Elipse Tight-fitting Half-mask Range from GVS-RPB is an innovative solution for users requiring respiratory protection in hazardous environments.

The unique design of the NIOSH approved mask incorporates filter cartridges that are embedded into the base, providing a more secure and form-fitting seal to the user's face. This technology reduces interference with welding shields and other PPE while increasing the field of vision for the user.

The Elipse half-mask enhances safety and comfort for users, making it an ideal choice for the organic industrial base.

Benefits

- The respirator can be effective while worn with multiple items of PPE, allowing for increased flexibility, comfort and versatility in hazardous environments.
- The sleek profile provides an unobstructed field of vision for increased safety and convenience.
- The double-layered nasal ridge design allows for a comfortable breathing experience while offering increased protection and reducing fogging of glasses.
- The adjustable four-point harness provides a secure and comfortable fit.
- The facepiece comes with pre-installed filters or cartridges, ensuring it is ready to use right out of the box.



Comprehensive Cybersecurity Solution for Multiple PLCs and DERs

NanoLock Security

NanoLock Security Systems is developing a cybersecurity solution that provides zero-trust protection for operational technology (OT) systems, including multiple programmable logic controllers (PLCs) and distributed energy resources (DERs). The OT Defender is a software-based cybersecurity solution that protects the life cycle of OT systems, from manufacturing to deployment and end-of-life.

NanoLock's OT Defender solution provides a unique and innovative way to protect OT systems against unauthorized access, firmware attacks, and other cyber threats using software solutions. The solution can detect any attempts to modify critical code or data and immediately alert the user or system administrator. This feature can prevent internal threats and human errors, which can compromise the safety of OT systems, including PLCs and DERs.

The OT Defender's device-level security features can prevent both internal and external threats to OT systems, including multiple PLCs and DERs. NanoLock's solution is especially critical for DERs,

which are small-scale power generation systems that are distributed throughout a grid and can include renewable energy sources such as solar panels, wind turbines, and battery storage systems. DERs are becoming important for offering secure, reliable, and cost-effective sources of power in critical situations.

NanoLock's cybersecurity solution has undergone extensive testing and simulation to ensure its effectiveness in protecting OT systems, including PLCs and DERs, against cyber threats. The technology has been tested in different scenarios and demonstrated its ability to prevent unauthorized access and firmware attacks. Next steps for development include further testing and validation in DOD applications to ensure its efficacy in critical situations.

Contact

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Problem Statement

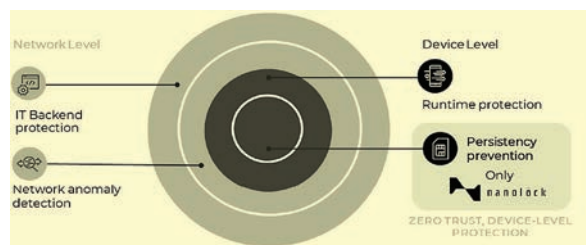
Operational Technology (OT) systems, including Programmable Logic Controllers (PLCs) and Distributed Energy Resources (DERs), are vulnerable to cyber threats, compromising their safe and reliable operation. Traditional cybersecurity solutions do not provide the necessary protection for OT systems, putting them at risk of unauthorized access, firmware attacks, and other cyber threats.

Benefits

NanoLock's OT Defender improves the agility, effectiveness, efficiency, and affordability of maintenance and sustainment operations for OT systems. Its zero-trust protection and device-level security prevent unauthorized access, firmware attacks, and other cyber threats, preventing internal threats and human errors. This technology is especially critical for DERs, which provide secure, reliable, and cost-effective sources of power in critical situations. Overall, the OT Defender can help ensure the safe and reliable operation of OT systems, including multiple PLCs and DERs, in critical situations.

Technology Solution

NanoLock Security Systems' OT Defender provides zero-trust protection for OT systems, including multiple PLCs and DERs. The software-based cybersecurity solution can detect any attempts to modify critical code or data and immediately alert the user or system administrator. Its device-level security features prevent internal and external cyber threats, protecting the entire lifecycle of OT systems.



Confined Space Monitoring System (CSMS)

Portsmouth Naval Shipyard, Innovation Project – Group I

The main goal of the CSMS is to monitor the health and safety of shipyard workers. This is accomplished by instrumenting mechanics with several sensors (e.g., physiological, location, and atmospheric) and other supporting hardware, which collect data from both the entrant and the environment. All sensors and portable hardware within the CSMS will be managed devices configured with specific device management policies that comply with required government security standards and operational constraints. The sensor data is processed and analyzed in near-real-time to generate estimates of health status and alerts for notable events or behavior. In addition to monitoring workers, the CSMS also streamlines several processes such as submitting and approving entry forms, signaling

confined space entry/exit, and locating personnel during an emergency.

In May 2022 initial shipboard testing was successfully completed with minor findings/changes. Software updates are underway to meet local intranet requirements. Further hardware testing will determine if fewer components can be used to produce the same results, saving costs and bandwidth. Final shipboard testing and final deliverable are scheduled to occur in Q3-Q4 of FY23.

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Problem Statement

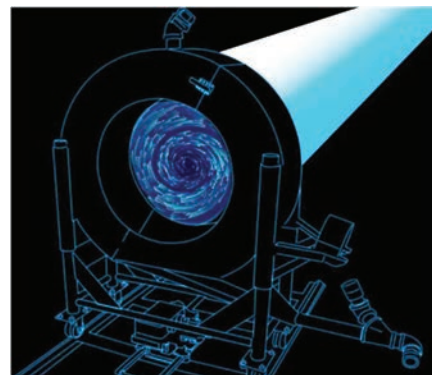
Most submarine overhauls require work to be performed in a confined space. The space must be tested for air quality and deemed safe for personnel to inhabit. Depending on the type and size of the space the clearance will expire after a certain amount of time. In that time, the air quality and the health of its inhabitants is largely assumed to be satisfactory. The CSMS provides real-time atmospheric monitoring of the space and the health of its inhabitants.

Benefits

- CSMS is a proven system that will immediately reduce availability man-days.
- Resources can be reallocated to other critical path jobs to further increase avail. efficiency.
- Improved understanding of entrants' health status via continuous physiological monitoring.
- Improved understanding of environmental conditions via continuous atmospheric monitoring.
- Faster response to changes in entrants' health status and requests for help/assistance.
- Faster response and increased awareness for first responders in emergency situations.

Technology Solution

The CSMS will support prevention, detection, and intervention of health and safety hazards while reducing the time and costs required by current practices. Key benefits include the ability to remotely monitor the environmental conditions of each confined space, the physical status and location of the mechanics in these spaces, and a communication link between remote monitors and the mechanics. Mitigating risks in confined spaces through more efficient and reliable monitoring will increase the safety of our personnel.



Enhancing DOD's Sustainment Capabilities with US-Made High Energy Density and Local Sourced Lithium Sulfur Batteries

Valgotech LLC

Valgotech is developing advanced lithium-sulfur (Li-S) batteries with a unique cell design and abundant, locally sourced cathode materials that protect against thermal runaway (fires), which are common with lithium-ion batteries. Valgotech's Li-S batteries have higher energy density than traditional batteries and use sulfur that is low-cost, locally sourced, and eco-friendly. The company's technology features sustainable sulfur-carbon cathode material and electrolyte systems that enable superior safety and high-performance batteries while using environmentally friendly processes.

Valgotech's Li-S batteries offer several advantages. First, they have a higher theoretical capacity for the sulfur cathode and a higher theoretical specific energy density. Second, they use low-cost sulfur, which is abundant compared to foreign-sourced Ni, Co, and Mn. Third, they greatly reduce overcharge dangers compared with conventional lithium-ion batteries by utilizing "integration chemistry" instead

of insertion chemistry. Fourth, Valgotech's Li-S batteries have a wide operating temperature range, making them suitable for use in harsh environments.

Li-S batteries face several challenges, which Valgotech is addressing by focusing on a unique electrolyte design with special additives and cathode optimization. Initial results show promising improvements in cycle life and high-power rate performance of the Li-S batteries. Valgotech's Li-S batteries have the potential to revolutionize energy storage with their high energy density, low-cost, and eco-friendly components. Next steps include further optimization of the materials to improve stability and performance.

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Problem Statement

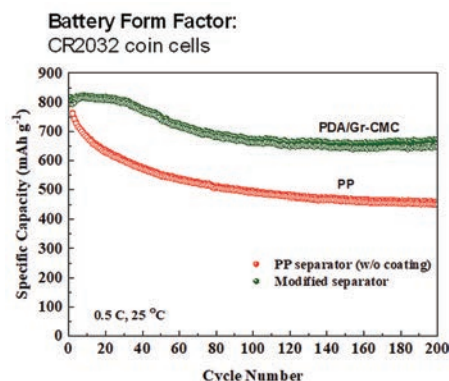
- Current lithium-ion batteries (LIBs) cannot meet the society's demand for batteries with longer cycle life and higher energy density.
- About 90% of battery cells used for different applications in the US come from Asia, mostly China, which poses a great national security risk.
- There is a need for locally-made battery technology.
- The locally-made battery technology should offer higher energy density, be cost-effective, eco-friendly, and have a longer cycle life.

Technology Solution

- An innovative lithium-sulfur (Li-S) battery technology is being developed to address the limitations of LIBs.
- These Li-S batteries have higher energy density, are cost-effective, and eco-friendly.
- The cathode material used in these batteries is sustainable sulfur-carbon, which replaces expensive and foreign-sourced cobalt, nickel, and manganese.
- The batteries use a system-based approach with unique electrolyte and cell design to create environmentally-friendly and high-performance Li-S batteries.
- This technology aims to reduce United States' dependence on foreign-sourced cells and cell materials.

Benefits

- Valgotech Li-S batteries offer a high theoretical capacity of 1675 mAh g⁻¹ for sulfur cathode, high specific energy density of 2600 Wh kg⁻¹ and low cost.
- Li-S batteries greatly reduce overcharge dangers by utilizing "integration chemistry" instead of insertion chemistry.
- The advantages of the cathode material include low cost, Earth abundance, and environmental friendliness, which make a viable chemistry for achieving an energy density above 500 Wh kg⁻¹.
- Li-S batteries' wide operating temperature range make them suitable for harsh environments.



Enhancing DOD's Sustainment Capabilities with US-Made Ultra Low Temperature Lithium-Ion Batteries

Valgotech LLC

In conjunction with Purdue University, Valgotech is developing ultra-low temperature lithium-ion battery technology that addresses the challenges of operating batteries in extreme temperatures by optimizing the electrolyte, separator, and cathode components for high-performing extreme temperature cells.

The technology employs a system-based approach to optimize the key components of the battery, namely the electrolyte, separator, and cathode. The innovation lies in the integration of a newly developed high salt concentration electrolyte (HSCE) and an advanced modified separator with a high-performance electrode to achieve high-performing extreme temperature cells.

The HSCE is compatible with various commercially obtained electrodes and has excellent electrochemical performance at extreme temperatures. Test data shows that the HSCE outperforms conventional electrolytes at sub-zero temperatures, with over 80% capacity retention at -20°C and over 40% capacity

retention at -40°C. The modified separator, which is a proprietary tri-layer polypropylene separator deposited with polydopamine and graphene-carboxymethyl cellulose, improves electrolyte wettability, electrical conductivity, and regulates Li-ion flux, resulting in increased cycle stability and Coulombic efficiency.

The optimized electrode, NbWO₃, has shown promising in sub-zero temperatures under high current rates, with over 95% capacity retention at -20°C. The technology has been demonstrated in various cell configurations, including high-voltage NCM/graphite full cells, LTO half-cells, and sub-zero pouch cells.

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Problem Statement

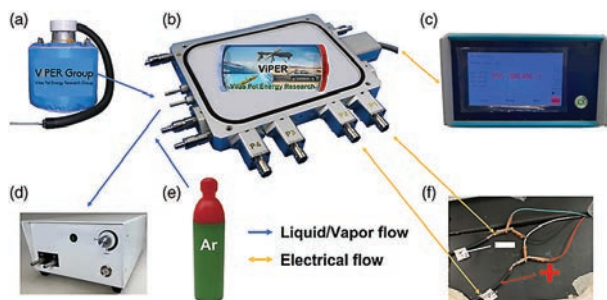
- Operating batteries in extreme temperatures is challenging
- Low-capacity retention, decreased cycle stability, and decreased Coulombic efficiency are common issues
- These limitations hinder the application of batteries in space, military, and other industries where extreme temperatures are common

Benefits

- Test data shows that the technology outperforms conventional batteries.
- The technology achieves over 80% capacity retention at -20°C and over 40% capacity retention at -40°C.
- The modified separator improves cycle stability, Coulombic efficiency, and electrolyte wettability.
- The optimized electrode has shown promising sub-zero temperature performance under high current rates.
- The technology has potential applications in various industries, including transportation, energy storage, and defense.

Technology Solution

- In conjunction with Purdue University, Valgotech is developing ultra-low temperature lithium-ion battery technology that optimizes the electrolyte, separator, and cathode components for high-performing extreme temperature cells.
- The technology uses a high salt concentration electrolyte (HSCE) and an advanced modified separator with a high-performance electrode.
- The HSCE electrolyte is compatible with various commercially obtained electrodes and has excellent electrochemical performance at extreme temperatures.



Improved Visibility and Comfort While Painting, Thanks to a Respirator?

GVS-RPB

The T-Link Painting Respirator is a great solution for painters, as this equipment not only protects them from breathing in the chemicals in their environments, it also helps with visibility and keeping the overspray off of their skin. A painting hood, a typical form of protection, can become too loose when filled with breathing air. This can mean that when a painter turns their head, the hood doesn't move with it. Furthermore, wet paint overspray can settle onto the face shield and block the clarity of vision.

The T-Link offers a great solution to the above challenges for 3 main reasons.

- It has suspension and padding that are very customizable to any painter's head size/shape
- It has a larger field of vision, both when looking side-to-side and down.
- It has an optional 7-layer tear-off lens which help to mitigate the challenges of overspray both because each layer is easy to remove, and because the layers are laminated together.

The main benefits of this design include:

- Better ergonomics and comfort for the wearer. This improves effectiveness (from increased alertness) and efficiency (because painters can wear them for longer).
- Better field of vision. The larger face shield and its ability to move with you mean that you're better able to see your work surface.
- Better Clarity. The 7-layer cassette lens means that when your vision is sacrificed because of overspray you just tear-off the outermost layer, re-establishing great clarity without stopping your work.

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Problem Statement

- The weight of a painting hood on a painter's head can tend to create muscle soreness due to an unbalanced or poorly fitting helmet structure.
- While leaning down or looking up to paint the bottom of structures, painting hoods often slide around on a painter's head. This reduces visibility and creates frustration while visibility may already be a challenge.
- In a painting environment where wet spray is used, overspray can cause visibility issues by layering onto the face shield of a paint hood. This can mean that painters apply too much or too little paint, both of which lead to rework.

Benefits

- The adjustability of padding and suspension mean better ergonomics for operators in painting environments, which means that operators can paint for longer periods of time while feeling more comfortable and alert throughout their shift.
- The adjustability of the T-Link means that it moves with you when you turn your head, and the larger face shield design increases your side-to-side and downward line-of-sight.
- The increased visibility of the Cassette Lens enabled Volvo Heavy Trucks to reduce rework by 90%, significantly reducing costs.

Technology Solution

- The T-Link Painting Respirator offers suspension and padding on the inside of the helmet that are very customizable to any operator's head shape, while other products take more of a one-size fits all design approach.
- The field of vision is much larger than other painting hoods on the market.
- Clarity of Vision - RPB's 7-Layer Ultra-Clear Cassette Lens includes 7 layers of super clear plastic that is laminated together. Once the outside most layer is covered in overspray, it is easy to remove to expose the next layer, which offers you an ultra-clear vista once again.



Innovative Solvent Technology

Aurora Supply LLC

Triple7 and Purasolve chemical technologies offer safer and more environmentally compliant alternatives to traditional maintenance solvents and degreasers used across all sectors of Defense.

Traditional toxic substances not only pose a threat to human health and the environment but also carry a high risk of fire and are expensive to manage. This emerging technology provides solvents that work as well as or better than traditional chemicals, with solvents replacing TCE, benzene, n-hexane, and others for weapons cleaning, brake cleaning, parts cleaning, paint clean-up, and more.

Though these alternative technologies may be initially more expensive to purchase, they result in significantly lower handling costs, less storage and transport issues, and reduced mechanical and administrative controls in the use of solvents. Additionally, these solvents promote greater human safety and environmental outcomes.

In Australia, the Army, Navy, and Air Force have already adopted the technology, eliminating solvent

waste streams from parts washers and saving thousands of dollars on ventilation requirements while reducing exposure to toxic chemistries. The US Marines recently noted that no other weapons cleaner works as well as what they've experienced with this technology. And NATO's Codification Support Section Chief commented that the technology is an effective approach.

However, recognition and support from the US DOD and DLA are necessary to support the development of a full range. The next steps for the technology include testing, integration, and adaptation to DOD sustainment systems. The development of the full range of solvents could lead to significant savings, greater safety, and environmental benefits.

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Problem Statement

- The use of solvents and degreasers such as MEK, Acetone, Toluene, TCE, n-hexane, and chlorinated solvents in the Defense Industrial Base pose a serious threat to human health and the environment, akin to the worldwide issue of asbestos.
- Despite their recognized dangers, the adoption of safer alternatives has been painfully slow, leading to increasing litigation, rising costs, climate change, and fatalities.
- It is imperative that urgent action is taken to address this pressing problem and phase out the use of these hazardous chemicals before it's too late.

Technology Solution

Revolutionary Triple7 and Purasolve technologies harness the power of renewable plant sources to create fully recyclable solvents with minimal toxic levels, delivering innovative and sustainable solutions.

By placing safety, health, and the environment at the forefront of product development, while optimizing efficiency and cost-effectiveness, these next-generation solvents perfectly align with today's needs.

With low vapor pressure and high flash points, they enable 50+ times reduction in consumption, lower the cost of ownership, and help organizations to achieve their EHS and ESG goals.

Benefits

- Triple7 and Purasolve technologies offer a solution to compliance, litigation, and chemical/solvent ownership costs for the DOD
- Safer and sustainable alternatives to hazardous solvents and degreasers
- Reduce maintenance expenditure and asset damage
- Recyclable solvents and degreasers that are low evaporants has led to an 80% reduction in inventory, streamlining assets for a safer environment
- Protect service personnel from toxic health issues, fire, and fumes
- Conform with OSHA and EPA legislation



Mineral Oil Recycling

Apfelbaum Industrial, Inc.

Oil is an element indispensable for the operation of machinery, tanks, trucks, and all types of military vehicles, vessels, helicopters, and airplanes. We offer state of the art automatic and mobile technology for mineral oil recycling. Successfully tested for more than 20 years in transformer oil, we restore the oil to close or better than its original standard values. We leave the oil as base oil, the final process is to add the required additives. It is potentially applicable to all the DOD branches with a small addition; instead of having one additive injection device, we have to add more tanks and a pump. Their mobility allows you to bring the equipment anywhere, even remote sites. The transition should be easy and short term—feasible to use by the DOD.

Every year more than two billion gallons of oil are improperly disposed of, according to the Department of Energy. The solution is our oil reclaiming mobile equipment. The technology has already been proven for over 15 years in different countries; no chemicals are used in

the innovative process. We have basically four processes: moisture removal, dust removal, metal particles and the rest of the solids' removal, and vacuum to remove all the gases. The reclaiming process removes the rest of the contaminants as paints, and the most important, sulphur removing under the standard values. The oil is left ready to make any type of oil by just adding the additives, depending on the type of oil required.

Contact

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Problem Statement

Every year more than two billion gallons of oil are improperly disposed according to the Department of Energy. There is a need for a mobile technology for mineral oil recycling.

Benefits

- Reduce the annual cost for mineral oil purchasing
- The logistics for oil supply can be reduced
- Oil changes can be done on time because the reclaimed oil is made on the same site where is needed.
- Final disposal for waste oil can be reduced dramatically, reducing the expenses
- Compliance with carbon reduction
- Power transformers' useful life should be extended

Technology Solution

The solution is our oil reclaiming mobile equipment. No chemicals are used in the innovative process. We have basically four processes: moisture removal, dust removal, metal particles and the rest of the solids' removal, and vacuum to remove all the gases. The reclaiming process removes the rest of the contaminants as paints, and the most important, sulphur removing under the standard values. The oil is left ready to make any type of oil by just adding the additives, depending on the type of oil required.



MRO Chemical and Equipment Rationalization

Unichem

Unichem assists government, defense and industry eliminate risk through the rationalization of chemical inventory.

By utilizing the hierarchy of controls principle and other globally recognized practices, Unichem helps organizations reduce costs, improve productivity and create safer work environments.

The opportunities of improving the financial base line by implementing safer work practices

through chemical rationalization are endless, and a project we are passionate about working on with you.

Contact

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Problem Statement

Over many years and as a result of numerous Defense environments, the accumulation of chemical inventory and related equipment has become a logistical nightmare, with transportation, storage, and disposal being only few of the more obvious issues.

Chemical safety, audits, EPA compliance, environmental guidelines, dangerous and toxic liquid and gas exposure, high compliance costs, asset damage, personal health, workplace risks, reduced equipment life cycles and even death are all problems that can be addressed via MRO Chemical and Equipment Rationalization.

Benefits

- Reduce the annual cost to the DOD of asset damage caused by corrosive chemicals in all areas of Defense
- Significantly reduce personnel exposure to toxic gases and dangerous goods
- Extend the service life and performance of assets through reduced sustainment requirements and improve maintenance procedures
- Reduce “cost of ownership” due to reduced handling and storage requirements
- Sustain fewer chemical assets—up to 80% reduction
- Protect service personnel from dealing w/toxic health issues

Technology Solution

Since 2000 Unichem have dedicated resources to safer, cleaner, greener working environments. Fundamentally the inclusion of purpose-built chemical solutions for Defense will transform workplace safety, improve environmental outcomes and sustain morale, whilst reducing sustainment issues and improving maintenance practices.

Smart technology implementation will help preserve and care for Defense workforces through smart chemical applications that eliminate workplace hazards and environmental risk. By conducting business in an environmentally responsible manner, it will also help to protect the earth and its natural resources and prevent climate change.



Oyster Restoration

Chemistry, BSC, Valdosta State University

Our shorelines are a critical parameter for various national security issues. With parameters such as rising sea levels and increasingly destructive storms, an economical method is needed to let nature restore herself. The use of treated pine and nutrient-enriched concrete (NEC) is a unique approach for oyster restoration that focuses on the chemistry of the material being deployed. It contains a chemical cue to attract oyster larvae in the water column, nutrients that can initiate a biofilm needed for oyster settlement, and nutrients that are critical for the early stages of life for the oyster. NEC can be molded into different shapes and sizes and be deployed as a standalone material or attached to an existing structure. The NEC and treated pine can be mass-produced and easily deployed by an individual working in a small boat or carrying materials from a shoreline. We have successfully tested our materials along the Florida panhandle and the Georgia coast.

“With nearly 562,000 installations on 4,800 sites scattered across the globe, America’s armed forces rely heavily on safe, secure infrastructure, free

from outside threats. The Pentagon has come to recognize sea level rise as a direct threat to the 1,774 of their sites that occupy 95,471 miles of the world’s coastline...” said John Conger, who served as Secretary of Defense for Energy, Installations and Environment. A 2018 *USA Today* article entitled “Military on front line of battle with sea level rise,” reported Conger saying, “This year, for the first time, the Secretary of Defense is conducting a military-wide climate change/sea level rise threat assessment. Each of the five branches of service will be required to provide a list of its 10 most threatened installations and suggestions for mitigating against whatever dangers exist.”

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Problem Statement

Climate change can have impact not only on our society but also our national defense. Sea level rise is a well-documented and growing problem, as is the increase in destructive weather patterns such as hurricanes. The problem is worldwide almost 90% of historically oyster bars have vanished not only increases the impact on shorelines but also lowering water quality and decreasing fish stocks.

Benefits

We believe our method can be implemented on a much larger scale for a smaller financial commitment. The materials are substantial and would provide a new market worldwide for U.S. timber (if patent rights secured). We have tested these approaches along the Florida panhandle and the coast of Georgia (Skidaway River). These materials are light enough to settle oysters in a larvae rich environment, then move them to an ecosystem with low/no oyster larvae to restore oyster populations.

Technology Solution

Our material can settle and rapidly grow diploid or naturally occurring oysters. It is economical and adapts to different terrains. Specifically, pine, when properly treated, can be used to selectively attract and grow oysters. Worldwide over 90% of historical oyster populations have been decimated and the current approach is not sustainable except for small areas. In addition a novel type of concrete dubbed NEC or nutrient enriched concrete is used and the selective growth for oysters (vs. fouling organisms, barnacles, etc.) is evident.



Passivating Descalers with Zero Corrosion

Envirofluid

Limescale or calcium scale is a major problem for many industries who rely on water equipment such as pipes, pumps, heat exchangers, boilers and cooling towers. Even small amounts of limescale build-up in systems like these can result in dramatic energy use increases, not to mention reduced flow rates and lost production. In some cases, components affected by limescale can become the root cause of large and extremely costly failures of expensive equipment.

Removing limescale build-up is necessary to keep water-operated machinery running efficiently and to prevent equipment failure. Harsh

acids such as Hydrochloric Acid and Sulphamic Acid, are commonly used as chemical descalers in the workplace.

These acids are corrosive and dangerous, with the potential to cause devastating injuries to people. Disposing of harsh acids also creates environmental challenges that can be expensive and time consuming for businesses to resolve.

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Problem Statement

Scale and calcium growth issues abound throughout the DOD, creating the need for costly sustainment that often cause added asset damage and increased maintenance expenditure. Standard descalers are corrosive.

Additionally, the servicing of onboard equipment requires costly disassembly and refit procedures (especially submarines). Dangerous goods (corrosive acids) also involve complex management and reporting programs as traditional cleaning substances used are composed of hydrochloric, sulphamic and phosphoric acids which are toxic and require extensive personal protective equipment when transporting, storing and handling.

Benefits

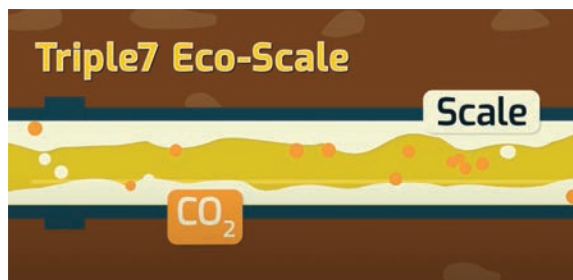
- Reduce the annual cost to the DOD of corrosion, asset damage, rubber deformation as a result of acidic chemical attacks
- Extend the service life and performance of systems, pipework and associated equipment and other damage to sensitive equipment
- Enable in situ cleaning operations reducing down-time and man-hour requirements
- Protect personnel from dealing with toxic health issues and acid burns
- Able to operate within sensitive radar system cooling
- Product has radiation reduction properties

Technology Solution

New technology has finally produced a work safe limescale removal system that doesn't rely on highly corrosive chemicals to dissolve away deposits.

Triple7 descalers will not erode or corrode metal surfaces or damage rubbers or elastomers. They are safe to use on pumps and pipework in situ, saving enormous time, effort and money by not having to remove equipment from cooling towers, ship systems, heat exchangers or other water-operated machinery.

100% biobased acids from renewable plant-based sources protect assets, people and the environment.



Ultrasonically Activated De-Paint (UADP) Technology

US Air Force – Group II



Coating removal from military components is commonly required during repair and maintenance operations to inspect for underlying physical damage. For aircraft wheels and other similar sized parts, soaking in hazardous methylene chloride (MeCl₂) or n-methyl-2-pyrrolidone (NMP) is followed by plastic media particle blasting to completely remove paint prior to inspection for cracks. Preventing exposure to volatile organic compounds, release of hazardous air pollutants, and disposal of the resulting hazardous waste is a serious environmental issue across all DOD maintenance operations.

Under Environmental Security Technology Certification Program (ESTCP) sponsorship, the AF Life Cycle Management Center (AFLCMC) worked collaboratively with IBC Materials & Technologies and University of Dayton Research Institute to develop an environmentally friendly aqueous-based ultrasonically activated de-paint process (UADP) that completely removes top-coat and primer without damaging underlying anodized coatings. Use and disposal of hazardous chemicals and plastic media is

eliminated, worker protective measures are minimal, and overall process time is competitive. The process was initially investigated as pretreatment for more complex processes, until it was discovered the ultrasonic activation in water with non-hazardous additives can work standalone, will remove the coating in sizable, easy to dispose pieces, and only requires three steps: basic preclean/degrease, ultrasonic agitation, and final pressure wash.

The process has been demonstrated on pilot lines at IBC and the AF Advanced Technology Training Center at Warner-Robins, GA. Honored with ESTCP Project of the Year Award in 2022, ESTCP recently awarded AFSC-Robins a follow-on project to further scale and demonstrate the process on additional depot and cross-service parts.

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Problem Statement

- Current DOD depot maintenance de-painting operations use chemical strippers and plastic media blasting (PMB)
- Generates large amounts of hazardous waste creating environmental issues
- Exposure poses significant employee health concerns
- AF landing gear overhaul operations annually consume 10,000 gal of paint stripper and 36,000 lbs of PMB
- EPA is restricting use of toxic paint stripping chemicals
- Problem exists across all military services

Benefits

- Elimination of toxic chemicals and plastic media from DOD de-paint operations
- Improved occupational health conditions for operators
- Reduced cost of hazardous waste disposal and pre-treatment requirements
- Significant reduction in employee personal protective equipment (PPE)
- Leaves intact substrate anodizing

Technology Solution

Ultrasonically Activated De-Painting (UADP):

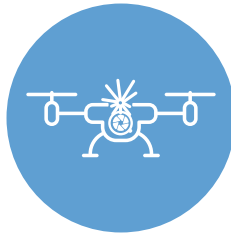
- Application of high-intensity and high-frequency sound waves to promote coating separation from component substrate
 - Water-based environmentally friendly solution
 - Easy filtration and disposal of separated paint
- In addition, no hazardous chemical paint strippers or PMB required, non-line-of-sight process—works for complex geometries, and process is scalable.



Before



After



ENHANCED INSPECTION

Prior to every military operation, weapon systems and equipment must be thoroughly inspected to ensure safe and reliable performance as well as mission completion. Additionally, every maintenance action is predicated on an in-depth and sometimes complex inspection of material condition. The sheer volume of inspection taking place across the DOD on a daily basis is mind-boggling. As most inspection is performed manually by experienced artisans, maintainers, and quality assurance specialists with “calibrated eyeballs,” a great opportunity exists to completely re-think how the DOD can enhance its inspection capabilities via innovation

and technology insertion. Non-destructive inspection and testing (NDI/ NDT) will continue to advance as new sensor technology matures, new imaging technologies are employed, AI-based interpretive algorithms are developed and validated, electronic diagnostics progress, built-in-testing expands, and the use of automation and robotics is integrated into maintenance. The former DOD Director for Enterprise Maintenance Technology once noted that “developing and integrating enhanced inspection represents the single greatest opportunity to drastically improve the ratio of maintenance dollars spent to materiel readiness provided.”

FLX BOT

FLX Solutions

FLX Solutions has produced a functional collaborative robot (cobot) prototype, the FLX BOT, to be used by maintenance techs to more safely, effectively, and efficiently inspect and repair critical equipment while reducing planned and unplanned downtime. The FLX BOT is a patented 1" diameter, handheld snake-like cobot that can be safely inserted into dangerous confined spaces or running machines without costly dismantling time while also minimizing downtime. Its modular configuration is made up of identical, interchangeable links each equipped with sensors to allow for autonomous obstacle avoidance. The FLX BOT can quickly be equipped with various, customizable end effectors such as 360° and 3D cameras, grippers, leak detectors, microphones, NDT sensors, etc. to visually and auditorily investigate potential problems, read part numbers, measure worn components, 3D map areas, or find leaks.

The FLX BOT has been identified as a tool that could benefit DOD techs on bases, ships, shipyards, or other areas with confined spaces. FLX Solutions received a paid demo with the US Navy as one of ten

finalists in the NSIN tank inspection competition. While onboard the USS Midway, the FLX BOT was successfully used to 3D map a naval tank, inspect overhead HVAC areas as well as other various confined spaces including within a jet engine. Other DOD departments have also expressed interest in demos, such as the Norfolk Naval Shipyard, where we presented the capabilities of the BOT to access confined spaces.

By continuing our engagement with further interested parties on large pilot implementations, we will continue to expand the FLX BOT user experience and grow our possible end effectors. The ultimate goal is to be listed in the GSA catalog, which was requested by numerous folks aboard the USS Midway.

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Problem Statement

- Maintenance and operations technicians within the DOD face a major challenge to quickly and efficiently inspect critical machinery and confined spaces on bases, ships, and shipyards
- The status quo (manual labor using simple hand tools) usually requires costly dismantling/repair, significantly increases the time to complete projects and perform routine maintenance, and frequently puts maintenance technicians in precarious situations
- Collaborative robots (cobots) are the clear solution, providing a safer, more effective way to inspect and make repairs in confined spaces

Benefits

- FLX BOT is lower cost, lighter, smaller and provides more articulation than the other robotic competitors
- Each link = 0.5lbs so easily handheld
 - 1" diameter
 - Ability to rotate 360° with extendable links
 - Autonomously avoids obstacles within confined spaces resulting in minimal training needed
 - Can be attached to an extension pole to reach overhead locations
 - Allows worker to remain safely on the ground while inserting into confined space or inspecting at heights

Technology Solution

- The FLX BOT is a patented 1" diameter, handheld, snake-like cobot that can be used with minimal training by technicians to access hard-to-reach areas to keep them safer and provide a more efficient method of maintaining key pieces of equipment
- It is modular, made up of identical, interchangeable links that each have a camera and sensors for autonomous obstacle avoidance
- Interchangeable, customizable end effectors include 360° and 3D cameras, grippers, leak detectors, NDT sensors, and more



Spector AI-Based AR Platform for Aircraft Inspection

Spiral Technology

The USAF's 71.5% mission-capable rate in 2021, due to an aging fleet with some aircraft exceeding 50 years of service, poses a threat to national security. Inspection procedures take up to 30% of repair time, and manual data collection often leads to incomplete records and duplicated effort.

We propose Spector, an augmented reality (AR) platform for aircraft inspection with automated quality assurance capabilities. It works on an AR headset like Microsoft HoloLens2 allowing users to tag the defect location on an aircraft with a virtual marker and attach relevant information to it. Technicians would be able to create a comprehensive quality record of the discovered issue with accurate defect location, digital-first notes, and rich media.

Markers are persistent in space which means that they could facilitate the handovers between the different repair teams. Technicians would not need to flip through the inspectors' hand-written notes trying to find the defect location, they would rather see the areas of interest directly through the AR headset.

In addition, Spector has an AI-powered image recognition model that analyzes pictures taken during the inspection and prompt the users if there is an actual defect or problem on them. It is already capable of detecting corrosion such as paint cracks and craters while in some time it will be able to recognize erroneous assemblies and mistakes in circuit connections.

As a result, Spector could streamline the inspection workflow and facilitate the repair and overhaul of the aircraft. In addition, the repair activities would accelerate due to increased accuracy of the quality records, and availability of the historical maintenance data aggregated on the digital twin of the aircraft.

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Problem Statement

- Aircraft depot level repair requires continuous inspection / re-inspection efforts, meticulous tracking of the performed procedures, and multiple handovers between different crew. Record-keeping is often paper-based.
- This takes significant time (inspection could be taking up to 30% of the total overhaul time) and raises the risk of a human error. Miscommunication during handovers and incomplete records cause idle time and duplication of work.

Benefits

Higher mission capable rates of the fleet and lower repair costs achieved due to:

- Faster inspection workflow with fewer data recording errors and hands-free issue reporting
- Faster engineering disposition and repair with accurate capturing of the defect location, more comprehensive quality records (pictures, videos of the inspection and repair), and higher transparency of the defect resolution status
- Better intelligence with focused continuous improvement using data aggregation on a digital twin

Technology Solution

- Our solution is Spector, augmented reality (AR) platform for quality inspections. It allows aircraft technicians document the defects via the AR headset and plug them the digital twin of the part to save time and avoid creating inaccurate quality records.
- The key ingredient is a marker in AR connecting digital quality records with the physical defect location. Markers are persistent in space.
- In addition, it has an AI-enabled automated quality assurance capability helping to detect defects in paint, cracks in the aircraft skin, incorrect assembly, etc.
- It is a TRL 7 product, it was implemented and tested in composite manufacturing with Fortune-500 company.



Thermal Imaging for PCB Inspection

2d Maintenance Battalion/ELMACO

Thermal cameras are an essential tool for repairing electronics equipment. These cameras can quickly identify areas of high temperature that may indicate faulty components, enabling repair technicians to accurately and quickly diagnose faults. In addition, thermal imaging can detect issues that are not visible to the naked eye, ensuring comprehensive repairs and minimizing the likelihood of future failures.

The current development status of thermal cameras is advanced, with many manufacturers producing high-quality cameras capable of detecting even the slightest variations in temperature. Moreover, recent advancements in camera technology have made these devices more compact and more affordable.

Test and simulation data supporting the performance claims of thermal cameras demonstrate that these devices can detect a wide range of faults in electronics equipment, including overheating components, damaged or corroded wiring, and failing circuit boards. These cameras can also detect temperature changes in complex electronics

systems, such as those found on aircraft, submarines, and other vehicles.

To continue developing and improving this technology, further research is necessary, including additional testing and simulation of thermal cameras in a variety of environments. It may also involve exploring new applications for thermal imaging technology, such as in unmanned aerial vehicles (UAVs), robotic systems, and other emerging technologies.

Overall, the use of thermal cameras in repairing electronics equipment in the DOD offers significant advantages, including improved fault identification, reduced repair time, enhanced repair accuracy, lower repair costs, and improved equipment readiness.

Contact

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Problem Statement

Long lead times and ineffective troubleshooting methods for identifying faults in electronics equipment are reducing unit readiness and the level of which units can operate upon deployment.

A mitigating factor to reduce repair lead time is increasing a technician’s ability to identify defective areas, quickly, efficiently, and reliably.

Benefits

- Reduced repair time: by promptly identifying faults, equipment downtime is reduced
- Saves on average 1 to 4 days of fault isolation
- Lower repair costs: reduced equipment downtime and improved repair accuracy allow repair cost reductions
- Improved equipment readiness: with faster and more accurate repairs
- Training to use the camera only takes one hour with provided user guides
- Scales to allow fault isolation at all maintenance levels
- Simple and scalable integration DOD wide

Technology Solution

Thermal cameras solve the problem of accurately identifying faults in electronics equipment during repair, a process that is often time-consuming and unreliable. By quickly detecting areas of high temperature that may indicate faulty components, these cameras provide an efficient and effective solution, reducing equipment downtime and repair costs. Additionally, they can detect issues that may not be visible to the naked eye, such as heat build-up in components that could lead to future failures, ensuring comprehensive repairs.



Vacuum Crawler Robotic System (VCRS)

Boston Engineering Corporation

The Vacuum Crawler Robotic System (VCRS) is a modular, ruggedized work execution platform enabling workers a means to complete inspection and modification tasks from safe locations without requiring erection of scaffolding or other temporary infrastructure. The capability is developed from a commercial version and modified to provide open architecture and common robot operation system (ROS) software. The VCRS is modular, allowing reconfiguration and common interconnectivity interface to support multiple sensing and work execution payloads. Development activities began with additional scope added to a NAVSEA SBIR and currently is advancing under contract from NCMS in collaboration with Portsmouth Naval Shipyard (PNSY). Testing of the system is planned for PNSY in 2024.

The above water variant design, technical data package for production, and shipyard certification will be completed in 2024. The modular nature of the technology sets the stage for establishing an underwater suction attached variant and dual

configurations of the commercial version. The Technology Readiness Level (TRL) is 6 for the ruggedized DOD version and will be TRL 7 once testing is completed in 2024. The Manufacturing Readiness Level (MRL) is 4 but is expected to be MRL 5 at the completion of the NCMS contract. The VCRS offers significant benefits in work execution efficiency (less time to complete required tasks) and increased worker safety (execution of tasks from a safer location). VCRS has similar applications in many industrial settings such as commercial shipping, wind power systems (shore and offshore) and energy infrastructure and where structural surfaces are non-ferrous.

Contact

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Problem Statement

- The need to erect support structures, like scaffolding, to get workers to desired locations requires added time to maintenance schedules already under pressure.
- Rapid deployment of maintenance and sustainment capabilities, such as inspection or cleaning systems, is needed to allow flexibility in the skill level required to perform required tasks.
- Capabilities are needed that reduce requirements for workers wearing safety gear or working in unsafe locations.
- Multiple design solutions increase overall training time and required spare parts stocking.

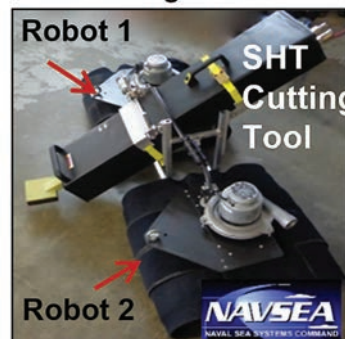
Benefits

- Quick System setup. Allows rapid work start and eliminates the need to erect scaffolding.
- A modular TRL 7 design provides easier modifications to special configurations and new sensing and work attachments.
- Ruggedized system worthy of operating in DOD operational environments, such as shipyards and depots.
- Scalable platform providing versions sized for specific applications; e.g., smaller for aircraft, larger for ships.
- Open architecture enables capability advancement contributions by multiple people/organizations in industry, academia and DOD R&D Centers.

Technology Solution

- The Vacuum Crawler Robotic System (VCRS) provides workers a safer work location and eliminates the need for temporary erected infrastructure, use of safety gear or harness.
- VCRS can be outfitted with work and inspection capabilities appropriate for the job; i.e., spray nozzles similar in capabilities to those carried by workers needed to remove biofouling of hulls of vessels in dry dock.
- VCRS, part of the Family of Sustainment Assisting Robotics (FOSAR), leverages open architecture, interchangeable work packages, and inspection devices.

Dual Configuration



WeldScout™: Intelligent Welding Inspections For Critical Infrastructure

Cumulus Digital Systems



WeldScout™ is an image recognition technology that ensures quality for welding by using artificial intelligence (AI) to rapidly identify defects in weld inspection scans. Its primary purpose is inspecting weld integrity for the structural and piping connections that compose the world's most vital industrial infrastructure, including aerospace, shipbuilding, bridges, data centers, and more.

The system uses a trained algorithm to evaluate phased array ultrasonic testing (PAUT) scans of welding and identify potential defects. PAUT is rapidly replacing radiography as the preferred method to inspect welds. WeldScout™ improves the speed and accuracy of welding inspectors by flagging potential defects and prioritizing those for closer study. It also enables scans to be reviewed by certified inspectors anywhere in the world, not just those at the facility.

WeldScout™ has been piloted on multiple projects, proving its effectiveness in real-world environments. During a pilot on a large project in South Korea,

WeldScout™ was found to make inspections 5X faster, increasing welding inspector productivity from 5 meters/hour to 27 meters/hour. Overall, it decreases inspection and data processing time by over 50%.

This technology is especially relevant for maintenance purposes, because proactively detecting potential welding defects before accidents occur is the most cost-effective and sustainable approach.

WeldScout™ is currently in prototype form. Cumulus plans to complete development for the first commercial release later this year, and then expand the platform to include many other types of inspection data.

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Problem Statement

- Inspecting weld integrity is a critical maintenance function, yet a shortage of certified inspectors is causing significant delays
- This is causing a backlog of maintenance projects that contributes to major safety and sustainability issues
- A system to augment human inspectors and increase their bandwidth is needed in order to ensure the continued quality of the world's most vital infrastructure

Benefits

- During a pilot on a large project in South Korea, WeldScout™ was found to make inspections five times faster, increasing welding inspector productivity from 5 meters/hour to 27 meters/hour.
- Overall, it has been found to decrease inspection and data processing time by over 50%.
- Analyzes inspection data to ensure quality, safety, and strength, and that welds meet all governing regulations and specifications.

Technology Solution

- WeldScout™ uses a trained AI algorithm to evaluate Phased Array Ultrasonic Testing (PAUT) scans of welding and identify potential defects.
- This improves the speed and accuracy of welding inspectors by flagging potential defects and prioritizing those for closer study.
- It also enables scans to be reviewed by certified inspectors anywhere in the world, not just those at the facility.





FACILITIES AND INDUSTRIAL PROCESS MODERNIZATION

The National Defense Strategy calls for improving the readiness posture of the DOD's weapon systems through innovative and sustainable methods and processes. The recently issued OSD Sustainment Strategy aligns with these goals and calls for modernizing and innovating the organic industrial base (OIB) in order to remain relevant, competitive and cost-effective. The 19 major maintenance depots and arsenals constitute the DOD's OIB, many of which have not had a major update since World War II. Through novel approaches that enable the modeling and simulation of process

operations, many maintenance facilities across the OIB are now working to optimize MRO processes and are investing in tools and technologies that maximize production at the best overall cost. Similar modeling and simulation tools are being employed to redesign maintenance facilities to accommodate these processes and tools. With each new advance, the OIB and supporting maintenance facilities gain more opportunities to integrate maintenance process improvements and bring best-in-class technologies and tools to bear while sustaining America's fighting force.

BOMA: Building Block Orthogonal Multiple Access for DOD Readiness and Maintenance

Ahsan Labs

Ahsan Labs, LLC, a recently formed innovation and technology transfer company, focuses on improving spectral and energy efficiencies in digital communications networks. Our patented Building Block Orthogonal Multiple Access (BOMA) technology can significantly increase the capacity of any existing and future digital communication network operating in point-to-multipoint mode with a “software/firmware” update at the transmitter and receiver.

A typical digital communication network has users with different channel conditions at any given time; e.g., outdoor, near base station (strong channel), outdoor, far from base station (medium signal strength) and indoor, far from base station (weak channel). A digital communication network like 4G LTE base station assigns different spectral resources to different users with different modulation schemes based on their channel conditions. BOMA uses the concept of sparse constellation to increase the average SE of the communication carrier. A sparse constellation

has the same/similar minimum Euclidean distance separation between constellation points as that of a standard constellation but contains only a subset of all constellation points.

Key features of this technology include:

- 200%+ instantaneous capacity increase at physical layer downlink.
- 50~60%+ average capacity increase at the physical layer downlink for mobile wireless networks. Capacity gains for wired cable networks expected to be even higher due to the usage of higher-order modulation up to QAM 4096.
- Only software/firmware update is required—no change is needed in the hardware or antenna.

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Problem Statement

Due to exponential growth of data traffic, global communication networks need to increase capacity to meet demand. Unfortunately, increasing the bandwidth/capacity of a wireless / wireline communication network is a very expensive, difficult and long process.

For cellular networks, new spectrum cost billions USD and low band spectrum is already exhausted. For Wifi, spectrum at 2.4Ghz & 5Ghz is already congested. And for cable networks, each satellite covers a large geographical area; customer speeds will drop as take rate increases.

Technology Solution

AhsanLabs is developing proprietary “software/firmware” based solutions to increase the capacity of any digital communication network. Patented BOMA (Building Block Orthogonal Multiple Access) technology can significantly increase the capacity of ANY existing and future digital communication network operating in point-to-multipoint mode with a “software/firmware” update at the transmitter and receiver. There is 100% instantaneous capacity increase at the physical layer downlink, and depending on user distribution, 50%+ average capacity increase at the physical layer downlink.

Benefits

BOMA promises to improve spectral and energy efficiencies in 4G/5G and next-gen digital communications networks. BOMA allows network operators to service more users and alleviate congestion. Speed and practicality of the proposed solution are also benefits:

- Only software/firmware update is required - No change needed in the hardware / antenna
- “Software/firmware” patch can be developed, integrated and deployed in a matter of weeks or months.
- Potential gains of BOMA technology have been verified with extensive simulations.



End-to-end over the air testing of BOMA technology using 3gpp 4G LTE air-interface BOMA Technology prototype using open-source LTE protocol Stack, Nuand Blade RF SDR based transmitter (eNB) and receiver (UE) running on MSI GF65 Intel i7 Laptops.

MRO Digital Twin

Andromeda Systems Incorporated

Examining repair processes within maintenance, repair, overhaul, and upgrade (MRO&U) operations is a tedious and exhausting chore where stakeholders work diligently to recreate a factory floor in their conference room discussions to address constraints. These processes are documented, mapped, recorded, or photographed on dry erase boards repeatedly, when necessary. While minor tweaks can occur to ongoing operations, there is often great difficulty in developing “what if” scenarios for changes to workload demand and/or resources.

Not unlike the assets they maintain, repair, overhaul, or upgrade, production lines can also be modeled as digital twins within 2-dimensional (2D) or 3-dimensional (3D) configurations. Andromeda Systems Incorporated (ASI) has uniquely combined technologies to do this. The technology includes an enterprise model with advanced computing capabilities, operations research techniques, and modeling and simulation (M&S) tools to optimize resourcing strategies and business practices. A key enabler of the MRO&U digital twin is ASI’s state-of-the-art process

capture methodology (PCM). The PCM ensures that all resources as well as any production idiosyncrasies are effectively harnessed for proper modeling.

ASI’s research indicates that most DOD MRO&U lines can benefit significantly from a 2D digital twin model. The technology readiness level (TRL) for this capability is at a TRL 9 and has been operationally employed to provide an unprecedented view of resource utilization. In multiple simulations, resource utilization/readiness scenarios increased over 20% on average over the baseline planning for the H-1 upgrade program. While the 3D software is at a TRL 9, the application in a production setting is currently at TRL 6. Next steps include modeling and testing 3D capabilities in a production environment.

Contact

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Problem Statement

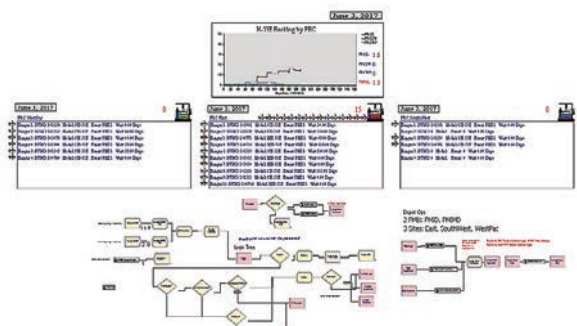
- Accurate assessments of capabilities and capacities within a single DoD repair location can prove elusive, especially across product lines. Add in multiple repair levels (i.e., organizational, intermediate, and depot) as well as other locations and a credible analysis of capabilities and capacities becomes almost insurmountable
- While great gains have been made within the DoD repair organizations to initially identify production constraints, it is often a noniterative and very time-consuming process

Benefits

- Digitization of maintenance, repair, overhaul, and upgrade processes across multiple activities and locations allows leaders to optimize activities and understand limitations of capabilities and capacity
- Quickly quantifies and supports objective enterprise-wide resourcing decisions
- Modeling and simulation attributes of repair digital twin allow system of record to be rapidly manipulated to support extensive “what if” scenarios for decision makers

Technology Solution

- ASI has developed an asymmetric advantage with its unique Process Capture Methodology (PCM) to create a digital twin of repair lines (e.g., component overhaul, asset modification, inspections)
- PCM is used to accurately assess resources (personnel (available hours/skill sets), support equipment, etc.) in repair lines at respective locations
- Resources are then modeled and programmed with appropriate attributes in either 2D or 3D environment (depending on required specificity) to create a digital twin simulation that can be easily employed



OT Defender–Zero-Trust Cybersecurity Solution for Industrial Control Systems

NanoLock Security

NanoLock Security Systems is developing a cybersecurity solution that provides zero-trust protection for industrial control systems (ICS) in the facilities and industrial process modernization mission area. NanoLock's OT Defender software-based cybersecurity solution protects the operational integrity of ICS against outsider and insider cyber threats, supply chain cyber events, and even technician mistakes. NanoLock's zero-trust protection ensures that access to ICS is always authenticated and authorized, regardless of its origin.

The OT Defender provides a unified protection with centralized visibility that offers reliable visibility and security posture with zero-trust user management. NanoLock's solution has no impact on performance, functionality, and downtime, and supports multiple legacy and new ICS vendors and environments. The solution is quick to install, and it requires no downtime.

NanoLock's OT Defender solution protects the operational integrity of production lines, securing productivity and revenue streams, and supporting business continuity. The technology provides broader protection, preventing outsider, insider, and supply chain cyber events, as well as human errors.

This technology has undergone extensive testing and simulation to ensure its effectiveness in protecting ICS against cyber threats. It has been tested in different scenarios and environments and has demonstrated its ability to prevent unauthorized access and firmware attacks. The next steps for the technology's development include further testing and validation in DOD applications to ensure its efficacy.

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Problem Statement

Evolving cyberattacks on Industrial Control Systems (ICS) jeopardize the operational integrity and uptime of production lines, risking employees' safety, product quality, business continuity, and reputation.

Benefits

This system protects the operational integrity of production lines, securing productivity, revenue streams, and supporting business continuity. The technology provides reliable visibility and security posture with zero-trust user management, with no impact on performance, functionality, and downtime. The solution offers broader protection, preventing outsider, insider, and supply chain cyber events, as well as human errors, thus mitigating risks to employees' safety, product quality, and the company's reputation.

Technology Solution

NanoLock's OT Defender is a software-based cybersecurity solution that provides zero-trust protection for ICS. The technology protects against outsider and insider cyber threats, supply chain cyber events, and even technician mistakes. The OT Defender ensures that access to ICS is always authenticated and authorized, regardless of its origin, and supports multiple legacy and new ICS vendors and environments.



Robotics and Superoxalloy Abrasives Technology for Transformational Safety and Efficiency in Surface Preparation of Confined Spaces

10X Engineered Materials

Confined Space Robotics, Inc. (CSR) and 10X Engineered Materials, LLC (10X) are combining autonomous robotics and superoxalloy abrasives as a synergistic and transformational technology for safer and far more efficient surface renewal using abrasive blasting in confined spaces. CSR brings proven robotic solutions to complete jobs quickly with minimal exposure of humans to exhausting and unsafe work conditions inside confined spaces. 10X superoxalloy abrasives technology brings environmentally sustainable, verifiably safe, non-magnetic, and durable particles that efficiently remove difficult coatings, leave a clean surface, delay rust formation, and require only one blasting pass before recoating. Both CSR and superoxalloy abrasives technologies are commercially available and are being applied in a wide variety of applications.

Among the overarching maintenance challenges for the DOD is returning fleets of ships, aircraft, vehicles,

and other critical assets back into service in a timely manner. Abrasive blasting to renew surfaces is a significant driver of overall maintenance schedules.

Surface restoration in confined spaces is an exhausting, time-consuming, and unsafe task performed by humans. Workers must withstand the forces of high-pressure abrasive nozzles in unergonomic positions for extended periods of time. Robotic blasting using durable and efficient abrasive technology eliminates safety hazards and provides new levels of quality and productivity that can greatly reduce out-of-service time of defense assets.

Contact

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Problem Statement

- Returning critical defense assets to service from maintenance in a timely manner is a critical objective across DOD services.
- Surface renewal for recoating is a critical-path task in maintenance schedules.
- Abrasive blasting in confined spaces is slow, unsafe for workers, and ripe for technology innovation.
- Work stoppages from exhaustion, abrasive vacuuming, and clearance of dust to restore visibility compromise efficiency.
- Surfaces must often be blasted more than once due to off-spec surface finish or rapid onset of corrosion.

Benefits

- Minimizes human blasting in confined spaces.
- Delivers clean surface finish for maximum performance.
- Operates continuously without work stoppages at least 2.5X faster than humans.
- Decreases time and cost of confined space surface prep.
- Clean, white metal finish in one pass.
- Efficient removal of the most difficult coatings and corrosion.
- Minimizes abrasive usage, clean-up time, and waste disposal.
- Reusability of the abrasive up to six times.

Technology Solution

- Autonomous robot combined with superoxalloy abrasives.
- 4-phase algorithm scans, plans, and executes blasting tasks in confined spaces.
- Flexible 3D movement for complex tasks & obstacles.
- Multiple robots can be operated with a single operator.
- Lightweight (< 55 lb), fits through 18-inch manways.
- Tempered amorphous particles with high impact strength maximize robotic capabilities.
- Unique & patented particle shapes for high surface area finish and maximum coating performance.
- SSPC-AB 1 certified and approved under MIL-A-22262B.



CSR Robot operating in a tank



Patented superoxalloy abrasives

Small Tool Inventory Location and Tracking System (STILTS)

Andromeda Systems Incorporated

In dynamic DOD maintenance environments, exceptional tool control still eludes many. Damaged equipment, aircraft returned from flight, and countless maintenance man-hours searching for lost tools are all symptoms of inadequate tool control. While “smart” toolboxes have offered some progress, they are expensive and don’t provide accountability once the tool is out of the box.

Through precision integration of real-time location system (RTLS) technologies at the macro and micro levels, ASI has created a “web of accountability” with the Small Tool Inventory & Location Tracking System (STILTS). Every tool is tracked from the toolbox to the point of maintenance and back. The RFID “lock” and “web of accountability” contain the story of a tool’s journey within ASI’s software, so maintainers are not left trying to recreate the day’s events to find a lost tool. “Who last had contact with the tool?”, and most importantly, “Where is it currently?”, are answered with STILTS. The rapid validation of tool control discipline, especially during shift changes, makes STILTS an invaluable management tool.

STILTS integrates existing technology, so the system is very stable and robust. Due to the rapid evolution of RFID technology, the open architecture within STILTS has allowed for easy adoption of even smaller, more powerful tags and antennas as well as the inclusion of other sensors. The components used in STILTS range from Technology Readiness Level (TRL) 7 to TRL 9 and the integration and accompanying software are currently assessed at TRL 6 to TRL 9. The current system has been tested in a laboratory setting and is ready to be tuned, tested, and further perfected in a dynamic maintenance setting. It is estimated that it will take less than 90 days of prototyping in an operational environment for the integration and software to reach full maturity.

Contact

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Problem Statement

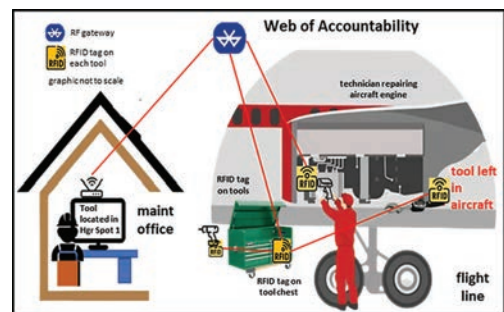
- In dynamic and fast-paced DoD maintenance environments, exceptional tool control still alludes even the most disciplined units
- Damaged equipment, aircraft returned from flight, ramp freezes, and countless maintenance man-hours searching for lost tools are all symptoms of inadequate tool control
- While “smart” toolboxes have offered some progress, they are expensive, can’t be used outdoors, and don’t provide accountability once the tool is out of the box

Benefits

- Prevents foreign object damage (FOD) due to lost tools
- Increases warfighting readiness at the point of performance
- Recaptures thousands of wasted man-hours spent searching for tools to DoD maintenance units across organizational, intermediate, and depot levels
- Provides tool accountability outside the toolbox
- Solutions can be applied to indoor or outdoor areas (i.e., hangar and flight line) and in deployed locations

Technology Solution

- Each tool & maintenance asset is tagged with inventory tracking technology to include RTLS (real time locating systems) beacons, UHF passive RFID tags, machine vision identifiers, and operational sensors all cohesively integrated into one backbone
- All tools are tracked from the toolbox or tool room to the point of maintenance and back. The RFID “lock” and “web of accountability” contain the story of a tool’s journey within ASI’s OptiAM software suite



Lost Tool Found @ Hgr Spot 1

STTATT: The Portable, Remotely Activated Emergency Response Station for Disaster Mitigation

If & When

STTATT is an integrated, portable, battery-powered, variable-pressure electric liquid pump and emergency power station which can be triggered remotely. The technology is designed to serve as a first response in the case of multiple emergencies. The STTATT system offers a solution to manufacturing plants in zones in high risk of wildfire or flood damage.

The patented STTATT system is a portable emergency station that enables owners to act as their own first responders to defend and prepare their property in those critical moments before additional help can arrive—even if they are not on-site. It's a smarter, easier-to-use, more efficient device for mitigating disasters. When alerted wirelessly, STTATT begins charging its battery systems, communicates with designated clients, and activates user-programmable protocols to respond to a variety of emergency situations, including wildfires, floods, and power outages.

- Fire mitigation: A professional-grade hose will be attached to a battery-powered electric pump to deliver water and/or fire-retardant foams at emergency-service pressures, sourcing water from nearby hydrants, pools, cisterns, lakes or rivers
- Flood control: In reverse, the system will drain liquids at emergency-service speeds
- Automatic backup power generation: In anticipation of an electrical outage, the station will automatically recharge its battery array to power a range of owner determined ancillary equipment
- Integrated System: A simple user interface is designed to monitor and distinguish between emergencies in specific geographic locations to provide timely situational responses.

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Problem Statement

In the United States alone, climate change is increasing the severity and frequency of wildfires in the West, Pacific North, and South, particularly where home building and population growth has increased in so-called wildland-urban interface (WUI) regions. These patterns, combined with the growing effects of global warming, are putting the lives of Americans at risk and raising the odds of property damage—both residential and commercial.

Benefits

- Implementing STTATT into manufacturing plants and including it in disaster procedures can save them from destruction by fire. STTATT provides a way to sustain these plants from the hazard of wildfire and supports the National Defense Strategy, providing an opportunity for residential, commercial, and military sectors of the economy.
- It provides a way to make response to fire in manufacturing plants more agile, effective, efficient, and affordable.
- It will save money on potential property damage by natural disaster.

Technology Solution

STTATT, a portable, battery powered, high pressure firehose—Currently in development, the STTATT emergency system will provide portable models for use in homes, farms, ranches, apartment complexes, and commercial buildings. The STTATT Emergency Station is a remotely-activated, emergency response system which can activate preemptively, empowering its owners to act as their own first responders, addressing problems in the crucial moments before additional help can arrive. STTATT enables its owners to prepare and defend their property in the event of a potential disaster, even when they are not on-site.



UHP Shaft Water Blaster Robotic Shroud

Portsmouth Naval Shipyard, IPX – Group II

Submarine maintenance requires removing a glass reinforced plastic (GRP) covering from the shaft that is used to preserve the steel from the undersea environment. Ultra high pressure (UHP) water blasting is used, because that reduces the need for abrasive media thus extending the shaft lifecycle. Mechanics used to wield a 45-pound jet lance for hours to remove the coating. A new process increases the safety of the mechanic while also decreasing production time using a robotic UHP water blast shroud to get the jet lance out of the mechanic's hands and remove them from hazard exposure.

Portsmouth Naval Shipyard (PNS) sought Office of Naval Research funding through the Institute for Manufacturing and Sustainment Technologies. Personnel from Pennsylvania State University's Applied Research Laboratory (ARL) designed a robotic crawler which runs on a track the length of the shaft. The robot was designed to be capable of moving a metal shroud used to control the debris and excess water coming off the shaft during the process. The equipment has adjustable speed and direction and

multiple safety features such as a sensor to monitor the shaft as it rotates on a drive and idler.

PNS personnel designed the shroud, which surrounds a portion of the shaft. The shroud robotically moves along a track straddling the ARL crawler and has a clamshell opening, telescopic legs and a coupling to connect an industrial wet vacuum recovery system hose to process the water and fiberglass hazmat.

This equipment enabled a resource reduction from six to four personnel and reduced shifts from four to two. Together with savings from steps no longer necessary and from reduced clean up time, this resulted in saving nearly \$10,000 and two days of critical path schedule float per shaft.

Contact

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Problem Statement

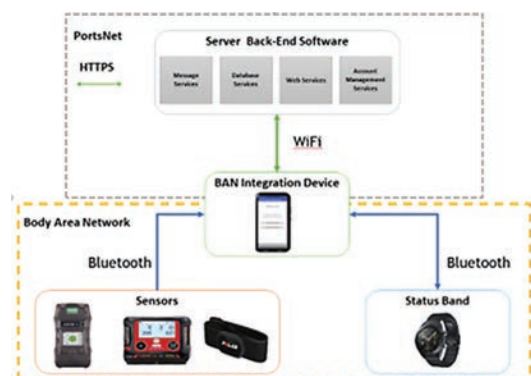
A submarine maintenance requirement includes removing a protective glass reinforced plastic (GRP) covering from shafts, which is used to preserve the steel from the undersea environment. Mechanics used to wield a 45-pound jet lance for several hours to remove the coating by ultra high pressure (UHP) water blasting. This labor-intensive process risked close proximity to the UHP water hazard and fiberglass hazmat. Personnel were required to wear full body Tyvek coverings and double hearing protection.

Benefits

Resource reduction from six to four personnel and reduced shifts from four to two. Together with savings from not enclosing the shaft entirely with Herculite and from reduced clean-up time, this initiative saves nearly \$10,000 and two days in the Critical Path per shaft. Useable across any shipyard or shaft maintenance facility. Removes mechanic from hazards and jet lance from their hands. Embraces the Naval Sustainment System – Shipyards goal of safely completing work on time, every time.

Technology Solution

Pennsylvania State University designed a Robotic Crawler that runs on a track and moves a Portsmouth Naval Shipyard designed Shroud that has an internal UHP blaster and surrounds a portion of the shaft. The system removes debris and water coming off the shaft with an industrial wet vacuum, has a clamshell opening, telescopic legs, adjustable speed and direction, and a safety sensor to interrupt the water flow if the shaft stops turning as it rotates on a drive and idler.



Vertex Connect for Cross-Org Collaboration

Vertex Software Inc. d/b/a Vertex Software

The Technology

Vertex Software's solution, Vertex Connect, is a revolutionary web-based app that enables instant sharing and collaboration of computer aided design (CAD) and building information modeling (BIM) data on any device—not just laptops and desktops but phones and tablets too. Vertex Connect enables fully-interactive visualization of massive 3D models from various sources—facility design, tooling design, and product design—while also delivering a unique collaborative user experience.

Vertex will introduce a zero-install, cloud-based approach to industrial 3D visualization that supports scale of use and quality. Vertex's software streams pixels, not part files, meaning intellectual property is always protected while enabling collaboration in 3D without transferring files with sensitive CAD data. Shared workspaces ensure easy collaboration for all stakeholders within the enterprise and across the supply chain, while models can be merged from different file formats to create a unified full-product model for use in projects and collaborative workflows.

Current Development Status and Next Steps

While the Vertex Connect platform is nearly completely developed, three critical steps remain. The Vertex team will need to document current process flow and data flow maps at specified locations. Next will be to identify opportunities for improvement. Finally, a working prototype is needed to deliver on the goal of modernizing facilities and industrial processes.

Test/simulation data

Vertex Connect provides Volvo Supply Management with a vastly more efficient way to distribute multi-CAD 3D models to suppliers for RFQs. Supplier Atlas Copco doubled their number of RFQ responses in 2022 and has an RFQ success rate of nearly 100% with Volvo since adopting Vertex Connect.

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Problem Statement

- Value chains and cross-org collaborations have become increasingly complex.
- Connectivity is now critical, requiring instant access to massive 3D models to make critical design engineering decisions
- There's a great need in manufacturing for a repeatable and scalable communication medium based upon the DOD's products and processes
- This medium must be capable of engaging, employees, and partners alike by providing rich visual engagement that speeds collaboration, decision-making, and execution.

Benefits

- Revolutionary zero-install, cloud-based approach to industrial 3D visualization that supports scale of use and quality never thought possible.
- Stream pixels, not part files, ensuring IP is always protected.
- Eliminate cumbersome data translation workflows required for 3D solutions.
- Merge data from multiple CAD, BIM, and PLM systems without intermediary files and storage
- Enable fully-interactive visualization of large 3D models otherwise impossible to view
- Instantly view CAD or BIM data for full products.

Technology Solution

Vertex Connect, a revolutionary web-based software that enables collaboration with CAD and BIM data on any device. This can be a turnkey solution to modernize all DoD facilities and industrial processes. The Vertex solution will do this by:

- Dramatically reducing or eliminating the need to exchange large data files.
- Enabling broad use of high-quality 3D data with low-cost software and hardware - regardless of the development platforms.
- Maintaining the security of manufacturers' intellectual property.





RELIABILITY IMPROVEMENT (HARDWARE)

In the maintenance realm, less is more—the less a system requires maintenance, the more it is ready for its intended purpose. Unexpected material failure of weapon systems and components initiates a labor-intensive and often expensive chain of events necessary to return the equipment to ready status. The DOD refers to this as the “sustainment kill chain,” which begins with system failure or fault indication, requires experienced inspection-test-troubleshooting, initiates supply ordering and fulfillment, necessitates trained maintenance action and quality assurance, and ends with system-level check and test in hopes of achieving first time repair yield. With the rapid growth of advanced manufacturing capabilities and digital engineering, designing for ultra-high reliability is

now within our reach. Artificial intelligence and machine learning coupled with advanced modeling and simulation capabilities enables astounding increases in the reliability of components and systems and minimizes the surprise unscheduled failures that begin the sustainment domino effect. Additionally, these same model-engineering and advanced manufacturing technologies are enabling engineers to drastically improve the reliability of electronic components via SWaP (Size, Weight and Power) processes and methods. Armed with these capabilities and others, industry and the DOD can make marked improvements in system and component reliability and improve the readiness posture of the US Armed Forces.

Advanced Sphere Brake (SB) Kits

Sphere Brake Defense Inc.

Under sponsorship and partnership with Army's Rapid Capabilities and Critical Technologies Office (RCCTO), Marine Corps Systems Command, and PM Advanced Amphibious Assault, Sphere Brake Defense, Inc. (SBD) has developed, integrated, and track-tested the bolt-on Sphere Brake (SB) Kit for the Stryker, Family of Medium Tactical Vehicles, and Amphibious Combat Vehicle. The bolt-on SB Kit uses hemispherical brake pads to compress around a spherical brake surface, requiring a smaller brake effective diameter to achieve the same level of brake torque.

The SB Kit was designed to address the needs of the maintenance technician, the program manager, the PEO, and the warfighter. The SB Kit doesn't require any tools or wheel removal to change brake pads. This takes a maintainer level task down to an individual warfighter task while significantly increasing vehicle readiness.

The SB Kit is scalable to numerous vehicle platforms as a bolt-on solution. Kits can integrate with Antilock Brake Systems (ABS) and Central Tire

Inflation Systems (CTIS). The SB Kit is also lighter per wheel-end compared to existing drum and disc brake systems providing numerous opportunities to increase fuel efficiency, improve stability, improve mobility, while affording additional payload options such as ammunition, medical supplies, and fuel.

The first and second iteration SB Kits were track-tested at Aberdeen test center on the Stryker Double V-hull and MTVA1P2. LTG Robert Rasch, Director of RCCTO, successfully changed out a brake pad in under 2 minutes during a demonstration at the automotive test and evaluation facility (ATEF). Testing at ATC provided essential test results, information, and feedback, which were added to the Amphibious Combat Vehicle (ACV) SB Kit design.

Contact

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<p>Problem Statement</p> <ul style="list-style-type: none"> • Ground tactical vehicle brake systems are experiencing heavy corrosion, wear, and performance degradation. • Some ground tactical vehicles have to replace brake pads every 500 miles. • It currently takes at least 15 tools, infrastructure, trained technicians, and at least 12 hours to change brake pads on all wheel-ends for one vehicle. • This problem impacts safety, performance, operational availability, maintenance time, and money. • What's needed is a scalable holistic solution to satisfy the needs of the maintenance technician, the program manager, the PEO, and the warfighter. 	<p>Benefits</p> <ul style="list-style-type: none"> • Brake pads can be replaced without any tools or wheel removal which significantly increases vehicle readiness. • Scalable to numerous ground vehicle platforms as a bolt-on kit which integrates with other vehicle systems to include ABS and CTIS. • Weighs 20% less per wheel-end compared to existing brake systems. • Less unsprung and rotational mass at the wheel-end, which directly improves stability and mobility. • Warfighters require less than 5 minutes of training to gain competency in replacing brake pads.
<p>Technology Solution</p> <ul style="list-style-type: none"> • The Sphere Brake (SB) Kit uses hydraulic pressure to compress hemispherical brake pads against a spherical brake surface requiring a smaller brake effective diameter to generate the same force requirement. • The SB Kit is designed to bolt-on to existing ground tactical vehicle wheel-ends integrating with antilock brake systems and central tire inflation systems. • The SB Kit has completed federal motor vehicle safety standards (FMVSS) 121 track testing on the Stryker and FMTV. • The system will be executing reliability qualification testing on Marine Corps' Amphibious Combat Vehicle in FY23. 	<div data-bbox="739 1466 1070 1632"> <p>Maintainer replacing pads on Sphere Brake Kit</p> </div> <div data-bbox="739 1648 969 1711"> <p>Sphere Brake Kit installed on Stryker</p> </div> <div data-bbox="972 1648 1326 1858"> </div>

Humanity's First Reactionless Drive

Lewa Farms/EM Sektet

A reactionless drive is a device that produces motion without the ejection of a propellant. Overall, a reactionless drive would be a major asset in contested logistics. It would allow for the rapid and unimpeded movement of supplies and personnel, and it would make it possible to operate in remote and hostile environments. This would make it easier to sustain military operations in a contested environment, and it would give military forces a major advantage over their adversaries.

Additionally, this system would allow for the delivery of supplies and personnel to areas that would otherwise be inaccessible, and it would reduce the logistical footprint of military operations, which would make it easier to move forces around and to sustain them in the field. Further, it could be used for creating supply satellites, which can be deorbited to anywhere on the surface. This would be a valuable asset for a number of reasons.

A reactionless drive could improve tactical mobility and ground vehicles in a number of ways.

First, it could allow vehicles to move much faster than is currently possible. This would give them a significant advantage in combat, as they would be able to outmaneuver their opponents. Second, a reactionless drive could allow vehicles to move over difficult terrain more easily. This would be especially useful in areas with rough terrain or obstacles, as it would allow vehicles to reach areas that are currently inaccessible. Third, a reactionless drive could allow vehicles to change direction more quickly. This would be useful in combat, as it would allow vehicles to avoid enemy fire and to take cover more easily.

Contact

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Problem Statement

The reactionless drive could solve the problems of contested logistics in a number of ways. First, it would allow for the rapid and unimpeded movement of supplies and personnel. Second, a reactionless drive would make it possible to operate in remote and hostile environments. Finally, a reactionless drive would reduce the logistical footprint of military operations.

Benefits

- Rapid movement of supplies and personnel.
- Operation in remote and hostile environments.
- Reduced logistical footprint.
- Runs off electricity with about half the efficiency as a gas engine.
- Does not require friction.
- Can be added to existing platforms to add breaking efficiency and maneuvering efficiency without friction.
- One (1) moving part

Technology Solution

- Our current capability is a 2 kg thruster which makes 10 Newtons of reactionless thrust.
- Unlike other reactionless thrusters, these thrusters may be easily scaled up to provide larger thrusts for non-space applications.
- Simple basic revolutionary technology can be manufactured using the existing manufacturing base for power and transformer devices.
- Solution has a total of 4 major components and be rapidly adopted onto existing platforms.



Integrating Lean Maintenance Processes to Reduce Waste & Increase Readiness

Skyplates

Up to 50% of maintenance is spent utilizing screws to maintain and repair parts. The Skyplate process tool organizes, maintains, and controls screws to reduce the volume of maintenance and foreign object and debris (FOD) incidents. The Skyplate process tool can be leveraged to control unsecured and unsorted screws, nuts, bolts, washers, etc., that pose thousands of daily unnecessary but preventable risks in aviation hangers and flight lines. Misplacement of these items can result in

millions of materiel repair dollars, thousands of manhours in preventable maintenance and rework, and a failure to meet mission readiness requirements for deployments and training.

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Problem Statement

- 64% or 14 NAVAIR aircraft systems failed to meet the annual mission capable goal at least once
- 90% or 20 NAVAIR aircraft systems received a red rating
- A need exists to simplify, scale, and streamline maintenance processes across weapon systems

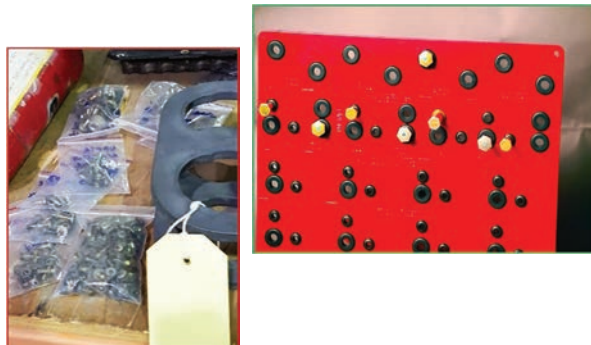
Benefits

Improved:

- Meet NAVAIR annual mission capable goals
- Optimize Takt time (pace of production) to meet mission demands
- Organization and control of mission critical maintenance items (screws, nuts, bolts, washers, etc.) to mitigate FOD
- Identical schematics on Skyplate and weapon systems helps train technicians and increases proficiency
- Supply chain optimization and reduced cost of logistics through adoption of Skyplate maintenance kits

Technology Solution

- The Skyplate organizes, maintains, and controls screws to reduce the volume of maintenance and foreign object and debris (FOD) incidents
- The Skyplate is adaptable to any weapon system, can be scaled to support multi-domain operations, and can integrate into research and development efforts across the entire life cycle of NAVAIR weapon system



Lattice Framework for Unmanned Vessels

IR Technologies

The Lattice Framework (patent pending) is a system of embedded powered rails, tracks, and cables central to construction of the internal and external points of a manned or unmanned vessel, to which autonomous systems (robots) are attached to perform maintenance and other operations. The Lattice also contains electromagnetic grids for tracking and hull breach detection and a back-up system for operation when the vessel power is unavailable.

The Lattice Framework addresses the problem of making autonomous UVs as resilient and self-maintaining as possible. Current concepts rely on using multiple expensive and independently mobile robots capable of their own stability while requiring the ability to self-navigate through a UV. The Lattice eliminates the 3D movement requirement, supporting development of robots and capabilities focused on repair and sustainment. Our concept follows an assembly line/industrial robot philosophy. However instead of the parts moving on a line, robots move within a lattice of adjacent track or rail systems. Vessel equipment and the racks are permanently

affixed to the vehicle, and the robots move along the tracks as necessary to conduct operations. Spares bins are strategically located, just as they are in a factory or warehouse. Multiple robots can be on a track or a single robot with a multifunction arm can be employed so the combinations are endless. This approach eliminates 3D mobility processing requirements for robots while still providing a high level of flexibility and scalability. The impact of vessel motion is mitigated as both robot and machinery are moving at the same time on the same plane. Track/rails or thick cables are straightforward parts that can be replaced organically. They also lend themselves to multiple materials and designs.

Contact

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Problem Statement

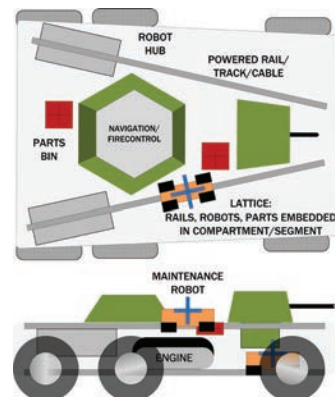
The Lattice Framework addresses the problem of making autonomous unmanned vehicles (UV) as resilient and self-maintaining as possible. Current concepts rely on using multiple expensive and independently mobile robots capable of their own stability while requiring the ability to self-navigate through a UV. The Lattice eliminates the 3D movement requirement, supporting development of robots and repair capabilities focused on repair and sustainment.

Benefits

- Provides a new design, manufacturing, assembly, and maintenance framework that achieves high operational availability and resiliency for UVs
- Maintenance robots are affixed to the Lattice in a manner that the robots do not move on the Lattice independently of the Lattice, regardless of vessel movement
- Promotes current and near future robotic capability at reduced cost
- Promotes true self sustainment design for autonomous vehicles, reducing the expense of accounting for unmanned AND manned support and access.

Technology Solution

The Lattice Framework (patent pending) is a system of embedded powered rails, tracks, and cables central to construction of the internal and external points of a manned or unmanned vessel (UV) (ground vehicle, military ground vehicles, ship, aircraft, spaceship, etc) to which autonomous systems (robots) are attached to perform maintenance and other operations. The Lattice also contains electromagnetic grids for tracking and hull breach detection and a back-up system for operation when the vessel power is unavailable due to damage.



Quick Fit Oil Change System

Parker Hannifin Corp

Maintaining military vehicles is critical to ensure maximum operating efficiency and long service life. Failing to perform maintenance can greatly reduce vehicle service life and can lead to failures.

Changing the oil on an armored ground vehicle can be a time-consuming and difficult task which immobilizes the vehicle. To access the oil pan and drain the oil, heavy armored panels must be removed. After removing the armor and oil plug, the oil must be gravity drained adding as much as 20 minutes to the oil change process. Upon completion, the armor must be reinstalled. The oil change process on a combat vehicle is time consuming and uses excess manpower.

Parker's quick change oil system benefits servicemembers by providing a faster and safer process through a simple three-step process that prevents oils spills and uses a single point connection for oil extraction and refill. The Quick Fit system utilizes a single connection point to

purge, evacuate, and refill the oil for a complete oil change can be achieved in three easy steps: (1) purging the oil filter reduces oil in the filter before removal; (2) evacuating the oil from the pan to the waste containment via a suction pump; (3) refilling the engine through the filter. This also pre-pressurizes the system.

Parker Quick Fit increases safety and reduces maintenance time to perform oil changes on military assets by 50% so the assets deploy in theater more rapidly. The system is currently on test with GVSC, and provides a critical solution for sustaining the Army's fleet and increasing safety.

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Problem Statement

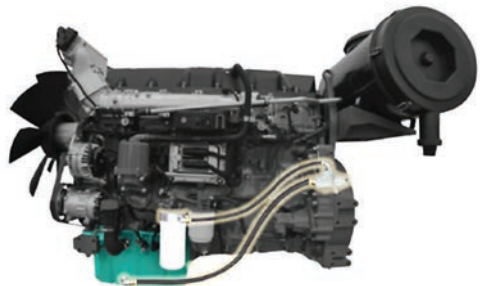
Properly maintaining military equipment is critical given the long life of the vehicles. However, with armor and other challenges added, performing maintenance oil changes are dangerous and burdensome to our military. Lack of oil changes can cause premature vehicle failure. Performing this maintenance in an austere environment can create safety issues for the maintainer, environmental spill concerns, and risk outside contaminants getting in the engine.

Benefits

- Decrease Maintenance time by up to 50%.
- Increase safety
- Minimize oil spills
- Reduce ergonomic risks for servicemembers
- Reduce servicemen exposure to oil
- Reduce risk of oil cross-contamination by consolidating multiple access points to a single point

Technology Solution

The system uses a single connection point to purge, evacuate, and refill the oil for a complete oil change can be achieved in three easy steps: (1) purging the oil filter reduces oil in the filter before removal, minimizing oil spills; (2) evacuating the oil from the pan to the waste containment via a suction pump, reducing the evacuation time; (3) refilling the engine through the filter, reducing the risk of contamination entering the engine. This also pressurizes the system, reducing the need to idle the vehicle.



Starlink Powered 5th Gen

748 AMXS, USAF

F-35 operations rely on a connection to the Autonomic Logistics Information System (ALIS) for mission planning, supply-chain management, and maintenance. ALIS requires an internet connection to the ALIS server, or the Standard Operating Unit (SOU). To access ALIS from a deployed location, you must either deploy the SOU or utilize a Dynamic Multipoint Virtual Private Network (DM-VPN) over a secure internet connection to “tunnel back” to the SOU. Both methods require high-bandwidth internet connection. Many countries do not have the digital infrastructure to obtain a reliable connection to transmit F-35 flight data to the SOU. Additionally, some portable Wi-Fi pucks are not suitable for F-35 use.

Starlink coverage provides greater bandwidth than military SATCOM or commercial ISPs, and its transfer speed meets the F-35 server requirements. The 48th Fighter Wing at RAF Lakenheath is using Starlink for F-35 operations as Starlink coverage broadens.

One of the greatest benefits of Starlink is its agility and portability. When the 495th Fighter Squadron

was tasked to deploy to the Eastern Flank of NATO with 48-hours' notice, the unit was required to scale the equipment footprint down due to airlift constraints. To tunnel back to the home-based server, high bandwidth is necessary for stable data synchronization in a deployed environment. Starlink enabled a secure tunnel-back connection with a DM-VPN during the deployment.

Another benefit of using Starlink for deployed F-35 operations is the ability to connect to a deployed SOU. When the 495th Fighter Squadron deployed to Souda Bay, Greece, the unit deployed the SOU. However, Combat Communication capability was unavailable. Starlink powered and connected the SOU to sustain flying operations for two weeks and transmit flight data for 84 sorties.

Contact

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Problem Statement

- Sustained F-35 operations require an ALIS connection to support mission planning and maintenance, and ALIS connection is achieved through internet connection to the Standard Operating Unit (SOU)
- High bandwidth is vital for F-35 communication, operations and SOU tunnel-back capabilities
- Many countries don't have the bandwidth infrastructure to gain reliable internet access
- Portable Wi-Fi pucks can have compromised parts
- Combat Communication Squadrons are in high demand, have long lead times, and are limited by number of personnel to perform their mission

Technology Solution

- ALIS can be accessed off-station via a Dynamic Multipoint Virtual Private Network (DM-VPN) to the home-based SOU over a Starlink internet connection
- Starlink provides quick and reliable connection to either connect deployed SOU or tunnel back to home base network
- It is not reliant on local country ISP/infrastructure
- Its small size allows easy transport and is accessible for Agile Combat Employment (ACE)
- It has >1 hour set up time, and Internet transfer speed meets server requirements

Benefits

- Deployment connection options include connecting deployed SOU without Combat Communication support; or tunnel-back to home base SOU via Starlink
- Allows for a stable, faster process via a direct connection to home base ALIS server vs. older process of burning DVDs and transferring data between sites
- Reduces F-35 MX/flight data sync time from 8 hours to 36 minutes
- A test took 20 mins to pull data from the PMDs/zip the files, followed by 16 mins to transfer the information to the server





WORKFORCE DEVELOPMENT & VISUALIZATION

Even with the greatest set of tools in the world, broken military hardware will remain that way until a maintainer with the right skillset is applied to the process. The DOD's maintainers are the single greatest asset the sustainment community possesses, and the readiness of America's fighting forces is directly dependent on the competency of those individuals. Traditionally, maintainers are trained in a classroom environment, where many of the training materials are paper based. Similarly, many of the maintenance manuals and guides needed by maintainers to sustain the readiness of military equipment are paper based as well. But today's generation of maintainers are attuned to multimedia learning, with content presented on their phones, tablets, laptop

computers, 3-D goggles and gaming consoles. These electronic media coupled with enhancements via artificial intelligence, machine learning, augmented reality and virtual reality technologies open up an entirely new way to train the workforce and guide maintainers through the most complex maintenance tasks with greater precision and repeatability than ever before achievable. The new workforce development and visualization capabilities being widely adopted in industry are now being implemented across the DOD. These strategies enable rapid transfer of knowledge, experience, and know-how from seasoned veteran maintainers to the next generation more effectively than legacy methods. Tools don't fix broken weapon systems, maintainers do!

Mixed Reality Expert Guidance (MREG)

Boston Engineering Corporation

Mixed Reality Expert Guidance (MREG) is an augmented reality (AR) enhanced secure remote video support tool connecting experienced workers with nascent workers. The platform is built using open architecture and supports multiple operating systems. The capability was purposely developed to operate on premises disconnected from cloud infrastructure but will work in a cloud instance when needed. The dual operational mode between cloud and non-cloud allows collaborations when cloud infrastructure is disabled (for whatever reason) and resyncing once the cloud connectivity returns. MREG increases worker efficiency by significantly reducing work execution time by providing guidance from experienced workers on demand and avoiding workers leaving work sites to resolve issues. The initial proof-of-principle prototype was completed in collaboration with Portsmouth Naval Shipyard (PNSY) and NAVSEA. The capability was demonstrated at Port Hueneme as part of the REPTX event organized by NCMS. Successful

demonstration leveraged a portable 5G communications capability enabling ship-to-shore operation and sufficient bandwidth to support video, audio, and AR mark-up exchange. The Technology Readiness Level (TRL) is 6/7 for the nascent version of the software but there are many enhancements planned on the technology roadmap. MREG can be provided on Boston Engineering computing platforms or installed on government systems and equipment. The concept for MREG was developed as part of a Defense Logistics Agency (DLA) SBIR and DLA continues support for the development, testing and implementation in distribution environments. Support from Air Force sustainment centers is expected in 2024.

Contact

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Problem Statement

- Experienced workforce is needed for weapon systems maintenance and sustainment, but is declining due to retirement and fewer people available for training.
- Nascent workers require training and significant mentoring before achieving the proficiency of highly skilled workers.
- Nascent workers often experience work package execution issues and must leave the work site to seek advice or help with decisions enabling continued work execution.
- Many maintenance requirements are discovered only after a weapon system reaches its destination.

Benefits

- Provides experienced guidance in-situ, reducing time spent by nascent workers who otherwise need help.
- Allows for sharing of experience across the DOD to less experienced workers from remote locations.
- MREG can record work assessments in the field providing planners advanced information, resulting in reduced schedule.
- Connects nascent workers with retired workers who can work from home or part-time.
- Open architecture enables capability advancement by multiple people and organizations in industry, academia, and DOD R&D Centers. Achieved TRL 7 demo.

Technology Solution

- Mixed Reality Expert Guidance (MREG) is an Augmented Reality (AR) enhanced secure video remote assistance tool connecting experienced workforce to nascent workforce.
- MREG operates on premise, on cloud infrastructure, or in mixed connected and unconnected configurations.
- The capability is built using open architecture and open standards.
- MREG has been demonstrated on portable 5G communications ship-to-shore in port providing the necessary bandwidth to support video communications.
- MREG is device agnostic, although initial versions demonstrated with iOS consumption devices.



Tech Companion

Modest Tree



Tech Companion is a COTS solution that effectively integrates emerging digital in-service technologies for equipment readiness. Tech Companion modernizes the maintenance processes for complex assets. The stand-alone software enables technicians to access information in digital formats to support repairs and reduce maintenance backlogs. Technicians access Tech Companion on their PCs, tablets or mobile devices, gaining immediate access to digitalized and up-to-date manuals and step-by-step procedures of detailed 3D models for training or reference, and augmented-reality-enabled remote support when they require assistance remotely.

The Digital Work Cards provide a digital and optimized version of technical work instructions rapidly created through automation using XML-based conversions of the respective maintenance manual. Digital work cards provide ease of information access and detailed instruction on steps associated with a maintenance task. This includes data reporting and analytics capabilities that track data associated with a technician's completion of a maintenance task.

Digital work cards are digitalized, paper-free manuals that provide information on a task including procedure steps, safety precautions, and required tools. This ensures technicians have streamlined access to work orders, maintenance manuals, and other documentation from their preferred platform.

The Integrated 3D work instruction module provides step-by-step 3D instruction which the technician can access to support their maintenance task. 3D instructions can be launched from within a digital work card to supplement instructions. 3D maintenance instructions provide a visual reference for the maintenance task completion requirements. 3D maintenance instructions work on tablets, desktops, or in AR.

Contact

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Problem Statement

Due to the aging workforce there is currently a shortage of technicians for complex equipment which must be maintained for mission and equipment readiness.

The shortage is causing significant backlogs in Depots and facilities due to legacy methods of technical information consumption (i.e., binders, IETMs, PDFs).

Benefits

Tech Companion enables organizations to leverage their enterprise data to transform their maintenance regimes, resulting in:

- reduction in asset downtime and increased efficiencies
- improvement in delivery of essential knowledge onsite to improve technician efficiency
- creation of a robust and operable data structure for maintenance modernization
- digitalization of instruction manuals and step by step procedures
- centralized and improved service reporting on assets

Technology Solution

Tech Companion provides interactive digital support and a highly visual electronic maintenance operations system that improves how complex equipment is maintained and repaired with emerging technologies. Tech Companion's platform modules enable technicians to access: work cards and instructions in digital formats, enter and track data for procedural compliance, remote expert video support with AR markup tools, and training in 3D formats to review operational steps. Digital Work Cards are automated through data ingestion for rapid delivery in a familiar layout.



Virtual Paint Training Simulator

US Air Force – Robins Air Force Base

Government training resources have been extremely limited and unable to process approximately 360 WG-4102 painters within a 1-year time frame at Robins AFB. Under a Small Business Innovative Research (SBIR) contract, the government developed a Virtual Reality Paint Trainer (VRPT) solution to provide these painters with basic skills to create airframe paint skill consistency across the board. This solution is currently available for all WG-4102 AC painters within Robins AFB/WR-ALC. The solution will also be deployed soon at Hill AFB.

Prior to VRPT development, RAFB paint training occurred during one monthly class for 12 students, averaging 100 personnel a year trained on a very limited, antiquated system. With a 20% yearly turnover rate of 350 painters, the VRPT solution is needed to train 8 students a week for 44 weeks a year.

The VRPT was developed in accordance with USAF Corrosion Prevention/Control and Coating Application/Removal Technical Order requirements. It renders realistic, full-sized C-5 Galaxy, Global Hawk,

and F-16 aircraft, paint panels, paint carts, hangar, aircraft grounding points, air pressure sources/manifolds, manlifts, scaffolding, PPE, and fire extinguishers. The solution combines a uniquely designed core physics engine and COTS hardware to include a head mounted display, VR controllers with paint gun integration, and haptic feedback via air compressors to solidify learning of the specific techniques. The VRPT displays real-time paint spray performance indicators and patterns/deficiencies and records for later assessment all user movement.

During VRPT development, it was discovered that RAFB corrosion control for twenty-eight C-17s per year yielded paint-related issues for each aircraft, with rework costing nearly \$4.5M annually. These issues are specifically preventable with the VRPT.

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Problem Statement

The Air Force Maintenance Groups required a training program that would ensure consistently accurate and effective painting for the air platforms. The solution needed the following acute requirements:

- User-friendliness
- Multiple users operating in the same environment
- Render and simulate large and small aircraft
- Accurately train painting and safety operations in DoD Tech Manuals and OSHA standards
- Simulate and train on equipment/hardware currently utilized by the Air Force

Technology Solution

Realistic, full-scale simulation: C-5 Galaxy, Global Hawk, and F-16 aircraft, RAFB/HAFB Paint Hangars, peripherals:

- Functional/Configurable paint guns, carts, support systems (stands, scaffolding, etc.)
- Real-time paint spray performance indicators
- Speed, proximity, trigger position, stroke duration, paint depth, angle of the paint gun, and active transfer efficiency
- Paint deficiencies (wrinkling, sagging, etc.)

Learning Management System facilitates instruction of coursework and records all user activity.

Benefits

- The VRPT allows personnel to train in a safe, chemical-free environment, which prevents material waste and ensures an effective baseline of skill.
- Users are taught to DOD/0 SHA standards
- Supports learning retention of required tools, systems, techniques, and muscle-memory
- Mitigates knowledge/skill loss due to the 20% yearly turnover of personnel, and consistently trains to DOD standards
- Potential yearly savings of nearly \$5M in rework costs on C-17 alone. Saving across DOD would be \$50-70M/yr



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Influence investments in robotics to meet mission requirements



"JROBOT FOSTERS COLLABORATION, RECOGNIZES BEST PRACTICES AND CREATES SHARED INVESTMENTS IN ROBOTICS."

~Steve McKee, Director of Enterprise Maintenance Technologies, ODASD-MR

Objective:

Maximize asset availability across DOD and allied partners using robotic capabilities.

➔ The Joint Robotics Organization for Building Organic Technologies (JROBOT) is integrating efforts and investments in R&D to harness robotic technology for DOD maintenance and sustainment efforts.

JOIN THE EFFORT:

Government - JROBOT is always looking for new DOD contributors; if you are a government employee and would like to participate, please reach out to Dan Miller at dan.miller@ncms.org

Industry/Academia - Engagement opportunities will resume shortly. If you are interested in updates and insights from the JROBOT stakeholders you may sign up for the newsletter and be notified of updates.

JROBOT KEY THRUSTS:

- **New Robotics Requirements**
Generating process requirements and applying best practices from the industrial base.
- **Robotics Portfolio (Alignment)**
Offering ways to connect industry and the DOD's S&T communities to develop a unified plan.
- **Workforce Development**
Developing a common approach for defense industrial skills technical training.
- **Communications**
Providing regular outreach, portal development, and summit participation.
- **Leadership**
Influencing policy and service leads from sustainment and research communities.



**For more details on JROBOT planned events visit
www.ncms.org/events**

How do you address urgent, critical needs for technology innovations?

If a solution seems unknown or out of reach, NCMS is available to assist you in finding the right provider, with the right innovation, at the right cost.



Sources Sought solves challenges

NCMS has deep experience in rapidly locating cutting-edge technologies to solve issues and challenges, while meeting urgent needs.

Through Sources Sought, NCMS connects you to our comprehensive network of trusted, proven companies, who provide extremely specific and often hard-to-find technologies.

Working directly with our government customer, NCMS develops a high-level description of the specific need with required criteria included. We then alert our network to that need, and conduct market research into more companies if novel or supplementary capabilities are sought. NCMS acts as the gatekeeper, collecting and reviewing submitted proposals to ensure only qualified companies with a proven track record are delivered. The customer makes all final determinations for moving forward, and the entire process is tailored to the customer's timeline.

Why we're successful:

- Our trusted network of technology providers
- Our proven system of solicitation and follow-through
- Our expert facilitation of the process
- Our extensive track record of successful technology introduction
- Our ability to leverage Section 806 language to fulfill USG competition requirements

What our partners are saying:

“Sources Sought was effective in allowing us to quickly push out an urgent military requirement to the larger commercial/industrial base beyond common major defense companies to mitigate a major programmatic delay. We plan to make Sources Sought another tool in our tool belt to help discover new vendors who can fill various part requirements going forward.”

— Lt. Col. Joseph Lay, Materiel Leader, B-1 Systems Engineering Branch, Tinker AFB

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