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Features

18 SPECIAL REPORT

The next frontier of electro-optical sensors

Next-generation infrared sensors will blend advanced processing, artificial intelligence, and standards-based architectures to uncover more information in digital images than ever before.

28 TECHNOLOGY FOCUS

Trusted computing for national defense

Computer experts are deepening their defenses against cyber attack and information security breaches.

DI DIGITAL EXCLUSIVE

Commercial Aerospace

www.militaryaerospace.com/subscribe

Columns

2 TRENDS

4 NEWS

11 IN BRIEF

33 RF & MICROWAVE

37 UNMANNED VEHICLES

43 ELECTRO-OPTICS WATCH

47 PRODUCT APPLICATIONS

53 NEW PRODUCTS

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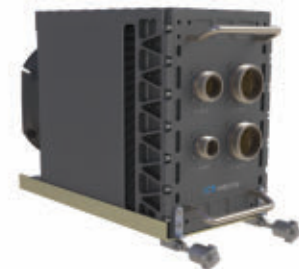
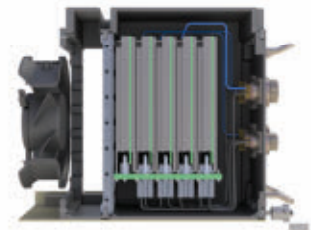
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Space Forces places a bet on orbital nuclear power for future space missions



BY **John Keller**
EDITOR IN CHIEF

U.S. military space experts are developing the ability to use nuclear power generation in orbit to provide electricity for a variety of future space applications ranging from small satellite sensor payloads to large integrated satellites, and even space stations orbiting the moon, Earth, and beyond.

The U.S. Space Force has engaged three defense systems integrators to design high- and low-power space nuclear power generation to support payload power and propulsion on future satellites and space stations.

U.S. Space Force, through the U.S. Air Force Research Laboratory Space Vehicle Directorate at Kirtland Air Force Base, N.M., is asking the defense contractors to design space nuclear power through the Joint Emergent Technology Supplying On-orbit Nuclear Power (JETSON) project.

The contractors are Intuitive Machines LLC in Houston, which is focusing on the JETSON Low Power System program; and Lockheed Martin Corp. Space segment in Littleton, Colo., and Westinghouse Government Services LLC in Hopkins, S.C., for the JETSON High Power Mission Application program.

JETSON is part of the Space Technology Advanced Research - Fast-tracking Innovative Software and Hardware (STAR-FISH) initiative, which seeks to develop enabling technologies for space-based radioisotope power systems.

Intuitive Machines won a \$33.7 million contract for the JETSON Low Power System program, while Westinghouse won a \$17 million contract and Lockheed Martin won a \$33.7 million contract for the JETSON High Power Mission Application program.

For the JETSON Low Power System, Intuitive Machines engineers will design space nuclear power

generation for future propulsion and sensor payloads on small satellites. The company will find new ways to develop compact radioisotope power systems, electric and hybrid propulsion for power conversion, power management, on-orbit mobility, thermal regulation, deployable structures, radiation shielding, and electronic hardening.

The continuous power levels obtainable using space nuclear power may provide advantages over current solar electric power for mission payloads and spacecraft, and could enable a new generation of military small low-power applications, which will be a 1U design that consumes five Watts or less, with a propulsion system able to operate for one to two years.

The JETSON High Power Mission Application program, meanwhile, will develop enabling technologies for high-power space nuclear generation for propulsion and power.

Lockheed Martin and Westinghouse Government Services will mature JETSON spacecraft systems and subsystems designs, and develop the overall space nuclear power program.

Nuclear electric power systems may provide unique advantages over conventional power systems for spacecraft, and drive enhancements to future space missions and spacecraft design that may lead to improved and new national security payloads for future defense missions.

While nuclear power today has somewhat of a bad reputation, and is widely considered to be dangerous, the ability to generate power in space by nuclear means has the potential to support a wide variety of orbital missions, starting with future long-term lunar exploration. It also has the potential to demonstrate utility and safety for possible future use in Earth orbit. ←

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2023 Military & Aerospace Technology Innovators Awards announced

NASHUA, N.H. – Military & Aerospace Electronics has announced the 2023 Technology Innovators Awards to recognize companies offering substantial military, aerospace, and avionics design solutions.

Awards are in three tiers — ranging from platinum, the highest, to the gold awards, and finally to the silver awards — and are based on the recommendations of an independent panel of industry judges.

Platinum honorees

The PacStar Secure Mesh Command Post (SMCP) from the Curtiss-Wright Corp Defense Solutions Division in Ashburn, Va., is for vehicle-mounted mobile command posts. It is a secure vehicle-to-vehicle tactical communications solution for expeditionary environments, and meets U.S. military demand for secure warfighter mobility. It provides secure encrypted access to classified networks at the edge of the battlefield. Mesh topologies eliminate the threat of a single point of failure. Unlike

hub-and-spoke network architectures, the loss of a single node or access point in a mesh network won't result in the loss of the entire V2V network. The PacStar Secure Mesh Command Post is aligned with Commercial Solutions for Classified (CSfC) requirements.

The X9 Spider AI System from General Micro Systems in Rancho Cucamonga, Calif., is a small rugged artificial intelligence (AI) system with advanced video capture for applications with small size, cost, and power constraints. Based on the GMS X9 Spider Mission Computer and a member of the X9 Spider family of rugged small form factor (SFF) modules, the X9 Spider AI system uses the NVIDIA AGX Jetson Orin compact system-on-module processor for autonomous applications where live real-time data collection and analysis is essential, such as unmanned aircraft and autonomous vehicles.

The X9 Spider Manpack from General Micro Systems is a rugged soldier-wearable computer that offers office-style computer workstation performance in a small portable package that



users can wear on the battlefield. Using the GMS X9 Spider mission computer the Manpack is mounted into a rugged enclosure that provides intelligent cooling and ruggedization to provide embedded computing at the individual, squad, and platoon level. It offers high-performance sensor, video, and AI processing for warfighters moving on-foot. Applications include Blue Force Tracking, tactical/moving maps, JADC2, IVAS, Nett Warrior interoperability, command and control, joint sensor review and display, and any application that would run on a server or high-performance workstation computer.

The Ticker from Inflection in Austin, Texas, is an atomic frequency reference for precise timing and holds the potential to revolutionize modern information systems. Within today's interlinked global landscape, time is the pulsating core that powers our data networks, telecommunications, and even mundane undertakings such as pinpointing the nearest grocery store. The accessibility of distributed and accurate timing plays a pivotal role in propelling innovation and creating new opportunities in the telecom, data, and geolocation industries. Ticker will deliver up to 100 times timing performance versus current industry standard solutions and will be 1,000 times quicker to achieve operational frequency stability. Applications include smart grids, timing services, wireless broadband, financial time-stamping, network synchronization, scientific test and measurement, radio astronomy, unmanned vehicles, sensor networks, GPS ground services, and national time keeping.

The MaxUp Maintenance, Repair & Overhaul Optimization (MRO2) tool from Lone Star Analysis in Addison, Texas, constructs a simulation of the existing sustainment environment, enabling the evaluation of labor cost drivers, material cost drivers, and lead time relationships. Military depots must control rising operating and sustainment costs of aging warfare systems and legacy equipment. Unplanned delays in replacement aircraft and higher than projected use have forced life extensions and equipment upgrades for most military legacy aircraft. Determining how best to recapitalize the fleet,

▲ **Platinum, gold, and silver awards are based on the recommendations of an independent panel of industry judges.**

while keeping aging aircraft flying longer requires detailed insight and sound risk-based assessment of the long-term capability to maximize readiness. MRO2

helps manage manpower, facilities, equipment, and assets in an ad hoc near real-time environment.

The FLYC-300 from Neousys Technology Inc. in Taipei, Taiwan, helps bring AI computing power and vision capability for unmanned aerial vehicles (UAVs) in military applications. 297-gram FLYC-300 is an AI-powered mission computer for UAVs, with the NVIDIA Jetson Orin NX. FLYC-300 can connect to several devices for surveillance, reconnaissance, border patrol, infrastructure monitoring and emergency medical aid. As more and more drones are deployed into battlefields, FLYC-300 brings artificial intelligence into drone systems. Currently, UAVs are mostly operated remotely by humans from the ground control center. Therefore, drones that can learn and have autonomous capability are preferable solutions for the future.

The Rigel Edge Supercomputer from One Stop Systems in Escondido, Calif., helps bring elements of data center GPU accelerated computing to rugged edge vehicle applications in land, sea and air. The U.S. and its allies have chosen to implement a distributed or decentralized command and control strategy, with commanders at the battlefield edge to act faster than their adversaries. Key to this strategy is the ability to implement AI to fuse sensor information, assess scenarios, and implement decisive action. Rigel enables data scientists, system integrators, and end users to deploy the same class of hardware they are used to in the lab and data center in vehicles where decisions have to be made now, without compromise.

RTI Connex TSS 3.1 from Real-Time Innovations (RTI) in Sunnyvale, Calif., conforms to the Future Airborne Capability Environment (FACE) technical standard, and the Modular Open Systems Approach (MOSA), and delivers a low-risk connectivity solution for modular, open, and safety-critical avionics systems. The FACE Approach is an integrated business and technical strategy that employs modular design tenets, uses widely supported and open consensus-based standards for its key interfaces, and has a validation and verification

process to ensure the openness of its key interfaces. The standard requires data-centric designs, and the FACE TSS is where this data is presented to the FACE application layer, the FACE Portable Components Segment (PCS). The FACE TSS integrates the flow of data from the FACE OSS, IOSS, and PSSS, and provides a consistent representation of this data to PCS applications.

The Node/Grid from Somewear Labs Inc. in San Francisco is a multi-network device for small team tactics that creates a dynamic mesh network where each device can serve as a relay in the network or as a mobile satellite backhaul. This can provide instant and reliable communication even when traditional networks are unavailable or unreliable. While SATCOM provides near 100 percent coverage on the battlefield, its effective coverage ends when individuals and teams enter subterranean and indoor environments. Additionally, traditional SATCOM equipment requires fixed infrastructure and prohibits teams from remaining agile and networking on-the-move. The advent of Node with Somewear's SmartBackhaul technology offers operators the ability to overcome these limitations by eliminating the need to establish and stay in range of fixed infrastructure for a dedicated backhaul. Paired with Somewear's SmartRouting, Node reduces cognitive load and ensures operators can focus on the tasks that matter most. Node provides a level of reliability, security, and efficient situational awareness that was previously unattainable.

The Kite-Strike II from Systel in Sugar Land Texas, is a MIL-SPEC rugged NVIDIA Jetson AGX Orin based edge AI embedded computer for demanding computer vision and sensor fusion data processing workloads for edge AI and autonomous mission-critical applications. Kite-Strike II helps bring server-class AI performance to forward-deployed missions in combat. The product is designed using a modular open systems approach (MOSA) and is highly configurable to match exacting mission-specific requirements. In addition to its robust base IO, it can be configured with up to (3) mPCIe and (2) m.2 expansion cards as well as removable u.2 NVME (with zeroize and FIPS 140-2 options) in an expansion "slice".

VxWorks – RTOS container support from Wind River Systems in Alameda, Calif., wraps up applications and services with all their dependencies and isolates several software components running on the same hardware, for the company's VxWorks real-time operating system (RTOS). VxWorks now supports application deployment through containers, which will be key to embedded application management. People are most familiar with containers as part of cloud-native architectures in which applications are decoupled from the infrastructure

— including hardware and operating systems — on which they are running. With this approach, teams can automate the software pipeline to remove manual errors, standardize tools, and accelerate the rate of product iterations. Teams can use traditional IT-like technologies to develop and deploy intelligent edge software better and faster, without compromising determinism and performance.

Gold honorees

Concurrent Real-Time, RedHawk Linux for NVIDIA Jetson AGX Orin; Curtiss-Wright Defense Solutions, CHAMP-FX7; Curtiss-Wright Defense Solutions, CHAMP-XD4 (VPX6-485); D-Fend Solutions, EnforceAir2; Elma Electronic Inc., SOSA Aligned Deployable Rugged ATR; Elma Electronic Inc., JetSys-5330 - Extreme Rugged AI based Edge Computing Platform; International Rectifier HiRel Products Inc., An Infineon Technologies Company, R9 Superjunction Rad Hard P-Channel FETs; Keysight Technologies, M9484C Vector Signal Generator with Z9500A Simulation View; Leonardo DRS 6KVA uninterruptible power supply; Milpower Source Inc., MILTECH 470 Smart Hub; MITRE Corp., Extremely Wideband Radio Frequency Spectrum Operations (EWO) Testbed; MPL AG Switzerland, Rugged conductive cooled Computer with GPU; New Wave Design & Verification, V6063 3U VPX Versal ASoC FPGA Optical I/O Module; New Wave Design & Verification, V6061 3U VPX Versal ASoC FPGA + Ethernet Offload Optical I/O Module; New Wave Design & Verification, V1163 12-Port Rugged XMC ASoC Card; National Instruments (NI), Vector Signal Transceiver 3; Pendulum Instruments, CNT-104S Multi-Channel Frequency Analyzer; and Quanterion Solutions Inc., Electronic Parts Reliability Data (EPRD-2023).

Silver honorees

Annapolis Micro Systems, WILDSTAR SAF1 Direct RF Small Form Factor Module; Anritsu, Rubidium; Anritsu, PhaseLync Enabled ShockLine Modular VNA; Atrenne Computing Solutions, 719 Series Air Flow Through Chassis; Curtiss-Wright Defense Solutions, DTS1X; Durabook Americas Inc., Durabook Z14 Fully Rugged Laptop; Durabook Americas Inc., Durabook R8 Fully Rugged Tablet; Elma Electronic Inc., Chassis Manager Aligned to SOSA; Elma Electronic Inc., NetKit-3110 - 3U VPX Rugged Cisco Router; Lynx Software Technologies, LynxElement; Neosys Technology Inc., Neosys Nuvo-9650AWP, IP66 Waterproof Intel 13th-Gen Core Computer; Quantic PMI (Planar Monolithics), 2 to 18 GHz High-Power Amplifier; Sciens Innovations, helux Development Kits; and Spectrum Control, SCI Blocks. ◀



Elma's Rugged ATR Aligned to SOSA Receives Gold Innovation Award

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Elma's NetKit-3110 Wins a 2023 Silver Innovation Award

The NetKit-3110 Cisco Router is a highly rugged, conduction-cooled 3U VPX GbE router based on Cisco's ESR6300 Embedded Series for deployment in harsh environments. Six high-performance GbE interfaces plus Cisco's IOS® XE software gives deployed applications a rugged routing engine with a separate encryption/decryption processor, with highly secure yet scalable video, voice, and data services.



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Navy to approach industry by year-end for aircraft hypersonic anti-ship missiles

BY John Keller

PATUXENT RIVER NAS, Md. — U.S. Navy hypersonic weapons experts will approach industry by the end of this year to develop a new hypersonic munition that can be launched from carrier-based aircraft for attacking enemy surface ships and shore installations.

Officials of the Naval Air Systems Command's Precision Strike Weapons Program Office (PMA-201) at Patuxent River Naval Air Station, Md., released a presolicitation on 25 Sept. for full-scale development of the Hypersonic Air-Launched Offensive Anti-Surface Warfare (OASuW) (HALO) Weapon System.

Preliminary development of HALO has been handled by Lockheed Martin Corp. and by missile designers at Raytheon Technologies Corp. (RTX) in Tucson, Ariz. Hypersonic is a missile or aircraft that moves faster than five times the speed of sound, or 3,836.35 miles per hour.

HALO will be a carrier-based long-range high-speed anti-surface weapon system. A HALO engineering manufacturing and development draft request for proposal will be issued this year by the end of December, and the final request for proposal will be issued by March 2024.

▲ **HALO will be a carrier-based hypersonic long-range anti-ship missile launched by Navy combat aircraft.**

HALO likely will augment or replace current carrier-based anti-ship missile systems like the Long Range Anti-Ship Missile (LRASM), Harpoon, and Penguin

missiles. Hypersonic missiles typically will be for attacking high-value targets like enemy capital ships, command posts, or forward-staging areas.

The HALO hypersonic weapon should have early fielding by 2029, and first operational capability by 2031. Only eligible prime contractors who have experience with carrier-based hypersonic weapons development — like Raytheon and Lockheed Martin — will have access to the upcoming HALO solicitations.

HALO engineering and manufacturing development (EMD) will design, develop, and test this weapon system, including the HALO all-up-round; system security; operational test and evaluation; and moving the HALO system into production. ←

Email questions or concerns about the HALO EMD effort to the Navy's Brittany Graves at brittany.n.graves4.civ@us.navy.mil, or Jessica Blackwell at jessi-ca.a.blackwell.civ@us.navy.mil. More information is online at <https://sam.gov/opp/af555b72c98b424bbccc0141302daa46/view>.



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Raytheon, Northrop Grumman to enhance power amplifiers for EW and advanced RF

BY John Keller

ARLINGTON, Va. — U.S. military researchers are looking to two prime U.S. defense contractors to limit waste heat in gallium nitride (GaN)-based power amplifiers that can limit the performance and lifetimes of military radar, electronic warfare (EW), communications, and other RF and microwave systems.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) awarded contracts last month to Raytheon Technologies Corp. (RTX) and to Northrop Grumman Corp for the Technologies for Heat Removal in Electronics at the Device Scale (THREADS) program.

THREADS seeks to develop RF and microwave micro-electronics technologies that will overcome the thermal limitations that can prevent transistors from operating reliably at RF output power density close to their fundamental electronic limits.

Raytheon won a \$14.9 million THREADS contract on 29 Sept. 2023, and Northrop Grumman won a \$14.2 million THREADS contract on 13 Sept. 2023.

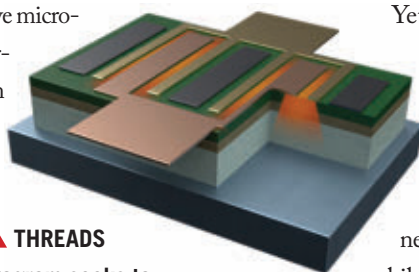
The performance of radar and communication systems depends on the signal-to-noise ratio achievable at the receiver, which

is proportional to the RF output power of the transmitter. The size of RF apertures in military systems often are limited, so the only way to increase range is by increasing the RF output power of the transmitter power amplifier.

The RF output power densities of today's military RF transmitters substantially are thermally limited to below their theoretical electronic limits. Wide-bandgap transistors like gallium nitride (GaN) were developed to improve output power in power amplifiers by as much as five times compared to older gallium arsenide (GaAs) transistor technology.

Yet limiting increases in sustained GaN power output continues to be excessive waste heat in the transistor channel layer, which causes elevated channel temperatures and device damage.

Achieving the transistor output power near the GaN fundamental electronic limit while maintaining a channel temperature below the nominal maximum temperature of 225 degrees Celsius requires a significant reduction in the thermal resistance of the transistor, while preserving electronic properties of wide-bandgap semiconductors.

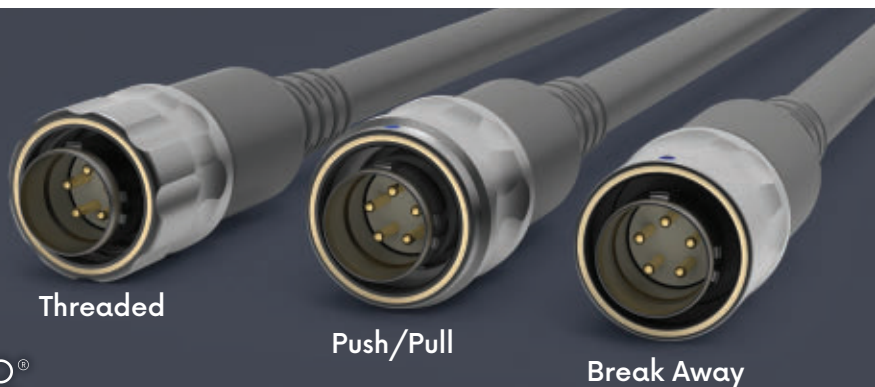


▲ **THREADS**
program seeks to limit waste heat in gallium nitride (GaN) power amplifiers for military radar, electronic warfare (EW), and communications.

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In the THREADS program, Raytheon and Northrop Grumman will focus on achieving high power density by reducing transistor thermal resistance in two ways: reducing thermal resistance within the device while maintaining good channel current transport properties; and moving heat away from high-power transistors more efficiently without degrading RF performance.

The companies will demonstrate efficient X-band transistors and power amplifiers, an eight-times reduction in transistor thermal resistance; and reliable operation with a mean-time-to-failure of 106 hours at 225 C channel temperature.

Raytheon and Northrop Grumman engineers will try to reduce thermal resistance within the device while maintaining good channel current transport properties by reducing interfacial and thin film thermal resistance within the device's epitaxial layer stack. THREADS also will develop new ways to spread waste heat and reduce transistor thermal resistance to maintain channel temperature of 225 C. The companies will incorporate electro-thermal co-design, modeling, and simulation to guide device optimization. THREADS is a four-year program. ◀

For more information contact Raytheon online at www.rtx.com/raytheon/what-we-do/advanced-technology/microelectronics, Northrop Grumman at www.northropgrumman.com/what-we-do/microelectronics-space-park, or DARPA at www.darpa.mil.

U.S. Air Force to share data with FAA on advanced air mobility testing

The U.S. Federal Aviation Administration (FAA) has signed an agreement with the U.S. Air Force to share flight test data to help integrate advanced air mobility aircraft into the National Airspace System. The FAA is capitalizing on existing programs and research conducted by other government agencies to integrate AAM more rapidly into the NAS, including the National Aeronautics and Space Administration (NASA), U.S. Department of Transportation (DOT), Department of Defense, and others. "A new era of aviation is taking off and safe and efficient operations require collaboration," says John Maffei, FAA technology development director. "This data will help inform FAA certification efforts, policies, standards and future airspace integration requirements."



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Georgia Tech eyes VLSI computing for artificial intelligence (AI) image recognition

BY John Keller

ARLINGTON, Va. — U.S. military researchers needed compute-in-memory accelerator technology based on very large-scale integration (VLSI) fabrication for applications such as artificial intelligence (AI)-based image recognition. They found their solution from Georgia Tech Research Corp. in Atlanta.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a \$9.1 million contract to Georgia Tech on Monday for the Optimum Processing Technology Inside Memory Arrays (OPTIMA) project.

Georgia Tech will try to demonstrate area- and power-efficient high-performance multiply accumulate macros with signal-processing circuits and architectures.

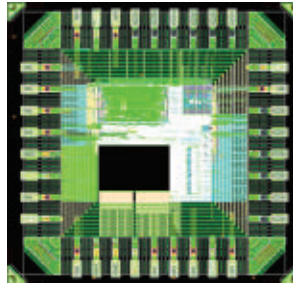
Accelerators based on von Neumann architecture have limited computational power efficiency and long execution latency, while compute-in-memory architectures with multiply accumulate macros can address these limitations. Still, these implementations have been hindered by the large physical size of memory devices and the high power consumption of peripheral circuitry.

The computational power efficiency, expressed in tera-operations per second per Watt of von Neumann general-purpose processors is limited by data movement between memory and computation — particularly for matrix-vector-multiplication intensive applications.

Tensor processing units and graphics processing units offer alternative architectures exploiting parallelism, but their power efficiency and throughput still are limited by the digital computation and data transfer.

Computer scientists recently have explored compute-in-memory architectures to keep data movement and computing energy at a minimum by employing memory devices such as multiply compute elements. Multiply accumulate macros carry out the parallel matrix summing calculations of the multiply compute element outputs.

Compute-in-memory architectures with arrays of multiply accumulate macros for parallel processing can enhance performance for applications such as AI-based image recognition, yet compute-in-memory implementations have been limited by the



▲ Georgia Tech will develop very-large-scale integration (VLSI) computing for artificial intelligence (AI)-based image recognition.

large size of multiply compute element memory devices and by the multiply accumulate macro power-hungry peripheral circuitry that is optimized for conventional circuit architectures.

To enable compute-in-memory accelerators with 300 tera-operations per second per Watt computational power efficiency and 20 tera-operations per second per square millimeter of computational area density, Georgia Tech experts will develop a small power-efficient multiply compute element; and a small, scalable, and power-efficient multiply accumulate macro architecture.

Innovations in multiply compute element and multiply accumulate macro are necessary

to overcome the technical challenges. Georgia Tech will aim at developing single-transistor-size VLSI multiply compute elements by capitalizing on the transistor transconductance gain for compact in-memory multiply compute elements with speeds faster than 1-nanosecond read access. Such devices could be transistors with built-in memory functions; 3D multiply compute elements with single transistor size.

Georgia Tech also will try to develop signal processing circuits and architectures like mixed domain and stochastic compute processing, and co-optimizing with the OPTIMA multiply compute elements to keep size and power consumption to a minimum.

OPTIMA is a 4.5-year three-phase program that will involve several contractors, so additional contracts are expected. In the project's first phase, Georgia Tech seeks to develop a low-energy single-transistor-size multiply compute element with 1 femtojoule per bit energy to data ratio, five-nanosecond read speed, six F2 nominal size, and 1,010 read endurance. ◀

The second phase will try to improve the multiply compute elements to 0.5 femtojoules per bit energy to data ratio, one-nanosecond read speed, 3 F2 nominal size, and 1,011 read endurance. Phase 3 will develop a compute-in-memory accelerator with 100 tera-operations per second throughput and 300 tera-operations per second per Watt energy efficiency. ◀

For more information contact Georgia Tech Research Corp. online at <https://gtrc.gatech.edu>, or DARPA at www.darpa.mil.

Nautilus Defense to develop smart textiles for wearable electronics

U.S. Navy researchers needed cloth with internally woven electrical data and power networks to create new generations of smart textiles for wearable electronics and computing. They found their solution from Nautilus Defense LLC in Pawtucket, R.I., and Leidos Inc. in San Diego. Officials of the Naval Information Warfare Center-Pacific in San Diego have announced an \$11.6 million contract to Nautilus Defense and a \$10.6 million contract to Leidos for the Smart Electrically Powered and Networked Textile Systems (SMART ePANTS) Program) program. SMART ePANTS seeks to develop active smart textile garments combining the singular micro yarn textile routing system and similar smart fabric technologies with low-power electronics. The project will develop prototype wearable and washable garments that incorporate active smart textiles components. Nautilus and Leidos have expertise in systems integration that enables the transparent integration of electrical data and power networks, distributed sensor systems, and antenna arrays within traditional textile structures. This capability could enhance wearable

electronics initiatives that seek to distribute power and data through a warfighter's clothing to run battlefield appliances like distributed computers, networked weapon sights, health sensors, and acoustic protection without wires that can snag and break. Using a warfighter's clothing to distribute power and data among body-worn electronics could enhance safety, enhance agility, and perhaps even reduce user fatigue. For more information contact Nautilus Defense online at www.nautilusdefense.com, Leidos at www.leidos.com, the Naval Information Warfare Center-Pacific at www.niwcpacific.navy.mil, or IARPA at www.iarpa.gov.

OSIRIS4CubeSat to demonstrate data transmission from a microsatellite by laser

Small satellites are becoming increasingly compact and powerful. The technology of conventional radio channels is reaching its limits due to the rising number of satellites. Laser communications offers solutions for the efficient transmission of high data volumes without interfering with other channels. For this application, the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; *Continued on page 16*

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Air Force asks industry for AI and machine learning for military command and control

BY John Keller

ROME, N.Y. – U.S. Air Force computer scientists are reaching out to industry for help in developing advanced technologies that involve disciplines such as nano-computing, neuromorphic computing, machine learning, and embedded deep learning.

Officials of the Air Force Research Laboratory Information Directorate in Rome, N.Y., have issued a broad agency announcement (FA875023S7004) for the four-year Extreme Computing program.

For now, Air Force computer researchers are asking industry for white papers on developing technologies in three areas: advancing computing technology and applications; nano-computing; neuromorphic computing and applying machine learning; and computers, algorithms, and applications for embedded deep learning.

Companies submitting white papers may be asked to submit formal proposals. The Air Force will accept white papers for the Extreme Computing program until 28 Sept. 2028. The program could be worth as much as \$497.9 million, and companies selected will receive contracts worth between \$1 million and \$100 million.

The program's first technical area, Advancing Computing Technology and Applications, involves developing computers with sophistication, autonomy, intelligence, and assurance for command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) and cyber applications.



Extreme Computing program focuses on advanced computing; nano-computing; neuromorphic computing; machine learning; algorithms; and embedded deep learning.

Researchers are interested in technologies with limited size, weight, and power consumption (SWaP), and that include high-performance embedded computing with advanced machine learning; secure machine learning and artificial intelligence (AI); and non-conventional neuromorphic applications.

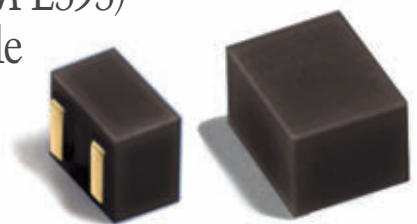
The technical point of contact for this technical area is Ryan Luley, who is available by email at ryan.luley@us.af.mil, or by phone at 315-330-3848.

The second technical area, Nano-Computing, involves for air and space systems operating at the edge, ranging from computer vision and knowledge extraction to autonomous flight and

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decision-making. This approach cannot rely only on current complementary metal-oxide-semiconductor (CMOS) technologies, but involves new CMOS-compatible materials that enhance existing nanoelectronics.

Target applications include bio-inspired computing architectures with ultra-low power consumption. The technical point of contact for this technical area is Joseph Van Nostrand, whose email address is joseph.vannostrand.1@us.af.mil, and phone number is 315-330-4920 Email:joseph.vannostrand.1@us.af.mil.

The third technical area, Neuromorphic Computing and Applying Machine Learning, seeks to advance computationally intelligent systems for perception, adaptability, resiliency, and autonomy for energy-efficient air and space systems.

Interest revolves around advancements in computational neuroscience; nanoelectronics; nano photonics; high-performance computing; material science; embedded deep learning; machine learning; pattern recognition and signature analysis; autonomous adaptive operations; human-machine collaboration; neural control of complex systems; in-situ training of neuromorphic hardware; and online learning in neural networks. The technical point of contract for this area is Clare Thiem, whose email address is clare.thiem@us.af.mil, and phone number is 315-330-4893.

Air Force researchers ask industry for SWaP-constrained embedded computing for artificial intelligence (AI)The fourth technical area, Robust and Efficient Computing Architectures, Algorithms, and Applications for Embedded Deep Learning, seeks to develop advanced efficient computing architectures and algorithms for orders of magnitude improvement in SWaP for deploying AI and machine learning for embedded computing in ground, air, and space applications. The technical point of contact is Mark Barnell, whose email address is mark.barnell.1@us.af.mil.

Air Force researchers ask industry for SWaP-constrained embedded computing for artificial intelligence (AI)Companies interested should email white papers to the

relevant technical point of contact by 30 Sept. 2024 for 2025 funding; by 30 Sept. 2025 for 2026 funding; by 30 Sept. 2026 for 2027 funding; and by 30 Sept. 2027 for 2028 funding. ◀

Air Force researchers ask industry for SWaP-constrained embedded computing for artificial intelligence (AI)Email contractual questions to the Air Force's Amber Buckley at Amber.Buckley@us.af.mil. More information is online at <https://sam.gov/opp/211b1819bd5f46eba20d4a466358d8bb/view>.



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Continued from page 13

DLR) Institute of Communications and Navigation, together with the company Tesat-Spacecom GmbH & Co. KG TESAT, developed OSIRIS4CubeSat, the world's smallest commercially available laser communications terminal. The reliability and error-free functionality of the terminal, which was specifically developed for use on microsatellites, was confirmed during a test mission in space. "This success is the result of our many years of research in the field of optical satellite communications," says Florian David, director of the DLR Institute of Communications and Navigation. "It demonstrates the impressive potential for designing small, light and at the same time powerful optical satellite terminals. This is an important building block for future satellite systems, for example for Earth observation or in megaconstellations. The first OSIRIS4CubeSat terminal was launched into space on board the CubeL satellite on 24 January 2021. During the PIXL-1 mission, images acquired by the camera system on CubeL could be sent to the Optical Ground Station Oberpfaffenhofen using the OSIRIS4CubeSat laser."

How to minimize downtime with smart power charging infrastructure

As the world continues to embrace the advantages of electric mobility, advanced charging technologies have become instrumental in optimizing electric vehicle fleets. Among these, the ground support equipment (GSE) sector, including electric forklifts, relies heavily on smart charging infrastructure to ensure operational efficiency and uptime. One of the primary causes of downtime in electric forklifts and GSE is battery cell failures. A single faulty battery cell can significantly impact vehicle performance and range, leading to operational disruptions

and increased maintenance costs. To address this issue, advanced charging technologies provide real-time monitoring capabilities that allow operators to detect potential battery cell failures early on. By identifying and resolving issues promptly, fleet managers can ensure the smooth operation of their electric fleets and extend the overall lifespan of the batteries. Battery cell failures can occur due to various factors, such as manufacturing defects, improper charging or excessive discharge. By continuously monitoring the health of individual battery cells, smart charging infrastructure can identify deviations from normal behavior and alert operators of potential issues. This proactive approach allows for timely intervention and corrective action, reducing the risk of unexpected failures and optimizing battery performance.

Baggage handling challenges demand new solutions

Demand for air travel in 2022 far exceeded the aviation industry's expectations and the trend has continued in 2023. The industry estimated that 3.42 billion passengers traveled in 2022. While that is a positive development, it has not been without its challenges. Most notably, the persistent labor shortages with increasing demand have caused many airlines to cancel flights to the disappointment of passengers. Advanced baggage handling optimization software takes a more holistic approach towards improving these processes. It tackles the problem of mishandled or lost baggage by providing critical information pertaining to passengers and their baggage connections in advance so that any potential problems can be resolved prior to an aircraft's landing. The software evaluates high priority flights and passenger connections

in conjunction with key performance indicators (KPIs), cost to benefit ratios, and passenger notification. The goal is to avoid preventable disruptions. It automatically updates information from flight information systems, booking systems, and flight departure control systems. All staff involved in baggage transfers from dispatchers to drivers are supported along with such tasks as the dispatch of agents for short and missed connections. Dashboard updates and other reports deliver valuable data relating to support optimal decision-making and operational efficiency.

Frankfurt Airport selects SITA biometric security technology

Germany's Frankfurt Airport sought a technology airlines and security personnel could use to verify identities of passengers. They found their solution from SITA in Geneva. Frankfurt, SITA says, is the first airport in Europe to offer biometric touchpoints to all airline passengers. Using SITA's Smart Path biometric solution, powered by NEC, the passenger's face becomes their boarding pass. Passengers can securely register in advance on their mobile device through the Star Alliance biometric app or directly at the check-in kiosk with their biometric-enabled passports. Once registered, passengers pass through the facial recognition-equipped checkpoints without showing any physical documents. The new technology is already in use by more than 12,000 passengers at check-in, boarding pass control, and boarding gates. SITA's biometric solution leverages the NEC I:Delight digital identity management platform, ranked the world's most accurate face recognition technology in vendor tests conducted by the US National Institute of Standards and Technology (NIST). This means passengers who have opted to use

the service can be identified quickly and accurately, even on the move. "We have seen that the more we can automate the passenger journey in the airport, the better the experience," says David Lavorel, CEO of SITA. "Biometric touchpoints significantly speed up the mandatory steps in the airport, giving

passengers more time to relax before the flight rather than waiting in line. We know from our research that where biometrics are introduced, more than 75% of passengers will gladly use them. Therefore, we are pleased to bring the benefits of a faster airport journey to Frankfurt Airport." ←

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The next of electro-optical

Next-generation infrared sensors will blend advanced processing, artificial intelligence, and standards-based architectures to uncover more information in digital images than ever before.

BY John Keller

Electro-optical sensors — those that sense light at a variety of different spectra — enable warfighters to see at night, detect disturbed soil that might suggest the presence of roadside bombs, detect missile launches, and find tiny boats at sea. While these sensors bolster the U.S. military claims to “own the night,” the battlefield capabilities that modern electro-optical sensors offer are poised for revolutionary improvements that promise to increase sensor ranges; enhance image resolution; reduce sensor size, weight, and power consumption (SWaP); and identify targets automatically through artificial intelligence (AI).

Electro-optical sensing technologies today are reducing the size of digital image pixels; developing revolutionary new materials that enable sensing at higher temperatures; finding new approaches for sensor cooling to enhance range and image resolution; and are reducing SWaP for new generations of uncooled sensors.

Perhaps more importantly, electro-optical sensor technology is tightly integrating sensor and digital image-processing capabilities not only to reduce SWaP, increase range, and enhance resolution, but also to introduce AI and machine learning algorithms to image processing for automatic target recognition, blending spectral sensing for multi-spectral and hyper-spectral sensing, and creating adaptable sensor and processor architectures that follow industry standards and offer rapid technology insertion.

“We are right now at this inflection point,” in which new sensor designs, huge advances in digital signal and image processing, new high-temperature sensor materials, and ever-smaller image pixels are poised to deliver unprecedented sensing capabilities at night, during the day, and in smoke, haze, and bad weather, says Art Stout, director of product management at the artificial intelligence solutions and OEM team at Teledyne FLIR LLC in Goleta, Calif.



The Family of Weapon Sights-Individual from Leonardo DRS is an advanced clip-on infrared weapon sight, based on the company's field-proven thermal sensor technology.

frontier sensors

Buzun Maksimilian / Stock / Getty Images Plus / Getty Images

Small pixels for resolution and range

“There’s a lot of working going into shrinking pixel pitch,” says Chris Bigwood, vice president of business development at electro-optical sensors specialist Clear Align LLC in Eagleville, Pa. “It changes the number of pixels you can put on target, and changes the resolution. It is driving complicated optical solutions to get the performance that people are looking for.”

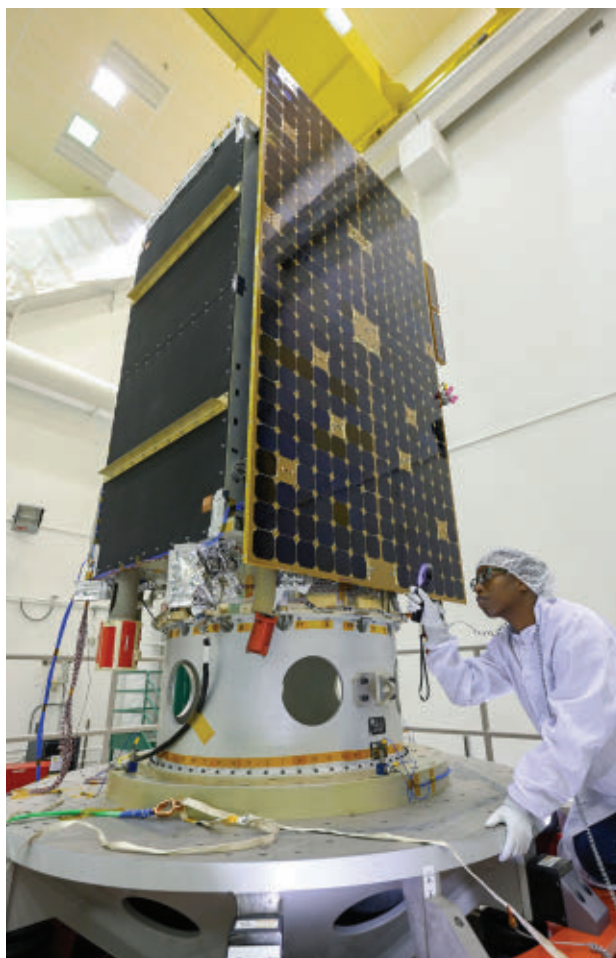
Small pixel pitch “can yield extremely large focal plane arrays, giving you situational awareness and long-range performance,” Bigwood continues. “In the past you had to choose one or the other, but now you can have long range and good resolution.”

Infrared search-and-track systems, in particular, can benefit from smaller sensors. “Low pixel pitch gives you no time delay at all; it takes time dependency out of things,” Bigwood says. “You get all the resolution and field of view without compromising performance in maritime and airborne applications.”

Yet small pixels are not always the best solution to every electro-optical sensing challenge. “We’re trying to improve the sensitivity of smaller pixels, but sometimes you need the larger pixels for the light capture,” points out Angelique X. Irvin, the Clear Align CEO.

Improvements in pixel pitch also can help enable fusing different kinds of electro-optical sensors to yield more situational awareness information to warfighters, says John Baylouny, chief operating officer of Leonardo DRS in Arlington, Va.

“With sensing in general it is about getting further and further range to see if there are threats,” Baylouny says. “Third-generation sensing is about seeing further and identifying further out.” This can enhance weapons sights to enable gunners to fire effectively at targets they can see.



A technician works on a variant of the Lockheed Martin space-qualified mid-sized multi-mission LM 400 satellite with electro-optical sensors for persistent Earth surveillance.



Night-vision sensors from Clear Align capitalize on several different infrared bands to enhance resolution, filter out smoke and haze, and extend detection ranges.

“Some of the trends we are seeing are about being able to merge these images together from several different weapons sights and sensors, and see from any of those sights,” Baylouny says. “We can overlay the DVE [driver’s vision enhancer] picture at longwave thermal, and overlay the commander or gunner’s sights for more situational understanding.”

Other trends afforded by enhanced pixel pitch also include fusing RF and microwave and other sensors onto electro-optical images, he says. “We can fuse RF sensing onto those same pictures and seeing what is on the battlefield by multiple modalities. If something is flying out there, we can fuse the RF, sound, and the image.”

Extending the range of electro-optical sensors is among the chief benefits of enhanced pixel pitch, says Aaron Maestas, technical director for electro-optical and infrared solutions at RTX Raytheon in McKinney, Texas.

“We value the operators, who are the experts,” Maestas says. “We want to provide them assistance with artificial intelligence (AI), get them inside that decision loop so they can respond more quickly than they used to. We are driving to increasing the survivability of platforms by recognizing threats at increased ranges. We will be able to see the bad guys 50 percent farther away than they can today. The farther away we can detect the threat the better off we will be.”

Shrinking the size of image pixels from electro-optical sensors has obvious benefits in reducing SWaP, points out Jeff Schrader, vice president for global situational awareness at the Lockheed Martin Corp. Space Systems segment in Denver. Schrader particularly is concerned with on-orbit electro-optical sensors where every gram of weight is critical. “We have to look at that SWaP

element — how much power does a sensor need, how does it influence what you want the sensor to collect,” Schrader says.

New materials for electro-optical sensors also are coming online to enhance pixel pitch, SWaP, range and resolution. “We are moving from mercury-cadmium telluride and indium antimonide to a material called strained layer superlattice, also known as SLS,” says Teledyne FLIR’s Stout. “These are semiconductor materials that can operate at much higher temperatures.” Sensors made from these materials also are called high-operating-temperature (HOT) detectors.

These materials help electro-optical sensors convert photons directly into electrons, and used to make infrared focal plane arrays. “The benefit of SLS material is you can make the pixels smaller than you can get with indium antimonide,” Stout says. “Smaller pixels can give you much better detector resolution and recognition performance. The benefits of this new material are better SWaP, and smaller pixels to enable high-definition imagers.”

Cooling and thermal management

High-performance electro-optical sensors for high resolution and long ranges today still require cooling to enhance the contrast between objects of interest and their backgrounds. Coolers tend to be large, heavy, and expensive, and can be critical single points of failure in important applications.

“Innovation in cooler longevity is critical,” says Clear Align’s Irvin. “A big part of the market is maintaining them; cooling is a big maintenance item. There is development for coolers with no moving parts, which represents a change in coolers’ getting less expensive and smaller.”



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The need to address cooling connects directly to new generations of HOT detectors, which by nature require less cooling than sensors made from older-generation materials. "If you operate at a higher operating temperatures, the cryogenic cooler power requirements goes down," says Teledyne FLIR's Stout. "There is an impact on cooler life expectancy. Here at Teledyne FLIR we have spent the past five years developing new cooler designs, knowing that we will transition to these higher-operating-temperature coolers."

The influence of these new HOT detectors on cooler maintenance is substantial. "We now have new world-class sensors with MTBF [mean times between failures] of close to 30,000 hours," Stout says. "The impact of that on users in the military is enormous — whether it is applications in border patrol continuous monitoring. Now we can double the cooler life."

Not only can materials in these new HOT detectors enhance logistics and maintenance, but they also can reduce cooling requirements for sensors systems designers. "A big part of this is less cooling demand, so your cooler capacity can be lower; it directly translates into power, and translates into the needs for power supplies like batteries, reducing the need for thermal heat dissipation contributes to reducing SWaP."



The Improved Bradley Acquisition System (IBAS) Block 2 from Leonardo DRS help improve operational efficiencies and lethality, and provides life-cycle cost and reliability improvements.

In HOT detectors, "coolers are more efficient, the heat load is less, and you have an extremely compact sensor module," Stout continues. "Power consumption is driven down, size driven down dramatically, and the resolution is better, relative to indium antimonide."

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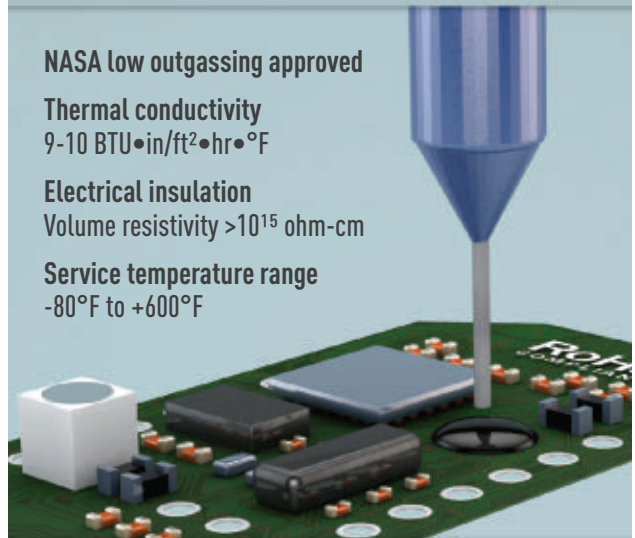
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Reducing cooling demands has a big influence on military electro-optical sensors design and capability, points out Leonardo DRS's Baylouny. "Of the electro-optical sights you see on combat vehicles, one is for the gunner and one is for the commander," he says. "These are cooled longwave detectors with long fields of view, and fields of view that change from wide to narrow. We won a third-generation program to replace cooled longwave detectors with midwave and longwave sensors on the same detector focal plane, which lets crews see in either band. The advantage of longwave is you can see through smoke and obscurants. Midwave has better resolution, so you can see further. We can toggle between the two or superimpose the two views."

Uncooled sensors

Some electro-optical sensors applications, such as infantry rifle sights, are extremely sensitive to size, weight, power consumption, and cost (SWaP-C). These applications often must compromise on range and resolution in the interest of small size and cost. "Uncooled longwave sensors represent a big market because they're cheap," Points out Clear Align's Irvin.

Uncooled solutions also must compensate for their relative weaknesses in range and resolution with larger lenses to enhance light sensitivity. Design tradeoffs for uncooled sensors often involve an intricate dance. "Uncooled cameras are used where cost is a major consideration, as is SWaP," says Teledyne FLIR's Stout.

"You have a certain sensitivity with a lens that has an F1 aperture," says Teledyne FLIR's Stout. "In a cooled solution you could do that with an F4 lens. An uncooled camera might have a 1-Watt load, but you typically get to a limit on the focal length and how far out you can see. Uncooled sensors are for drivers aides, not for long-range systems."

Still, there are advances in uncooled detectors that are improving resolution and range. The microbolometer camera that Teledyne FLIR designs for the Black Hornet 4 palm-sized unmanned

helicopter, for example, has moved from a 160-by-12-pixel detector in the Black Hornet 3 to a 640-by-512-pixel camera in the Black Hornet 4.

With those kinds of resolutions, "the ability to identify objects at the same range is so much more significant. That is 16 times the resolution of the previous-generation camera. You can go wider and have more situational awareness with same number of pixels, or can go narrow and have greater standoff.



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Digital image processing

The embedded computing digital signal processing capability of today's electro-optical sensors is just as important — if not more so — than the sensors themselves. Advanced processing technologies such as high-performance central processing units (CPUs), field-programmable gate arrays (FPGAs), general-purpose graphics processing units (GPGPUs), and a new generation of circuit technology called 3-D Heterogeneous Integration (3DHI) are helping reduce costs, increase range, enhance resolution, and help pull out a growing amount of situational awareness information from every digital image.

Add in advanced processing techniques such as AI, machine learning, neuromorphic processing, standards-based rapidly adaptable embedded computing architectures, and 3DHI, and electro-optical sensors designers can pull out more useful information from digital imagery than ever before.

"Signal processing, from a modality standpoint, helps to identify and recognize the target," says Leonardo DRS's Baylouny. It can help fuse the information together, in applications such as radar and in passive sensing in SIGINT [signals intelligence] and COMINT [communications intelligence]. We want to recognize the signal not for intelligence, but for understanding."

The idea is to squeeze as much useful information from electro-optical imagery as possible, and to eliminate noise from the image. "These sensors need very high-end image and signal processing, to get as much signal to noise ratio to bring the signal up and eliminate noise," Baylouny says.

Signal processing also helps systems designers blend information not just from electro-optical sensors, but also from RF sensors and even auditory sensors to create a rich, deep picture of the battlespace. "The soldier on the battlefield has a radio, and he pushes the push-to-talk button, you can sense the RF signature."

Signal processing also can help orbital electro-optical sensors such as those from Lockheed Martin make difficult predictions, such as where maneuvering hypersonic missiles will impact, and blend information from longwave infrared, midwave infrared, shortwave infrared, RF, radar, and other sensors.

How signal processing influences sensor data is where much technological innovation is being brought to bear today. "We are seeing a general shift between general-purpose computers to vector processors, and now we are seeing and are designing with these SOC [systems-on-chips] that have vector processing capability inside them," says Leonardo DRS's Baylouny. "We are seeing automatic target recognition, and image-recognition software at the sensor."

Some of today's SOC processors blend GPGPU, CPU, and FPGA processing all on one device. "The amount of development in there is for autonomy, Baylouny points out.



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“Over the past five or six years, we have embedded processors with the capability to run high-compute algorithms for image processing, extracting better nighttime imagery, that take raw output of the sensor and enhance it, says Teledyne FLIR’s Stout. “We now have chips with enormous compute capabilities. Five years ago you had to run these algorithms on a server, and now you are doing it right in the product — the drone or thermal weapon sight, gimbal, or targeting solution. We are doing all that in a very small and affordable package.”

As an example, the Jetson Orin processor, available today from NVIDIA Corp. in Santa Clara, Calif., offers 200 trillion operations per second, Stout says.

Other enabling technologies in which advanced signal processing are critical are multispectral and hyperspectral sensing, in which processors blend information from different light spectra to uncover information that only one light spectrum might miss. “Digital detectors that we use in our systems use 3DHI to bring multiple layers of sensors together in the same package, to build a system on a chip for our detectors,” says Raytheon’s Maestas.

“Going forward we will focus on event-driven sensing, so will send only the pixels that matter to our users, to turn that information into knowledge. Event-driven sensors are on the roadmap; today they are looking at very fast-moving objects. Our first cameras are in integration now, and in the next three to five will have integrated packages in the military.”

AI and machine learning

One of the most revolutionary improvements in electro-optical sensors will involve AI and machine learning. Not only can these enabling technologies help sharpen images, improve range, and



The Leonardo DRS Driver's Vision Enhancer Wide provides vehicle operators with enhanced situational awareness for combat, tactical-wheeled vehicles, armored security vehicles, and standard security vehicles.



The Joint Effects Targeting System (JETS) from Leonardo DRS is a hand-held target location system that enables forward observers to carry out necessary reconnaissance on targets and communicate the coordinates instantaneously to the network of maneuver commanders.

detect hard-to-find objects, but they also can help the sensors themselves key-in on important information.

“The operator doesn’t need to have constant eyes on target,” says Raytheon’s Maestas. AI helps to find conditions that are different than normal. It can say with 80 percent certainty that the target is a tank, a SAM site, or another kind of threat.

For the same token, AI also can help detect targets that might not be visible to the human eye, such as a small boat on a vast ocean. “The ocean is enormous, and people do not get a sense for how large it is,” Maestas says. “With AI we can scan all the visible ocean surface and find objects that are not waves, whether it is a fishing trawler, commercial shipping vessel, or a navy destroyer.”

Embedding AI in electro-optical sensors not only can help identify small targets, but also could help reduce SWaP of deployed systems. “Artificial intelligence and imaging systems will improve these sensors, make them smaller and denser, and really get to processing at the edge inside the camera where I see innovation happening,” says Clear Align’s Irvin. “We are doing processing inside the chip to get clarity, and we will get that in the artificial intelligence realm.”

AI can enable the warfighter to do object detection in real time with very low latency without power and thermal-management issues. “AI can offload demands on the operator to identify targets, and assist or offload some of the concentration of the operator.” In addition, AI algorithms can help filter-out noise from conditions such as atmospheric turbulence to reduce motion and distortion in the image.

One challenge of AI, particularly for the military, is training algorithms to key-in on the right data. Many of the military



OPTICAL SENSORS

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conditions necessary to train AI are rarely available. "Military targets of interest are not readily available, so how do you collect data on weather or targets of interest to get you a robust model you could deploy for target detection or situational awareness?" Stout asks.

Instead, companies like Teledyne FLIR are creating computer models and synthetic data generation for training AI systems. "We can create wire frames, and turn them into an infrared image, and use graphics engines, to look at that vehicle from every angle and every distance," Stout says. "The introduction of synthetic data to training is a significant advance."

AI also can help humans assimilate useful amounts of the mountains of data that today's sensors gather. "The trend is higher and higher dynamic range, and enhancements to present

to the operator of AI and machine learning," says Leonardo DRS's Baylouny. "The dynamic range of these sensors can present more than the human can consume, so we need the best detectability for the human. The predominance of the effort is automatic target recognition, based on signature and dynamics. Algorithm libraries are being built now to automatically recognize targets of interest."

Yet AI and machine learning have even broader benefits that automating sensors and sensor-processing tasks. "We can do things like digital twins to design things," says Lockheed Martin's Schrader. "We can have digital versions of our sensors and payloads to speed up development and predict failures before they happen."

Predicting failures and other problems in electro-optical sensors also is a job for AI and machine learning. "We could tell the system how it is performing," Schrader says. "Lockheed Martin is working with Intel on neuromorphic processors that enable distributed command and control, where processors onboard know what the other systems are doing. They have to communicate with each other, and work without each other if necessary, and allow our systems to be top-level smarter. ◀

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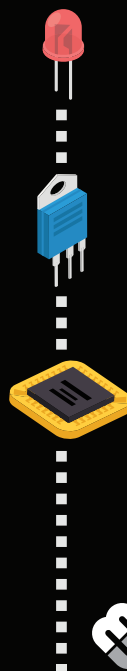
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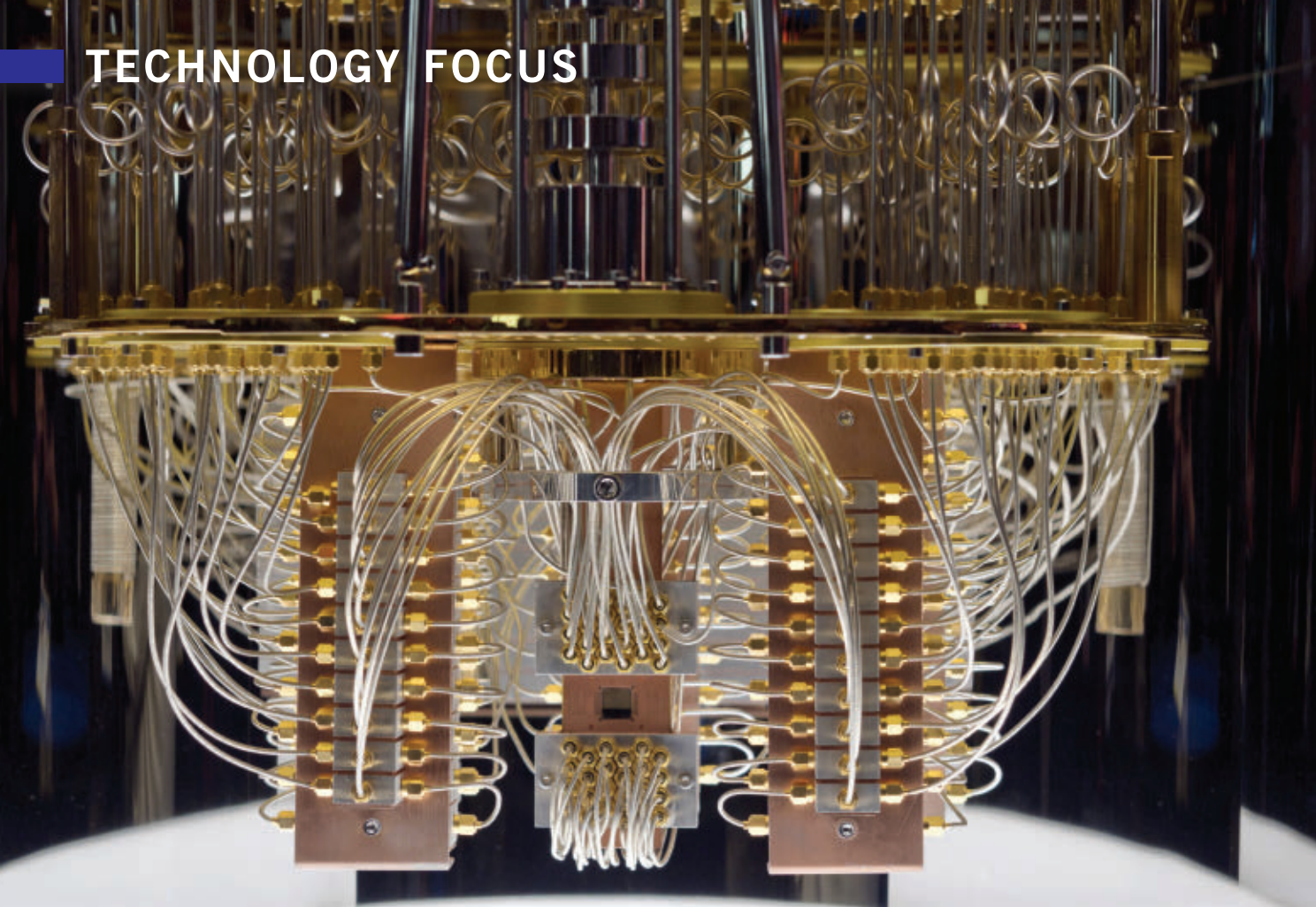
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Trusted computing for national defense

Computer experts are deepening their defenses against cyber attack and information security breaches.

BY Jamie Whitney

We live in an era where the front lines of national defense extend far beyond geographical borders. A technological battleground exists in the invisible realms of cyberspace. Perhaps nothing — save our warfighters — is more vital to military success than keeping classified information out of rivals' hands.

This information can be as varied as actionable intelligence like military movements, or it could be the secrets of game-changing technology that adversaries hope to reverse engineer.

In a world where data is the lifeblood of national security, the integrity of every bit and byte is a matter of utmost importance. To keep ensure such sensitive information does not fall

▲ IBM's Q System One quantum computer on display at the Consumer Electronics Show in 2020. Quantum computers capable of cryptography may make current encryption technology easily bypassible. Photo 172301229 © Boykov at Dreamstime.com

into the hands of any nefarious actors, the U.S. Department of Defense (DOD) insists on a trusted computing approach where systems are built on a foundation made with certainty in the supply chain, the hardware, the manufacturer, the software, the storage, and the end user.

After all, there are myriad ways nefarious actors can attempt to get into a system — from social engineering passwords or

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Digistor's Citadel C Series SSD's have built-in PBA unlocks access to the encrypted operating system on the Citadel solid-state drive, as well as its stored data.

in phishing attacks all the way to manufacturing counterfeit hardware or components to compromise a network or device.

“Attacks are more sophisticated,” says Dominic Perez, chief technology officer for the Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va. “[Adversaries] are collecting data from multiple resources to try and exploit that human element in terms of cyber security and I don’t know that for practical purposes that we can design that out. There’s probably always going to be someone with a key or a password or a multifactor authentication that can get someone into a system. And people generally are trying to be helpful and they think they’re doing the right thing, but if they don’t have all the knowledge in the context that is required to operate in today’s environment, then the mistakes are going to be made.”

Zero trust

Security can be made even more difficult when the DOD is pushing for a commercial off-the-shelf approach for embedded computing solutions.

One way to make commercial IT components and systems secure from state actors who can buy them off the shelf and probe for vulnerabilities is to embrace a “zero trust” strategy. Zero trust architecture (ZTA) removes the implicit trust that a user should get access to the system solely because they, for example, know the correct passcode.

Richard Jaenicke, marketing manager of Green Hills Software in Santa Barbara, Calif., says the DOD is progressing towards zero-trust implementation.

“In January 2022, the DOD established the Zero Trust Portfolio Management Office (ZT PfMO) within the DOD chief information office (CIO),” Jaenicke says. “Then, in November 2022, that office published the DOD Zero Trust Strategy. The four strategic goals outlined in that strategy are: 1) Zero trust culture adoption, 2) DOD Information Systems Secured and Defended, 3) Technology Acceleration, and 4) Zero Trust Enablement. David McKeown, the DOD’s deputy CIO, said in May 2023 that his office has been partnering very heavily with

commercial cloud providers and that the Defense Department is on track to implement its Zero Trust cyber security framework by fiscal year 2027 as planned.

He continues, “But zero trust isn’t just for cloud providers — it can also apply to embedded systems. Most deployed embedded systems implement perimeter-based security at the edge of the embedded system. That can be as simple as a user

ID/password combination granting broad admin-level privileges or something slightly more sophisticated like a firewall. Implementing zero trust starts with assuming that those perimeter defenses can be breached and not implicitly trusting any application already inside the perimeter.”

The most secure embedded systems use a separation kernel to isolate applications, providing a base for zero trust. A separation kernel limits access to the least privilege necessary to get the job done. It also follows a policy of ‘deny by default,’ allowing only pre-approved information flow as defined in a static configuration file. Separation kernels have a very small attack surface and can be small enough to enable security evaluation of each line of code.”

Curtiss-Wright’s Perez explains that zero trust concepts “can really be applied up and down the stack all the way down to the hardware ... Don’t just trust a user and their passwords, you need to understand the context. If Bob or Alice, they have credentials to a system, but they don’t generally go in and download a whole bunch of data from a system — that is something that a good zero-trust architecture can be built to at least alert, if not automatically protect against.



A MK18 Mod 1 unmanned underwater vehicle (UUV) launches from members of Explosive Ordnance Disposal Mobile Unit (EODMU) 5.

“What we’re doing when we’re talking about trusted computing is that we’re establishing that kind of base level of trust that we’re building all of the systems on top of,” Perez continues. “So, if I can’t trust the operator, which we can address through user education, I can’t trust the platform. If I can’t trust the platform, if I don’t know where it came from, I don’t know who wrote the code that is operating the platform and I don’t know its provenance and where it’s been, did it get shipped through certain channels where it could have been tampered with.

That is part of understanding your trust environment and your zero-trust environment, and there’s bleed in there with supply chain and software supply chain management. So those are all very active topics of consideration.”

Firming up

The foundations on which the zero-trust approach is built is assisted by firmware that enables systems to be booted and for constituent parts to communicate.

Ben Warner, director of applications engineering for CRU Data Security Group (CDSG) in Vancouver, Wash., explains that his company, which specializes in removable storage solutions, flashes the stock firmware even on when hardware comes from a trusted partner.

“It’s one thing to have the certification, but it’s another thing to have a trusted supply chain and something that’s actually vetted



Curtiss-Wright's PacStar Secure Wireless Command Post builds on trusted computing to deploy secure wireless access to classified networks via the NSA's Commercial Solutions for Classified (CSfC) program.

properly and ready to be used on a classified system,” Warner says. “So some things that we do is we flash firmware, we don’t use stock firmware that’s been flashed out of the factory, even if it is a trusted source, and just additional precautions to make sure that everything coming out of our doors is not going to infect your system.”

Another trend in the trusted computing for military applications noticed by Green Hills’ Jaenicke is banning container runtimes and orchestration engines. Container runtimes are an interface between the containerized application and the host operating system, which handle tasks like container creation, execution, and resource isolation. Orchestration engines are tools that automate the deployment, scaling, and management of containerized applications in a distributed environment. They ensure containers run reliably, efficiently, and at scale.

“Although the use of Linux containers has made some inroads into military and aerospace applications, there is a growing realization that containers lack the base-level security needed for national security systems,” Jaenicke says. “Containers and container orchestration systems bring the promise faster updates, but containers have long been known only to provide partial containment.”

One example has the underlying mechanism for Linux containers called ‘namespaces,’ yet “not all parts of the operating system kernel are namespaced,” Jaenicke says. “The parts that are not namespaced can allow information leakage among containers and possibly allow containers to attack each other or the host.”

Some container runtimes can allow information to leak backward through what was supposed to be a one-way communication channel. “Docker, as well as container orchestration engines, including Kubernetes, have been banned by the U.S. National Security Agency (NSA) from use in cross domain systems (CDS), which connect networks of different





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classification levels. "The biggest advantage of containers is the ability to package the dynamic link libraries (DLLs) and other dependencies, but security is much higher with statically linked libraries and many embedded systems are built statically anyway," Jaenicke says.

The "holy grail" for secure and trusted systems is be non-bypassable, evaluable, always invoked, and tamperproof (NEAT). "When the security monitor is NEAT, all applications are guaranteed to be isolated from each other with no unauthorized information flow, Jaenicke says. "With enough effort, that is very achievable for software, as exemplified by [Green Hills Software's] INTEGRITY-178 real-time operating system (RTOS) through its ability to meet Common Criteria EAL 6+ with high robustness. However, achieving NEAT for hardware is almost impossible because modern CPUs are too complex to be fully evaluable or completely tamperproof. To make up for that, security systems can use redundant hardware solutions of independent design to provide defense in depth that prevents compromise from a single point of failure. The resulting hardware solution is Redundant, Always-invoked, Independent, and non-bypassable (RAIN). RAIN adds a great deal of complexity and cost but is very achievable."



The high-speed recorder 10 (HSR10) is a dual channel 10 Gigabit Ethernet network-attached storage device for high-speed network recording.

Sensor safety

Today's military land, air, and maritime vehicles are filled with sensors generating an incredible amount of data. That data is a gold mine for bad actors, says Steve Petric, senior product manager for data solutions at Curtiss-Wright. "Everything is collecting data for post analysis. The need for greater storage, expanding storage, and faster performing storage, as well as secure storage plays into that. Artificial intelligence is an aspect of it. [Command] wants data so they can run their models...And the threats are not slowing down, right?"

As an example, Petric describes sensor data from a captured military vehicle being of incredible use for an adversary, even if it's not going to be usable in the foreseeable future.

"The harvest now, decrypt later," Petric says about the approach. "People are always trying to collect data. And what we're doing as a government, all the other adversaries are doing the same thing. They see all their vehicles as a way to collect sensor data and then the bad actors and internal threats — that's always present. So, for us, it's never ending for our customers. And unmanned vehicles, are you pushing that in places that maybe a human they would never push, right? So these are going into the most sensitive places. So, the need for rugged, secure, and now more so NSA approved encryption is needed."

While robust encryption is keeping sensitive data under wraps even if the vehicle were to fall into an adversary's hands, that encryption might not always be enough thanks to potential breakthroughs made possible by quantum computing, which can leverage the principles of quantum mechanics to perform complex calculations at speeds unattainable by classical computers.

Unlike classical bits, which can be either 0 or 1, quantum bits or qubits can exist in multiple states simultaneously, known as superposition. This enables quantum computers to handle vast amounts of data in parallel and solve difficult, previously near impossible problems, like cracking encryption. Thankfully, Curtiss-Wright's Perez says that there's likely to be time before quantum cracking is a major concern, though, given the nature of spycraft, we cannot be sure.

"I don't believe there will be what we in industry call a 'cryptographically relevant quantum computer' for quite some time," Perez says. "But along with that, I can tell you that our near peers are also working on those and they will not be issuing press releases when they achieve cryptographic relevance. There is on all sides a great deal of effort being put into harvesting data that's encrypted through conventional means for the day that it can be decrypted later. And the idea is that once we have that cryptographically relevant computer, this legacy encryption becomes almost trivial to break. And a lot of information that we protect with encryption is stuff that we need to keep protected for long periods of time, decades or more." ◀



New radiation effects testing eyed for high-reliability electronics in space and nuclear uses

BY John Keller

ARLINGTON, Va. – U.S. military researchers are asking industry for new testing methods for radiation-induced single-event effects (SEE) of high-reliability next-generation electronics.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., released a broad agency announcement (HR001123S0047) for the Advanced Sources for Single-event Effect Radiation Testing (ASSERT) project.

The 4.5-year ASSERT program will develop new capabilities for SEE testing of 3D heterogeneously integrated electronic components and circuits, and seeks to transform today's radiation-hardened electronics design process to enable rapid deployment of next-generation electronics for space and nuclear warfare applications.

Goals include generation energetic particles with penetration as deep as 5 millimeters in silicon with high-radiation-relevant linear energy transfers and beam diameters of less than 0.2 microns. Several contract awards are expected.

The ASSERT program involves one technical area that addresses two technical challenges: deep penetration depths

▲ **The Advanced Sources for Single-event Effect Radiation Testing (ASSERT) project will develop new single-event effects testing of 3D heterogeneously integrated electronic components and circuits.**

with space-radiation linear energy transfers; and charge tracks with fine spatial resolution. Proposals must respond to both technical challenges.

Radiation effects threaten electronic systems from three main natural sources: galactic cosmic rays; charged particles trapped by planetary magnetic fields; and solar particle events.

Artificial radiation sources like particle accelerators, reactors, and nuclear weapons also pose threats to electronic systems. Electronics are susceptible to upset, degradation, and failure from total ionizing dose; displacement damage dose; and the instantaneous response to single ionizing particles, such as SEE, which threaten the reliability of the U.S. nuclear arsenal, spacecraft, avionics, and terrestrial systems such as computer server farms and autonomous vehicles.

Linear energy transfer is a key SEE test parameter and measures the energy deposited per unit length as an energetic particle travels through a material. Space-radiation linear energy transfers fall in the range of 0.1 to 100 MeVcm²/mg.

Today, the principal method for SEE testing in the U.S. relies on heavy-ion sources that produce large-diameter beams for part- and board-level radiation qualification of electronics. These sources produce relatively large beam spot areas ranging from a few square centimeters to as large as 60 square centimeters with penetration depths to hundreds of microns.

Emerging advanced electronics are complex and integrated than previous generations, and can combine digital, analog, and optical functions using 3D topologies and several material types. 3D components are expected to reach several millimeters in vertical extent with a complexity and level of integration that will make it difficult, if not impossible, to de-package and disaggregate into parts to perform radiation testing using current heavy-ion sources.

SEE testing of integrated components will require an irradiation source that provides a combination of multi-millimeter penetration depths, space-radiation-relevant linear energy transfers, and fine spatial resolution and control to provide the linear and angular precision necessary to probe sensitive areas and to isolate faults.

Current SEE testing is unable to meet all of these requirements simultaneously, necessitating new sources to qualify next-generation microelectronics for nuclear and space applications that require high reliability in radiation environments.

The process of testing with ion beams is slow and laborious, and problems worsen with the increasing complexity of electronics. As a result, ASSERT sources must be compact and cost-effective so they can be incorporated into the development process.

In this way, radiation qualification will be integrated throughout the design and fabrication flow, with ASSERT sources providing the means to identify radiation design flaws rapidly and to facilitate swift correction and design optimizations. A key program goal is to reduce the time from design to radiation-qualified component by a factor of 10. DARPA researchers particularly are interested in technologies like short-pulse relativistic electron beams and ultrashort pulse X-rays. ◀

Companies were asked to submit proposals in September 2023 via the DARPA BAA website at <https://baa.darpa.mil>. Email questions or concerns to David Abe, the DARPA ASSERT program manager, at HR001123S0047@darpa.mil. More information is online at <https://sam.gov/opp/f4f70aefb2ee4586a9cfd46a78faee1/view>.

PCI Express digitizers for RF test introduced by Spectrum Instrumentation

Spectrum Instrumentation in Grosshansdorf, Germany is introducing two high-speed PCI Express digitizers to deliver accurate acquisition and analysis of signals in the gigahertz range. These PCI Express digitizers are for working with extremely fast signals in laser systems, semiconductor testing, spectroscopy, reflectometry, and many RF and microwave applications. The M5i.3360-x16 and M5i.3367-x16 provide one and two channels respectively, and go up to 4.7 GHz for -3 dB attenuation or even 5 GHz for -5 dB attenuation. Each card can sample at test and measurement rates as fast as 10 gigasamples per second, with 12-bit vertical resolution. The high bandwidth and fast sampling, helps analyze signals for frequency content anywhere from DC to the Nyquist limit (half the sample rate, or up to 5 GHz). Users can make acquisition in single-shot or multiple-waveform recording modes. Multi-waveform recording helps capture events even at very high trigger rates. The cards come with tools necessary to use them in a PC running either a Windows or Linux operating system. A software development kit enables users to program the cards with C, C++, C#, Delphi, VB.NET, J#, Python, Julia, Java, LabVIEW, and MATLAB. For more

information contact Spectrum Instrumentation online at www.spectrum-instrumentation.com.

40- and 65-degree antennas for wireless internet offered by KP

KP Performance Antennas in Lewisville, Texas, is introducing a line of wireless internet service provider (WISP) antennas for wireless communications applications. Designed to support internet service providers (ISPs), the antennas offer beamwidth patterns in 40 and 65 degrees to enable ISPs to choose the best configuration for their coverage needs. These antennas cover frequency bands such as 2.4, 3.3, and 6 GHz, with gain performance ranging from 12 to 18 dBi. KP Performance Antennas' WISP solutions incorporate four-port and eight-port antennas with a Type N female connector for a wide range of deployment scenarios and performance in diverse conditions. In addition to their key features, the communications antennas support 5G, WLAN, CBRS, and 6 GHz unlicensed bands, thus aligning with the global shift towards fifth-generation technology. KP's new WISP antennas are in stock and available for same-day shipping. For more information contact KP Performance Antennas online at www.kpperformance.com. ◀

Researchers approach industry for ultrawide-bandgap semiconductors for radar and communications

BY John Keller

ARLINGTON, Va. — U.S. military researchers are asking industry to develop new kinds of integrated circuit substrates, device layers, junctions, and low-resistance electrical contacts for a new generation of ultrawide-bandgap semiconductors.

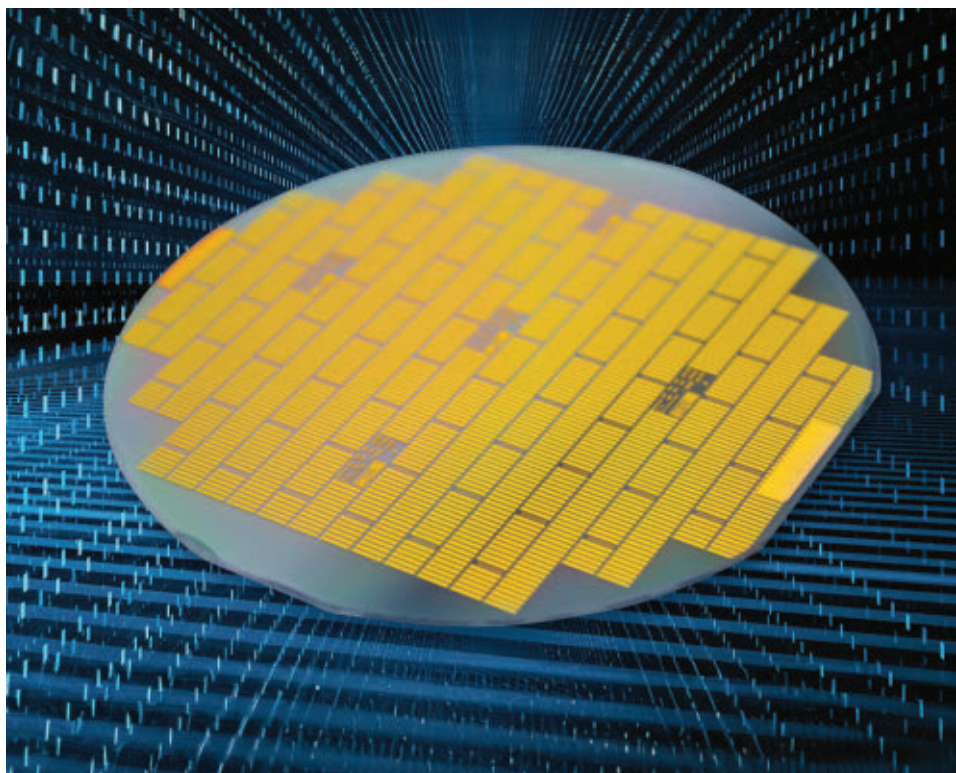
Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a broad agency announcement (HR001123S0051) for the Ultra-Wide BandGap Semiconductors (UWBGS) project.

Ultrawide-bandgap technology represents a new class of semiconductors for future applications of RF and high-power electronics, deep-ultraviolet electro-optics, quantum electronics, and systems that must operate in harsh environments.

Experts in the DARPA Microsystems Technology Office are interested in two kinds of ultrawide-bandgap devices: low-defect-density substrates larger than 100 millimeters in diameter; and device layers with high doping efficiency abrupt homo- and hetero-junctions with low junction defect density and ultralow-resistance electrical contacts.

Ultrawide-bandgap materials like aluminum nitride, cubic boron nitride, and diamond have the potential to revolutionize semiconductor electronics for applications like high-power RF switches and limiters; high-power-density RF amplifiers for radar and communications systems; high-voltage switches for power electronics; high-temperature electronics and sensors for extreme environments; deep-ultraviolet light emitting diodes (LEDs); and lasers, DARPA researchers say.

Yet today's poor quality of ultrawide-bandgap materials limit their performance, and scientists must overcome several technical challenges to bring this technology to fruition.



The Ultra-Wide BandGap Semiconductors (UWBGS) project seeks to improve the material quality of device layers and junctions, and improve the electrical quality of metal contacts.

The three-year UWBGS program seeks to improve the material quality of device layers and junctions, and improve the electrical quality of metal contacts. To do this, the project focuses on three areas: large-area ultrawide-bandgap substrates; dopants for ultrawide-bandgap materials for ultrawide-bandgap homo- and hetero-junctions; and blending ultralow-resistance electrical contacts and ultrawide-bandgap materials. ←

Companies interested were asked to respond by mid-December. Several contract awards are expected, and the program is scheduled to begin in July 2024. Email questions and concerns to DARPA's Thomas Kazior at HR001123S0051@darpa.mil. More information is online at <https://sam.gov/opp/3b75e7b92317410a9850686d7b724517/view>.

Army wants assured PNT navigation technologies for ground, maritime, air, and space

BY John Keller

ABERDEEN PROVING GROUND, Md. – U.S. Army researchers are surveying industry to find companies with relatively mature assured positioning, navigation, and timing (A-PNT) technologies for a variety of military ground, maritime, air, and space applications.

Officials of the Army Contracting Command at Aberdeen Proving Ground, Md., have issued a request for information (APNTSCFT-24) for the PNTAX 2024 project to find mature A-PNT technologies for the Assured Positioning, Navigation and Timing/Space Cross-Functional Team (APNT/S CFT), contested environment event next August at White Sands Missile Range, N.M.

Army experts want to identify potential sources of commercial off-the-shelf (COTS), non-developmental items (NDI), or near-NDI for assured PNT technologies for situational awareness,

defensive, and offensive capabilities in ground, air, space or cyber applications for navigation warfare (NAVWAR) missions.

Companies interested should be able to provide ground-, air-, space-, or cyber-based A-PNT and NAVWAR sensor capabilities that will be ready for test and demonstration at the APNT/S CFT event or deployment for as long as six months.

These A-PNT capabilities should be applicable to navigation, electronic warfare (EW) or satellite communications (SATCOM) applications, and should be at Technology Readiness Level (TRL)-6 within one year of assessment. TRL-6 is ready for prototype demonstration in a real-world environment.

Army experts also want to know for which military applications, platforms, and missions would the suggested A-PNT technologies be appropriate. Also of interest are fields of view; ranges;

external interfaces; remote-operation capability; size, weight, and power consumption (SWaP); GPS receivers used; M-code or selective availability anti-spoofing module (SAASM) capabilities; ruggedized or high-reliability capabilities; military standards involved; software requirements; VICTORY and Open System Architecture (OSA) requirements; cyber security standards; and expected mean time between failures (MTBF).

Companies interested were asked to submit 15-page white papers by November to the Army's Jason Sideman at jan.b.sideman.civ@army.mil and Lisa Reyes at lisa.t.reyes.ctr@army.mil, with RFI number APNTSCFT-24 in the email subject line. ◀



The PNTAX 2024 project seeks mature A-PNT technologies for the Assured Positioning, Navigation and Timing/Space Cross-Functional Team (APNT/S CFT), contested environment event next summer.

Email questions or concerns to the Army's Jason Sideman at jan.b.sideman.civ@army.mil and Lisa Reyes at lisa.t.reyes.ctr@army.mil. More information is online at <https://sam.gov/opp/d19d6a17bc3348d49a55f9552a10ea1f/view>.

Oshkosh Defense to provide unmanned land vehicles to launch anti-ship missiles

BY John Keller

QUANTICO MARINE BASE, Va. – U.S. Marine Corps expeditionary warfare experts are asking Oshkosh Defense LLC in Oshkosh, Wis., to provide unmanned armored combat vehicles as mission launchers for a new Marine Corps land-based anti-ship missile system.

Officials of the Marine Corps Systems Command at Quantico Marine Base, Va., announced a \$39.6 million order in September to Oshkosh for Remotely Operated Ground Unit for Expeditionary Fires (ROGUE-Fires) carriers for use in the Navy/Marine Expeditionary Ship Interdiction System (NMESIS).

The ROGUE-Fires long-range anti-ship missile launchers will be based on unmanned remotely operated versions of the Oshkosh Joint Light Tactical Vehicle (JLTV), each which will carry two Naval Strike Missiles (NSM) to help protect Marine Corps infantry on invasion beaches.

NMESIS will provide the Marine Corps High Mobility Artillery Rocket System (HIMARS) battalions with anti-ship missiles. NMESIS integrates a Naval Strike Missile (NSM) launcher unit, capable of launching two NSMs, onto a ROGUE-Fires carrier.

The NSM has an imaging infrared seeker, an onboard target database, and navigates by Global Positioning System (GPS), inertial sensors, and terrain-reference systems. It can detect, recognize, and discriminate among targets independently, and is designed to strike enemy ships at or near the water line to inflict maximum structural damage.

Raytheon is building the NSM in partnership with Kongsberg Gruppen in Kongsberg, Norway. In addition to NMESIS, the missile is to equip the littoral combat ship and FFG(X) future frigate with stand-off surface-to-surface weapons capability.

Raytheon and Kongsberg in their initial OTH-WS bid offered the Naval Strike Missile (NSM) — a fifth-generation long-range, precision-strike missile

that offers strike capability against heavily defended land and sea targets. NSM is a modernized version of the Norwegian Penguin anti-ship missile.

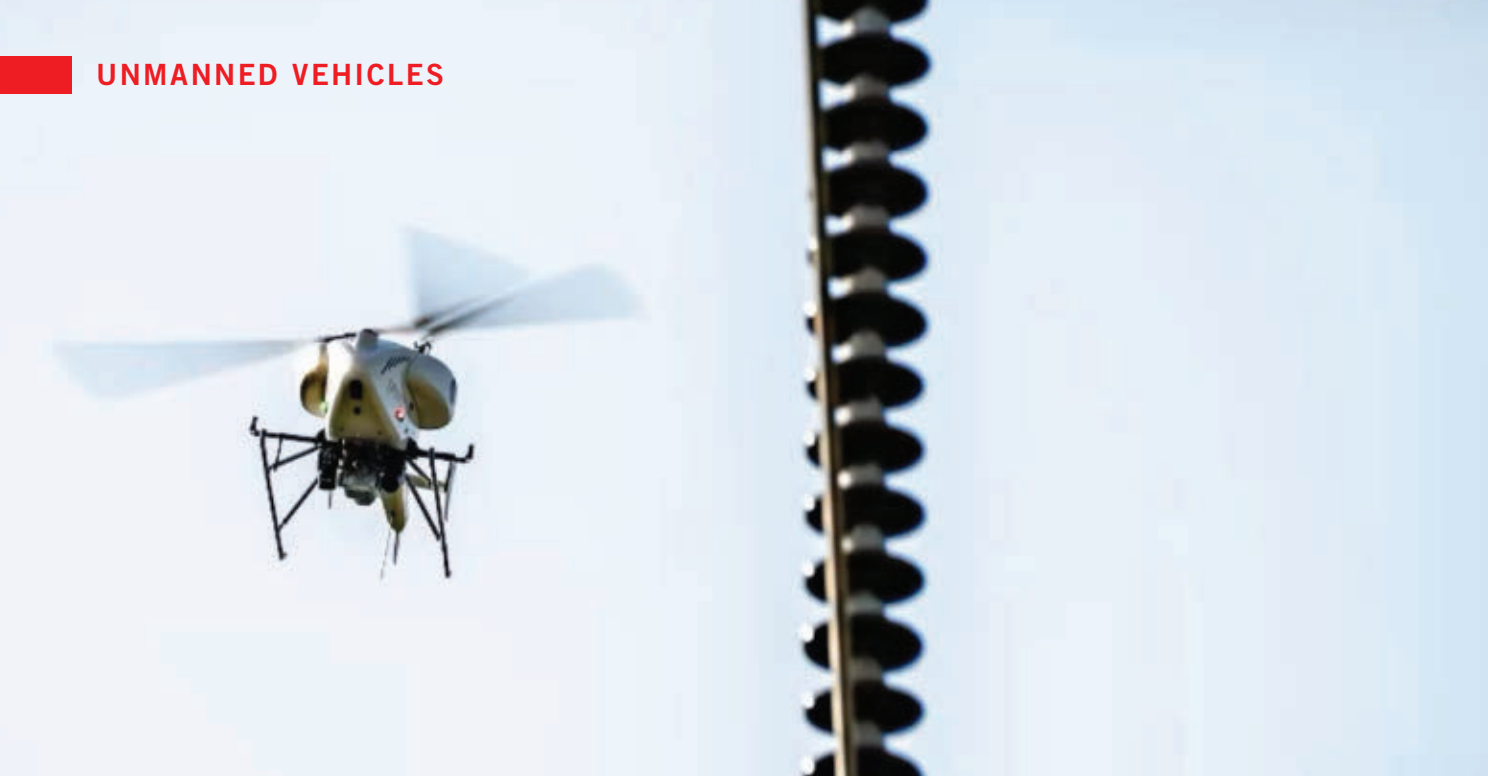
Experts from the Marine Corps and Raytheon tested the NMESIS off the coast of California in April 2021. The ROGUE Fires vehicle is remotely operated using the teleoperator or leader-follower modes. It was built for the Marines to support anti-ship operations from the ground.

The ROGUE Fires version of the JLTV lacks a crew cab and body, and is integrated with sensors and cameras, with a launcher mounted on top of the vehicle. Marine Corps leaders say they plan eventually to launch future weapons from ROGUE Fires. ←

On this contract Oshkosh will do the work in Alexandria, Va.; Gaithersburg, Md.; and Oshkosh, Wis., and should be finished by September 2025. For more information contact Oshkosh Defense online at <https://oshkoshdefense.com>, or Marine Corps Systems Command at www.marcorssyscom.marines.mil.



▲ ROGUE-Fires missile launchers will carry two Naval Strike Missiles, and be based on remotely operated versions of the Oshkosh JLTV.



FAA approves SwissDrones to fly uncrewed helicopters beyond visual line of sight

BY Jamie Whitney

ZURICH — The SDO 50 V2 multi-mission single-turbine uncrewed helicopter system from SwissDrones in Zurich has been granted special FAA authorization to allow aerial service provider Phoenix Air Unmanned (PAU) in Cartersville, Ga., to operate the SDO 50 V2 beyond visual line of sight (BVLOS) across the United States.

SwissDrones officials say the authorization will enable PAU to broaden its capabilities in inspection, patrol, and survey missions over extensive distances, and is the first-of-its-kind U.S. authorization.

SwissDrones and PAU collaborated over three years to build safe BVLOS operations and conducted flight trials in the U.S. with the SDO 50 V2, meeting all regulatory and safety requirements for extended-range inspection and patrol flights.

PAU officials say they intend to use this aircraft for data-gathering tasks like high-resolution imaging, lidar data collection, thermal imaging, and corona detection.

Depending on its sensor package and operating area, inspection flights may span distances exceeding 60 miles. This enhanced capability to collect diverse datasets over long distances enables PAU to conduct several inspections efficiently during one flight.

▲ **PAU will use the SwissDrones the SDO 50 V2 for data-gathering tasks like high-resolution imaging, lidar data collection, thermal imaging, and corona detection.**

The SDO 50 V2, with its maximum weight of 191 pounds, can carry sensors weighing between 30 and 70 pounds and maintain flights lasting more than three hours.

This extended endurance makes it suitable for missions that require several different sen-

sors. The aircraft offers nearly 10 times the endurance and three times the lift capacity compared to aircraft weighing less than 55 pounds that operate under Part 107 waivers, allowing BVLOS inspections.

“We take great pride in our partnership with Phoenix Air Unmanned, which has resulted in securing this first-in-kind BVLOS authorization in the United States,” says Ulrich Amberg, CEO of SwissDrones.

“This FAA authorization not only validates the strength of our CONOPS strategy but also paves the way for other commercial operators to leverage the capabilities of our SDO 50 V2 unmanned systems, setting a precedent for expanded operations in the industry.” ◀

For more information contact SwissDrones online at www.swissdrones.com; Phoenix Air Unmanned (PAU) at www.phoenixairunmanned.com; or the FAA at www.faa.gov/uas.



Leidos to build four Navy medium-sized unmanned underwater vehicles

BY John Keller

WASHINGTON – Unmanned systems designers at Leidos Inc. in Reston, Va., will design four experimental medium-sized unmanned underwater vehicles (UUVs) for marine environmental sensing and counter-mine warfare under terms of a \$36.3 million contract announced in July.

Officials of the U.S. Naval Sea Systems Command in Washington are asking Leidos to build four Medium Unmanned Underwater Vehicles (MUUVs) for torpedo tube-launched environmental sensing and maritime expeditionary mine countermeasures. This contract has options that could extend through 2032 and increase its value to \$358.5 million.

Leidos won a \$12 million Navy contract last year to design the MUUV, which will combine unmanned vehicle and sensors to provide persistent surface-launched and -recovered mine countermeasures and submarine-based autonomous oceanographic sensing and data collection.

The MUUV will be a modular open-systems unmanned underwater vehicle that will support the next generation of the Navy's

▲ **Razorback is a medium-sized UUV that launches from a submarine's dry deck shelter, instead of from the torpedo tube.**

Program Executive Office Unmanned and Small Combatants (PEO USC) Unmanned Maritime Systems Program Office (PMS 406) Razorback UUV program and the Expeditionary Missions Program Office (PMS 408) Viperfish Maritime Expeditionary Mine Countermeasures UUV.

Razorback is a medium-sized UUV that launches from a submarine's dry deck shelter, instead of from the torpedo tube. It carries environment-sensing payloads to enhance underwater surveillance capabilities.

Initial MUUV production systems will be for expeditionary mine countermeasures, while others will support submarine-based autonomous oceanographic sensing and data collection for environmental sensing and mine countermeasures. ◀

On this contract Leidos will do the work in Fall River, Mass.; Lynwood, Wash.; Arlington, Va.; and Newport, R.I., and should be finished by April 2026. For more information contact Leidos online at www.leidos.com/capabilities/integrated-systems/autonomy-and-autonomous-solutions.

Northrop Grumman to provide cyber intrusion protection for MQ-8C unmanned helicopter

BY John Keller

PATUXENT RIVER NAS, Md. — U.S. Navy cyber security experts are asking Northrop Grumman Corp. to provide cyber-intrusion protection for the Navy-Northrop Grumman MQ-8C unmanned helicopter to prevent adversaries from taking over control of the aircraft.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a \$19.1 million order to the Northrop Grumman Aeronautics Systems segment in San Diego to provide a cyber-intrusion protection system in support of the MQ-8C vertical takeoff and landing tactical unmanned air vehicle system.

The MQ-8C Fire Scout vertical take-off and landing tactical unmanned aerial vehicles (VTUAV) is based on the manned Bell 407 helicopter from Bell Helicopter Textron Inc. in Fort Worth, Texas.

The order includes non-recurring engineering, hardware qualification, systems integration, safety assessment, retrofit installation, and flight testing of the MQ-8C's payload interface unit and vehicle management computer to include a cyber-intrusion protection.

The original MQ-8A and MQ-8B versions of the Navy Northrop Grumman Fire Scout UAV are based on the Schweizer 333 helicopter from Schweizer Aircraft Corp., now owned by Rotorcraft Services Group in Fort Worth, Texas.

The commercial version of the Schweizer 333 seats three, can carry a payload of 1,250 pounds, can fly as fast as 105 knots, and has a maximum range of 319 nautical miles. The MQ-8B is limited to operating for eight to 12 hours per day of ISR coverage at a range of 100 nautical miles, Navy officials say. To meet the longer-range requirements, Northrop Grumman experts will use the avionics developed for the MQ-8B, as well as the software and ground-control systems, on the longer-range MQ-8C Fire Scout based on the Bell 407.

The MQ-8C provides the Navy with an increased range of more than 30 percent, twice the endurance, and an increased payload capacity over the MQ-8B variant, Northrop Grumman officials say. The unmanned systems architecture developed for the MQ-8B is re-used in the Bell 407.

The primary advantage of the MQ-8C Fire Scout over its MQ-8B and MQ-8A versions is the newest shipboard UAV has double the useful payload of its predecessors. The newest model also has a somewhat faster top speed and slightly more maximum range than previous models of the Fire Scout.

Manufacturing and assembly operations of the new Fire Scout variant are at Bell's facility in Ozark, Ala., and final assembly is Northrop Grumman's Unmanned Systems Center in Moss Point, Miss. ←

On this order, Northrop Grumman will do the work in San Diego and Mojave, Calif., and should be finished by May 2026. For more information contact Northrop Grumman Aeronautics Systems online at www.northropgrumman.com/who-we-are/business-sectors/aeronautics-systems, Bell Helicopter Textron at www.bellflight.com, Rotorcraft Services Group at <http://rotorcraftservices.com>, or Naval Air Systems Command at www.navair.navy.mil.



▲ Northrop Grumman will provide cyber intrusion protection for the Navy MQ-8C unmanned helicopter, shown above.



Honeywell and Hyundai collaborate on ground control station for UAV testing

BY Jamie Whitney

PHOENIX - Honeywell Aerospace in Phoenix and Hyundai Motor Group's Supernal subsidiary in Seoul, South Korea, are working together to develop a ground control station to enable pilotless advanced air mobility (AAM) operations.

This collaboration will enable Supernal's flight test program to use remote pilots to monitor and command aircraft safely while accessing real-time aircraft data.

Honeywell's ground control station software enables remote aircraft to fly beyond visual line of sight. Honeywell will customize a solution for Supernal as experts test the company's electric vertical takeoff and landing (eVTOL) aircraft.

Depending on the needs of an operator, Honeywell's ground control station technology could scale-up to manage hundreds or even thousands of vehicles across a series of stations, company officials say.

As a part of Hyundai Motor Group, Supernal is working together with more than 50 affiliate companies and external partners like Honeywell to develop eVTOL vehicles for commercial use starting in 2028. Supernal and Honeywell are co-creating an

▲ **This collaboration will enable Supernal to use remote pilots to monitor and command aircraft while accessing real-time aircraft data.**

AAM ecosystem that involves unmanned aircraft and ground control stations.

"The Honeywell ground control station features a certified, decentralized and redundant architecture that offers persistent connectivity for remote operations," says David Shilliday, vice president and general manager for AAM at Honeywell Aerospace.

The ground control station will integrate with the onboard Honeywell Anthem Flight deck, which already is part of Supernal's vehicle systems. This integration will reduce technical and schedule risks, and help Supernal experts to concentrate on building the aircraft. ◀

For more information contact Honeywell Aerospace online at <https://aerospace.honeywell.com/us/en/products-and-services/industry/urban-air-mobility>, or Supernal at <https://supernal.aero>.

Kit to give Puma unmanned aircraft vertical take-off capability for complex terrain

AeroVironment Inc. in Arlington, Va., is introducing the Puma vertical take-off and landing (VTOL) unmanned aircraft kit for plug-and-play integration into Puma 2 A and Puma 3 A small unmanned aerial vehicles (UAVs). The optional Puma VTOL kit expands the capabilities of the Puma in complex terrain, and does not require a runway or large open space to launch and land. The kit uses AeroVironment's Crysalis ground-control system to enable one Puma operator, and streamlines operations with features like one-button launch and recovery. Integration of the Puma VTOL kit requires minimal one-time modifications to the aircraft's airframe by qualified personnel. Once modified, the plug-and-play Puma VTOL kit can be added or removed in the field. The kit is available as an add-on option for new Puma 3 A system orders and as a retrofit kit for fielded Puma 2 A and Puma 3 A unmanned aircraft. For more information contact AeroVironment online at www.avinc.com/uas/puma-ae.

The future of urban air mobility and why it is taking off

What is UAM/AAM? It stands for Urban or Advanced Air Mobility. This transportation sector is projected to grow from \$5 billion in 2023 to more than \$23 billion globally by 2028, according to industry reports. Factors expected to drive this growth include a rise in demand for short-range routes; advances in batteries and electric propulsion systems; and the sustained efforts to reduce aviation's carbon footprint and operational costs. "We want first of all to bring advanced air mobility and a sustainable network to everyone," says Dirk Hoke, CEO at Germany-based Volocopter. Hoke pointed out that commercial operations for its battery-powered eVTOL are expected to begin next summer, when the company plans to offer commercial passenger flights during the 2024 Paris Olympics.

Skydio announces its X10 drone can be flown remotely from a web browser

Skydio, a manufacturer of uncrewed flight systems, unveiled its Skydio Remote Flight Deck, which enables remote flight for Skydio X10 drones via a web browser, anywhere over a cellular network. The solution offers a smooth handoff of flight control between local and remote pilots, allowing for uninterrupted situational awareness through live streaming. This new capability allows the organizations

such as public safety, utilities, construction and transportation to use remote drone operations. Drones can enhance response times and effectiveness in public safety scenarios, such as law enforcement operations, search and rescue missions, and firefighting. The agility and speed of drones provide first responders swift access to real-time aerial views, aiding in quality and decision-making and resource allocation. In the aftermath of a natural disaster, drones enable infrastructure inspections and help prioritize recovery efforts. In dangerous situations, a responding officer can set the drone down on the ground and have a remote pilot located anywhere take over flight and provide critical overwatch information, while the officer maintains local situational awareness. Remote pilots can use Remote Flight Deck to initiate flights from drones ready for launch by local personnel, or take control of missions already in progress. For more information contact Skydio online at www.skydio.com.

Sikorsky partners with startup Rain to remove pilots from firefighting helicopters

Firefighting pilots on Maui came to the rescue when wildfires decimated the Hawaiian island last summer, yet they soon could face stiff competition from autonomous helicopters. Rain, an autonomous aviation startup looking to fight fires with uncrewed aircraft, announced a collaboration with helicopter manufacturer Sikorsky to add the Lockheed Martin subsidiary's optionally piloted Black Hawk to Rain's fleet. The partnership could enable autonomous rapid-response capabilities for aerial wildland firefighting, and reduce the cost of suppressing the blazes. Rain in Alameda, Calif., will integrate the MATRIX autonomy suite from Sikorsky, a Lockheed Martin company in Stratford, Conn., into a civilian firefighting version of Sikorsky Black Hawk helicopter. Rain integrates with early wildfire detection networks to rapidly dispatch autonomous aircraft. Onboard the aircraft, the Rain Wildfire Mission Autonomy System identifies and locates wildfire, develops a suppression strategy, and plans flight path and drop timing to enable on-target delivery of suppressant. Throughout operations, the Wildfire Mission Autonomy System shares intelligence and plans, providing firefighters with situational awareness and oversight of the mission to ensure safety and coordination. For more information contact Rain online at www.rain.aero, or Sikorsky, a Lockheed Martin company, at www.lockheedmartin.com/en-us/capabilities/sikorsky.html. ←



Wanted: electro-optical imaging sensors for SWaP-constrained uses

BY John Keller

ARLINGTON, Va. – U.S. military researchers have approached industry for new electro-optical enabling technologies to enhance the precision and sensitivity of optical sensors in SWaP-constrained applications like active imaging; atomic sensing; navigation; microscopy; and communications.

Officials of the U.S. Defense Advanced research Projects Agency (DARPA) have released a broad agency announcement (HR001123S0052) for the Intensity-Squeezed Photonic Integration for Revolutionary Detectors (INSPIRED) project.

The goal is develop small size, weight, and power consumption (SWaP) optical sensors with sensitivity below the quantum shot noise limit by using so-called squeezed light. Several contractors are expected to participate in this program.

Low-noise detectors are vital components in optical science and technology, DARPA researchers explain. Decreasing the noise in optical detection could increase chances of

▲ **Electro-optical enabling technologies are necessary for SWaP-constrained applications like active imaging; atomic sensing; navigation; microscopy; and communications.**

deploying advanced optical technologies in SWaP-constrained systems.

The quantum sensing advantage of squeezed light to date has not exceeded 10 decibels due to imperfections in even the highest-quality discrete optics. Yet recent advances in nonlinear integrated photonics and heterogeneous integration are beginning to enable chip-scale photonic devices to outperform bulk discrete optical components.

The nonlinear effects that generate squeezed light are more efficient in chip-scale devices than in bulk devices due to stronger field confinement, researchers say. The inherent stability of solid-state photonic circuits and flexible component design also may provide significant performance advantages in manipulating quantum states of light.

The objective of the INSPIRED program is to develop electro-optical detector modules that integrate squeezed-light measurement techniques into form factors comparable to

commercial photodetector modules, and increase sensitivity well beyond the quantum shot-noise limit, researchers say.

Getting there, though, will require broad innovation in materials, design, and fabrication to realize chip-scale photonic devices and circuits that efficiently can prepare, manipulate, and detect quantum states of light.

One challenging aspect of the program lies in achieving low aggregate loss in complex multi-component photonic circuits. Other challenges include generating a high squeezing ratio in size- and power-constrained photonic devices. Ultimately, producing such electro-optical systems should enable INSPIRED detectors to measure weak signals with high sensitivity.

The three-year INSPIRED program has two phases to develop a squeezed-light detector prototype. The first phase will develop

the central chip-scale photonic devices for a squeezed-light detector, which will include a squeezed-light generator with high squeezing ratio and a phase-sensitive interferometer circuit with low optical loss.

The second phase will demonstrate squeezed-light detector prototypes with sensitivity exceeding the quantum shot noise limit in a module with volume comparable to commercial photodetector components. This will include a prototype module using phase-one test articles. ◀

Companies interested were asked to submit proposals by December to the DARPA BAA website online at <https://baa.darpa.mil>. Email questions or concerns to DARPA's Justin Cohen to HR001123S0052@darpa.mil. More information is online at <https://sam.gov/opp/b6bdb0f703c144728d937ebe82315f26/view>.

Northrop Grumman eyes infrared search and track sensors for military aircraft

U.S. Air Force researchers needed help in developing infrared sensors to enable combat aircraft to search wide areas covertly. They found their solution from the Northrop Grumman Corp. Mission Systems segment in Linthicum, Md. Officials of the Multispectral Sensing & Detection Division of the Air Force Research Laboratory Sensors Directorate at Wright-Patterson Air Force Base, Ohio, announced a \$8.1 million follow-on contract to Northrop Grumman as part of the Multi-Spectral Sensing Technologies R&D (MuSTeR) program. This contract is for the Advanced Staring Infrared Search and Track Technologies (ASISTT) portion of the MuSTeR program, which seeks to develop infrared sensors for use aboard aircraft. Overall, MuSTeR seeks to enhance the state-of-the-art in U.S. military sensor system research by using the entire electromagnetic spectrum to deliver next-generation capabilities for global persistent awareness. Northrop Grumman won an \$840,429 MuSTeR contract in July 2022 to support test flight of sensor systems. Other MuSTeR contractors are looking into low-cost infrared search and track (LC-IRST) system design tradeoffs, cloud clutter suppression algorithms and processing, and machine learning techniques with the potential to improve overall IRST detection performance. Infrared search and track capability is important for modern aircraft because it can detect and track enemy aircraft and missiles without giving away its presence. Active search systems like radar, for example, must emit electronic signals that tip off the enemy to its presence; it's like shining a flashlight in a darkened room. For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com, or the Air Force Research Laboratory at www.afrl.af.mil.

Raytheon to build Army TOW 2B optically guided anti-tank missiles

Raytheon Technologies Corp. (RTX) will build radio-controlled anti-tank missile systems for the U.S. Army under terms of a \$322.5 million order. Officials of the U.S. Army Contracting Command at Redstone Arsenal, Ala., are asking the RTX Raytheon segment in Tucson, Ariz., to build the Tube-Launched, Optically Tracked, Wireless-Guided (TOW) 2B munition — better-known as the TOW 2B missile. The multimission TOW 2A, TOW 2B, TOW 2B aero, and TOW bunker-buster missiles are a primary precision anti-armor, anti-fortification, and anti-amphibious landing weapons used throughout the world today, RTX officials say. The TOW 2B operator defines the aim point by maintaining the sight crosshairs on the target. The launcher automatically steers the missile along the line-of-sight toward the aim point via a one-way RF and microwave link, which links the launcher and missile for guidance. The operator uses an optical missile sight attached to the launcher. The sight is data linked to the missile. Wireless TOW missiles include an RF transmitter added to the missile case and an RF receiver located inside the missile. When the optically guided missile fires, the RF transmitter in the launcher relays information to the missile while in flight. The operator keeps the sight fixed on the target — even if the target is moving — to guide the missile to its target. Original versions of the TOW, which were called the tube-launched, optically tracked, wire-guided missile, trailed a thin wire that relayed information to the missile from the sight. On this order RTX will do the work in Tucson, Ariz., and should be finished by December 2026. For more information contact RTX Raytheon online at www.rtx.com/raytheon, or the Army Contracting Command-Redstone at <https://acc.army.mil/contractingcenters/acc-rsa/>. ◀



Draper eyes next-generation guidance system for submarine-launched ballistic missiles

BY John Keller

WASHINGTON – U.S. Navy strategic weapons experts are asking the Charles Stark Draper Laboratory Inc. in Cambridge, Mass., to move forward with research towards developing the next-generation guidance system of Trident II submarine-launched ballistic missiles.

Officials of the Navy Strategic Systems Program office in Washington have announced a \$2.2 billion contract to Draper to support strategic guidance, navigation, and control research for follow-on full-scale development of the Trident II's future Mark 7 guidance subsystem.

The Navy's Trident II D5 nuclear missiles are designed for launch from Ohio-class ballistic missile submarines, from the Navy's future Columbia-class submarine, and from British Royal Navy Vanguard-class ballistic-missile submarines.

The contract also is for engineering to maintain the Trident II's Mark 6 guidance subsystem, as well as support construction and integration of the U.S. Navy Columbia-class ballistic submarine, and the United Kingdom Royal Navy Dreadnought ballistic missile submarine.

The future U.S. Columbia-class ballistic missile submarine will enter service in 2031. The future Dreadnought submarine will replace the Royal Navy's fleet of Vanguard-class ballistic missile submarines.

The Trident II nuclear-tipped ballistic missile has a range of more than 7,000 miles and carries four independently targeted 475-kiloton nuclear warheads.

The Trident missile's MK 6 guidance system consists of an electronics assembly with the system's flight computers, and an inertial measurement unit (IMU) with the system's inertial sensors. The electronics assembly interfaces with the submarine's fire-control system and the missile's flight-control electronics assembly. The IMU, meanwhile, senses the motion of missile and provides navigation information to the mission computer.

▲ **The Trident nuclear missile has a maximum speed of 13,000 miles per hour, and has precision guidance from inertial sensors with star sighting.**

Trident missiles are aboard 14 Navy Ohio-class submarines and four British Royal Navy Vanguard-class submarines. Each Ohio-class submarine can carry as many as 24 Trident atomic missiles. These vessels together carry about half of all U.S. strategic thermonuclear warheads.

The Draper Lab order is part of a Navy effort begun in 2002 to extend the life of the D5 missiles to the year 2040 by replacing obsolete components with commercial off-the-shelf (COTS) hardware. Upgrades involved the missile reentry systems and guidance systems.

The first flight test of a D5 extended-life subsystem, the MK 6 Mod 1 guidance system, was in early 2012 aboard the ballistic missile submarine USS Tennessee (SSBN 734).

The Trident nuclear missile has a maximum speed of 13,000 miles per hour, and has precision guidance from inertial sensors with star sighting. No GPS-guided Trident D5 missiles have been deployed.

The Trident II missile warhead discharges the energy of 475,000 tons of TNT, and is roughly 30 times the size of the U.S. nuclear bomb dropped on Hiroshima, Japan, in 1945.

On this contract Draper will do the work in Cambridge and Pittsfield, Mass; Washington; Odon, Ind.; Huntsville, Ala.; Cape Canaveral and St. Petersburg, Fla.; and other locations, and should be finished by September/ 2028. ◀

For more information contact Draper Lab online at www.draper.com/business-areas/strategic-systems, or the Navy Strategic Systems Programs Office at www.ssp.navy.mil.

Raytheon to ramp-up production of AIM-9X air-to-air infrared-guided missile

BY John Keller

PATUXENT RIVER NAS, Md. — U.S. Navy aerial warfare experts are asking Raytheon Technologies Corp. (RTX) to prepare to increase infrared-guided air-to-air missile production to as many as 2,500 per year, under terms of a \$74.8 million order.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the RTX Raytheon segment in Tucson, Ariz., for additional non-recurring tooling, equipment, and labor to increase the annual AIM-9X production capacity to 2500 in support of the U.S. Navy, Air Force, Army, and foreign allies.

The AIM-9X is an infrared-guided heat-seeking missile that equips most jet fighters, fighter-bombers, and other offensive combat aircraft in the U.S. arsenal, and is for shooting down enemy aircraft close-by. The AIM-9X works by homing in on an enemy aircraft's hot engine exhaust. Variants of the AIM-9 Sidewinder have been deployed since the 1950s.

The AIM-9X is among the latest versions of the AIM-9 missile family. It entered service in 2003 on the Navy F/A-18C Hornet fighter-bomber and on the U.S. Air Force F-15C jet fighter. It has an imaging infrared focal plane array seeker with 90-degree off-boresight capability for accuracy.

The missile is compatible with helmet-mounted displays such as the U.S. Joint Helmet Mounted Cueing System, and features 3-D thrust-vectoring control for increased turn capability. The AIM-9X also includes an internal cooling system.

This contract involves the latest versions of the AIM-9X, called the AIM-9X Block II and AIM-9X Block II-plus. This newest version has lock-on after launch capability for use with the F-35 Lightning II joint strike fighter and the F-22 Raptor advanced tactical fighter.

The AIM-9X Block II-plus features specialized external materials to enhance aircraft survivability for the F-35. Until

another version of the AIM-9X is developed that will fit inside the F-35's enclosed weapons bay, the AIM-9X Block II-plus has stealthy coatings and structures to help reduce the missile's radar cross-section when the F-35 carries these missiles externally.

On this order Raytheon will do the work in St. Albans, Vt.; Simsbury, Conn.; Keyser, W.Va.; Tucson, Ariz.; Murrieta, El Cajon, Goleta, and Anaheim, Calif.; St. Petersburg, Fla.; Midland, Ontario; Anniston, Ala.; Vancouver, Wash.; Niles, Ill.; Heilbronn, Germany; Logan, Utah; Lexington, Ky.; and other U.S. locations, and should be finished by July 2026. ←



The AIM-9X anti-aircraft missile has an imaging infrared focal plane array seeker with 90-degree off-boresight capability for accuracy.

For more information contact RTX Raytheon online at www.rtx.com/raytheon, or Naval Air Systems Command at www.navaer.navy.mil.

UNMANNED VEHICLES

► ThayerMahan to develop undersea unmanned vehicles and sensors to enhance situational awareness

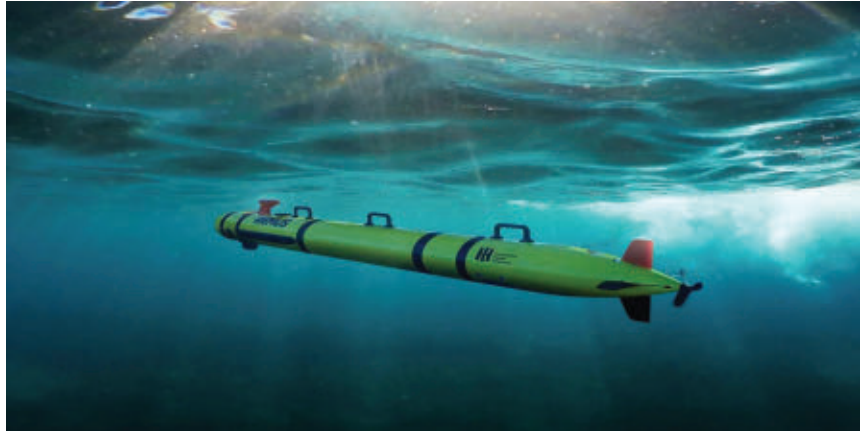
U.S. Navy undersea warfare researchers needed enabling technologies in autonomous maritime sensing to enhance Navy and Marine Corps undersea and maritime advantage. They found their solution from ThayerMahan Inc. in Groton, Conn.

Officials of the Office of Naval Research (ONR) in Arlington, Va., has announced a \$19.3 million contract to ThayerMahan for the Autonomous Mobile Maritime Systems for Tactical Surveillance, Undersea Warfare, and Subsea and Seabed Warfare project.

The contract calls for ThayerMahan to develop specialized long-endurance autonomous systems, sensors, autonomous behaviors, signal processors, artificial intelligence (AI), machine learning, and improved endurance capacity. The contract is part of the Navy's Long Range Broad Agency Announcement (BAA) for Navy and Marine Corps Science and Technology.

"This federal contract will help strengthen the Navy's and Marine Corp's eyes and ears undersea through advanced and innovative autonomous maritime systems," says U.S. Rep. Joe Courtney, D-Conn., the ranking member of the congressional House Armed Services subcommittee on seapower and projection forces.

The contract to ThayerMahan will enable the company to continue developing unmanned autonomous maritime sensing technology, Courtney says. "This federal contract



will help strengthen the Navy's and Marine Corp's eyes and ears undersea through advanced and innovative autonomous maritime systems, which will be a critical capability in the 21st century," Courtney says.

On this contract ThayerMahan will do the work in Groton, Conn., and should be finished by October 2027. For more information contact ThayerMahan online at www.thayermahan.com, or the Office of Naval Research at www.nre.navy.mil.

SPACE SENSORS

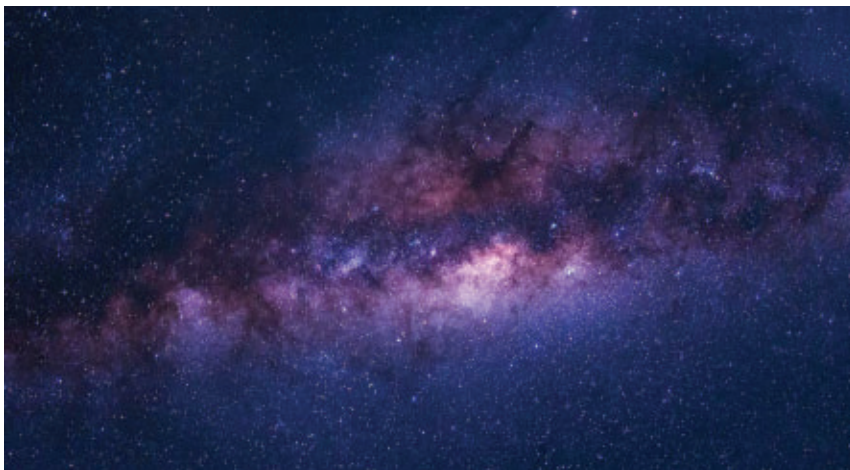
▼ NASA selects Spectra Vista for new spectroradiometer

The U.S. National Aeronautics and Space Administration (NASA) needed a calibrated spectroradiometer to measure the spectral irradiance and reflectance of photosynthetic pigments in the field under natural sunlight conditions. They found their solution from Spectra Vista Corporation in Poughkeepsie, New York.

The reflectance data will help model the detectability of surface biosignatures on exoplanets. The instrument will also be used in the lab to measure the spectral irradiance of artificial light sources used to simulate light from different type of stars.

The spectral measurements will be used in exoplanet biosignature experiments, the data from which will provide measurement requirements for the upcoming Habitable Worlds Observatory (HWO).

Spectra Vista's spectroradiometer meets NASA's requirements to measure from 350-2500 nanometers with a minimum integration of one



millisecond and a calibration accuracy of plus or minus five percent at 700 nanometers, plus or minus seven percent at 2200 nanometers, and has a wavelength reproducibility of 0.1 nanometers.

NASA notes that the new spectroradiometer will replace one that it purchased in the late 1980s, as it can no longer be supported or calibrated by the manufacturer, and it is experiencing failing battery packs.

NASA expects delivery prior to 24 January 2024. The primary point of contact for this contract is Tracy Bremer, who can be contacted via email at tracy.g.bremer@nasa.gov.

TACTICAL NETWORKING

▼ L3Harris to manufacture sensors and weapons tactical network equipment for anti-air warfare

U.S. Navy anti-air warfare experts needed an electronics manufacturer to build sensors and weapons tactical network equipment for Navy surface warships and carrier-based aircraft. They found their solution from L3Harris in Camden, N.J.

Officials of the Naval Sea Systems Command in Washington announced a \$67.4 million order to L3Harris to build AN/USG-2B System, AN/USG-3B System, spares, signal data processors for the Navy Cooperative Engagement Capability (CEC) program.

The CEC is a tactical sensor and weapons network that uses Navy ships and aircraft for anti-air warfare. It combines information from sensors operating over wide geographic areas in a common tactical picture for battle groups at sea. It improves overall situational awareness, and enables fleet commanders to work closely together to attack enemy forces from long ranges.

This order includes stock point, equipment repairs, repair material, engineering studies and analyses, configuration, obsolescence, tech data management, and technical data package.

The AN/USG-3 is the airborne designation of CEC deployed in E-2C and E-2D carrier-based radar surveillance aircraft. Other CEC terminals are aboard Navy surface warships; U.S. Marine Corps command posts, aviation command-and-control centers, and surveillance aerostats.

The AN/USG-2 for Navy surface warships — also known as the Cooperative Engagement Transmission Processing Set (CETPS) — coordinates all task force anti-air warfare sensors into one real-time, fire-control-quality composite track picture by distributing sensor data from each cooperating unit to all other cooperating units via a real time line of sight fire control sensor and engagement data distribution network.

The CEC blends sensors and weapons into an integrated real-time network that expands the battlespace; enhances

situational awareness; increases depth of fire; enables long intercept ranges; and improves decision and reaction times.

The system uses line-of-sight data distribution to share radar-measurement data among sensors and weapons to create one distributed integrated air picture. It combines surveillance and targeting information such that the combined system is greater than the sum of its parts.

On this order L3Harris will do the work in Largo, Fla.; Salt Lake City; and Menlo Park, Calif., and should be finished by October 2025. For more information contact L3Harris Technologies online at www.l3harris.com, or Naval Sea Systems Command at www.navsea.navy.mil.



MACHINE LEARNING

► **Vadum to refine AI and machine learning algorithms to counter waveform-agile radar**

U.S. Navy avionics experts have announced plans to hire Vadum Inc. in Raleigh, N.C., to continue a project to refine detection and classification techniques that identify new or waveform-agile radar threats and use artificial intelligence (AI) and machine learning to respond automatically with an electronic warfare (EW) attack.

Officials of the Naval Surface Warfare Center Crane Division in Crane, Ind., said Tuesday they will ask Vadum engineers to continue work on the Reactive Electronic Attack Measures (REAM) project.

Vadum won a \$9.4 million sole-source REAM contract in early 2019 to develop ways of keeping up with rapidly changing enemy radar frequencies, recognizing patterns in frequency shifts, and automatically devising methods to jam or spoof these frequencies-on-the fly.

On the REAM project, Vadum looked into detection and classification techniques that identify new or waveform-agile radar threats and automatically respond with an electronic attack.

Waveform-agile radar is an advanced technology that is able to change the time, frequency, space, polarization, and modulation of its signal from pulse to pulse to enhance its sensitivity, or to confuse potential adversaries about its design and use.

The contract will ask Vadum to improve and expand the capabilities the company developed in the REAM project. Company engineers will develop, refine, integrate, and test software algorithms that provide EW protection against new and unknown threats, as well as the capability to characterize unknown radar threats, and scalable and modular capability to support additional platforms. The value of this upcoming contract has yet to be negotiated.

Today's airborne EW systems are proficient at identifying analog radar systems that operate on fixed frequencies. Once they identify a hostile radar system, EW aircraft can apply a preprogrammed countermeasure technique.

Yet the job of identifying modern digitally programmable radar variants using agile waveforms is becoming more difficult. Modern enemy radar systems are becoming



digitally programmable with unknown behaviors and agile waveforms, so identifying and jamming them is becoming increasingly difficult.

Things will get worse in the future as radars develop the ability to sense their environment with artificial intelligence and machine learning, and adapt their transmission characteristics and pulse processing algorithms to defeat attempts to jam them.

New approaches like REAM seek to enable systems to generate effective countermeasures automatically against new, unknown, or ambiguous radar signals in near real-time. They are trying to develop new processing techniques and algorithms that characterize enemy radar systems, jam them electronically, and assess the effectiveness of the applied countermeasures.

Waveform-agile radar systems of the future will shift frequencies quickly in a pre-programmed electronic dance to foil electronic warfare attempts to defeat them.

The Northrop Grumman Mission Systems segment in Bethpage, N.Y., won a \$7.3 million contract in 2018 to develop machine-learning algorithms for the REAM program. The company is moving machine-learning algorithms to the EA-18G carrier-based electronic warfare jet to counter agile, adaptive, and unknown hostile radars or radar modes. REAM technology is expected to join active Navy fleet squadrons around 2025.

For more information contact Vadum online at <https://vaduminc.com>, or the Naval Surface Warfare Center-Crane at www.navsea.navy.mil/Home/Warfare-Centers/NSWC-Crane.



SIGNAL PROCESSING

▲ SRI International eyes artificial intelligence (AI) reconfigurable processors for EW and communications

U.S. military researchers needed to develop high-throughput streaming-data processors that reconfigure themselves within 50 nanoseconds for advanced RF applications in radar, communications, and electronic warfare (EW). They found their solution from SRI International in Menlo Park, Calif.

Officials of the U.S. Defense Advanced Projects Agency (DARPA) in Arlington, Va., announced a \$14.4 million contract to SRI International for the Processor Reconfiguration for Wideband Sensor Systems (PROWESS) project.

SRI International joins the University of Southern California (USC) in Los Angeles on the PROWESS project. USC won a \$9 million contract for the project in August.

On the PROWESS contract, SRI International and USC researchers will try to develop reconfigurable processors that provide autonomous RF and microwave systems with situational awareness about complex and uncertain electromagnetic environments.

PROWESS aims at RF autonomy, where radios use artificial intelligence (AI) to sense the spectrum and adapt to the environment. RF autonomy can help resist the effects of radio interference and improve the capacity of the spectrum to accommodate an increasing number of transceivers.

Although the preferred processors for today's autonomous radios are field programmable gate arrays (FPGAs),

signal environments can change in nanoseconds, which is far faster than FPGAs can reprogram. What are necessary are new classes of receiver processors.

PROWESS aims to develop high-throughput, streaming-data processors that reconfigure in real time to detect and characterize RF signals. Through processors that self-reconfigure within 50 nanoseconds, PROWESS will enable real-time synthesis of processing pipelines in uncertain environments.

PROWESS will help enable future radio receivers to optimize performance to measured spectrum condi-

tions and the needs of cognitive RF decision logic.

High-throughput streaming-data processors can enable just-in-time synthesis of receiver processing pipelines in uncertain environments where pre-programmed solutions are likely to fail, DARPA researchers say.

PROWESS is expected to combine emerging high-density reconfigurable processing arrays with embedded real-time schedulers to expose new architectural tradeoffs that deliver fast program switching and high-compute density.

Commercial and military demands on the electromagnetic spectrum (EMS) are driving radio frequency (RF) systems to operate in increasingly congested and complex environments, researchers explain. Spectrum sensing in these conditions drives the demand for edge processing beyond the capacity of today's devices.

The PROWESS project seeks create reconfigurable processors to improve RF autonomy by enhancing spectrum sensing, which enables RF systems to optimize to actual spectrum conditions and react to interference in real time, DARPA researchers say.

These kinds of computer architectures potentially offer significant benefits for spectrum sensing and related applications, particularly when systems must operate in dynamic and sometimes-confusing environments. PROWESS expects to focus on the development of runtime reconfigurable processing hardware and support software.

For more information contact SRI International online at www.sri.com, USC at <https://today.usc.edu/tag/research/>, or DARPA at www.darpa.mil/news-events/2022-10-06.



TEST AND MEASUREMENT

▲ Mosaic ATM to develop signal strength toolkit for advanced air mobility aircraft

The U.S. National Aeronautics and Space Administration (NASA) needed to use deep learning to predict signal strength at low altitude for an advanced air mobility (AAM) aircraft. They selected Mosaic ATM in Leesburg, Virginia, to develop that solution.

The machine learning system is trained using high-fidelity physics-based simulated data and actual data recorded from test flights. Using a combination of convolutional neural networks and deep learning systems, the accuracy of the estimation will be high, Mosaic says, with a speed that is about ten times faster than current physics-based algorithms, and will be applied to the low-altitude UAM communications system.

Mosaic ATM says its goal is to produce a quick and reliable signal strength estimate for an advanced air mobility vehicle within four minutes. The estimate will consider atmospheric effects, transmitter power, Doppler shifts, multipath interference, terrain obstructions, and many other effects. This tool is an example of training a machine learning system to understand physics, such as signal propagation.

The applications include pre-flight planning, route contingency management, transmitter health status, transmitter location placement, and others.

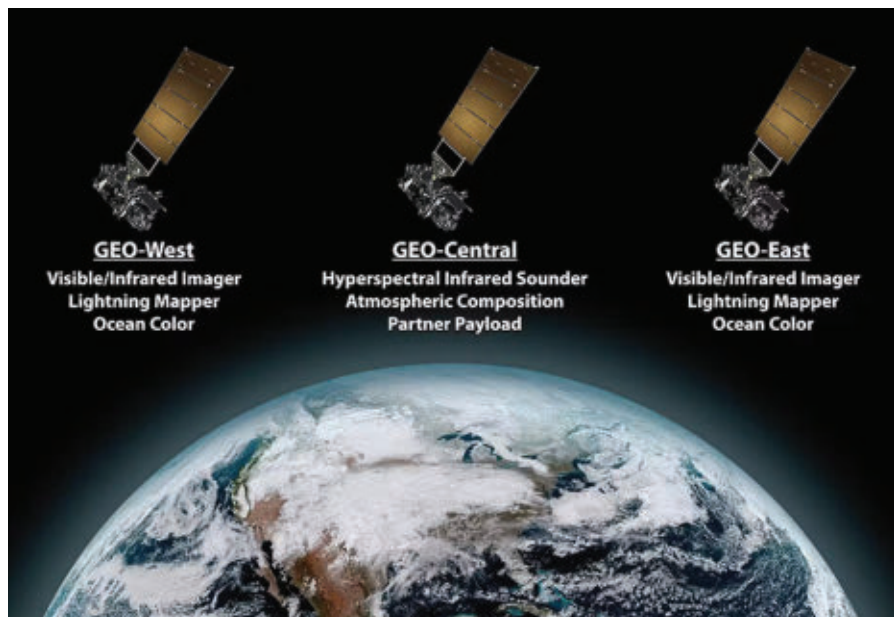
The project's Principal Investigator is Dr. Frederick Wieland, the Chief Research Scientist at Mosaic ATM. Mosaic ATM has provided services to NASA since the earliest days of Mosaic in 2004 through Small Business Innovative Research (SBIR) contracts and NASA Research Announcement (NRA) contracts.

SPACE INSTRUMENTS

▼ NASA selects Ball Aerospace to build instrument for NOAA observation constellation

The U.S. National Aeronautics and Space Administration (NASA) sought a provider to build a hyperspectral infrared sounding instrument for the National Oceanic and Atmospheric Administration's (NOAA) Geostationary Extended Observations (GeoXO) program. They found their solution from Ball Aerospace in Broomfield, Colorado.

GeoXO will collect data on weather patterns and ocean color, replacing and expanding on NOAA's current Geostationary Operational Environmental Satellite-R Series (GOES-R). The Ball-built GeoXO Sounder (GXS) will provide 3D profiles of the atmosphere over North America in real-time, enhancing numerical weather prediction models to better predict dangerous weather events like tornadoes and hurricanes, and help airlines avoid turbulence and monitor pollutants like ozone and carbon monoxide in the air.



Once launched, GXS will be the first hyperspectral infrared sounder flown by the United States in geostationary orbit.

"This long-awaited instrument will serve as an essential tool in improving the safety of our communities, the health of our residents and our understanding of extreme weather," said Dr. Alberto Conti, vice president and general manager, Civil Space, Ball Aerospace. "GXS will allow forecasters to track tornadoes and floods as they develop to provide earlier warnings to residents, and the higher resolution and frequency of atmospheric measurements will contribute new insights about the way weather patterns form. We're excited to continue our partnerships with NOAA and NASA on GXS and to support this important mission."

In 2021, NASA selected Ball Aerospace to conduct a Phase A study for GXS, which was used to set performance requirements for the instrument. Ball was also selected to conduct studies for the Atmospheric Composition (ACX) and Ocean Color (OCX) instruments that will fly in the new constellation. GeoXO is expected to launch in the early 2030s and continue operating through 2055.

POWER ELECTRONICS

▼ Saab picks EaglePicher for lithium-ion batteries for Gripen jet fighters

Military aircraft designers at Saab AB needed lithium-ion batteries for backup power aboard the company's JAS 39 Gripen E-series jet fighter. They found their solution from EaglePicher Technologies in St. Louis.



Saab has awarded EaglePicher a contract to design and develop a 24-volt lithium-ion battery for the Gripen E-series fighter aircraft. This is the first of its kind lithium-ion battery used on Saab's aircraft, company officials say. EaglePicher also has developed lithium-ion power for military aircraft like the Northrop Grumman B-2 Spirit stealth strategic bomber.

The EaglePicher lithium-ion batteries will power avionics and weapon systems aboard the JAS 39 Gripen jet fighters while delivering power for engine start in cold-weather. EaglePicher is developing these 24 volt, 36 amp-hour lithium-ion main and emergency batteries to redundancy on the JAS 39 Gripen E-series combat aircraft.

These batteries, designed specifically for the Gripen, feature extreme low-temperature capability and extended operational life cycles for extended service time on wing and reduced maintenance.

The batteries include integrated battery charging and advanced power electronics technology as well as an integrated battery management system with bi-directional communications bus.

The batteries are qualified to RTCA DO-311A safety standards mandated by the U.S. Federal Aviation Administration (FAA), and to the RTCA DO-178 DAL A safety-critical software standard.

EaglePicher is modifying and adapting its specialized electrochemistry and cell designs first introduced on the U.S. F-35 joint strike fighter's emergency battery system to power avionics and flight controls in an engine failure.

The Saab JAS 39 Gripen is a light single-engine supersonic multirole fighter aircraft with a delta wing and canard configuration with fly-by-wire flight controls. Early models of the aircraft entered service with the Swedish air force in 1996. Upgraded variants began entering service in 2003.

Compared to earlier models of the Gripen, the E-series has a larger fuselage, a more powerful engine, an increased weapons payload capability, new cockpit avionics, and electronic warfare (EW) system.

For more information contact EaglePicher Technologies online at www.eaglepicher.com, or Saab AB at www.saab.com/products/gripen-e-series. ◀



visible-light cameras to deliver live imagery and targeting information to vehicle crews. Operators can use the system for assessing if terrain is passable, sweeping for mines and improvised explosive devices, or performing close-up inspection under bridges using onboard illumination. For more information contact Teledyne FLIR Defense online at www.flir.com/applications/government-defense.

RF AND MICROWAVE

▼ MIL-PRF-55342-compliant fixed attenuators introduced by Smiths Interconnect

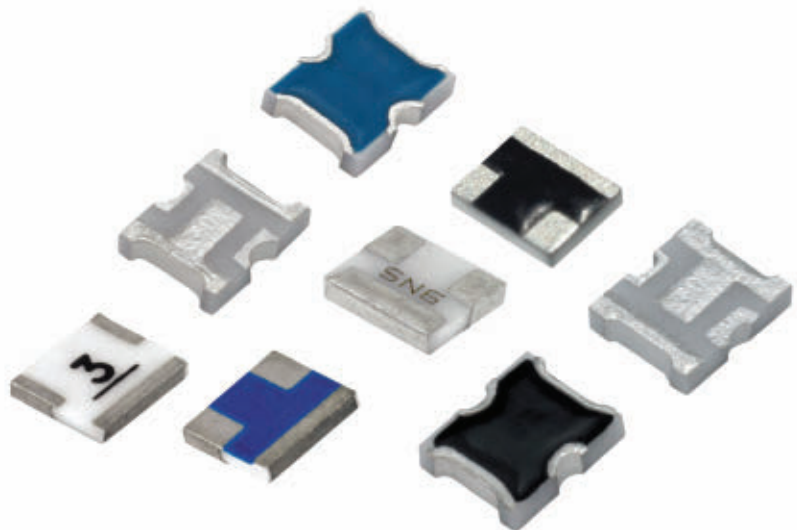
Smiths Interconnect Inc. in Sudbury, Mass., is introducing the SPL series

of fixed attenuators and Thermopad products for use in space, defense, and aerospace applications. The SPL series offers a relatively low cost of ownership based on MIL-PRF-55342 for fixed film chip resistors ensuring high quality and reliability levels. The fixed attenuators are available in styles from DC-6 GHz for low-frequency requirements to DC-20 GHz for broadband requirements. It is 100 percent electrical, visual, and mechanical tested; offers annual test data product qualification reports; has low cost of ownership; short lead times; is compact and light weight; and offers terminal wraps for solder inspection. For more information contact Smiths Interconnect online at www.smithsinterconnect.com.

UNMANNED VEHICLES

▲ Autonomous capability to operate unmanned reconnaissance aircraft from military vehicles offered by FLIR

Teledyne FLIR Defense in Wilsonville, Ore., is introducing a technology concept to enable crews to launch small unmanned aerial vehicles (UAVs) autonomously from inside military vehicles; perform reconnaissance, surveillance, and target acquisition (RSTA); and then recover the aircraft without leaving the vehicle. The Black Recon Vehicle Reconnaissance System (VRS) features a micro-UAV able to withstand the shock and vibration of traveling on infantry and other fighting vehicles. The system is built to provide continuous untethered reconnaissance at flight speeds that enable the UAV to work ahead of advancing vehicles, and supply situational awareness even beyond line of sight. Fitted inside hardened launch boxes mounted to military vehicles, Black Recon's deployment system can launch as many as three UAVs during a mission. When one returns, a cradle-arm recovers the drone autonomously that tracks, captures, and docks the UAV - day or night. The system then automatically recharges the UAV for its next mission. Black Recon uses thermal and





control plane interfaces, and 32 lanes of Gen4 PCI Express on the expansion plane. The rugged module is available in a conduction-cooled version with two-level maintenance covers, and supports alternate cooling mechanisms, such as air flow-through (AFT) and liquid flow-through (LFT). For more information contact Curtiss-Wright Defense Solutions online at www.curtisswrightds.com/products/computing/processors/6u-vpx/champ-xd4.

EMBEDDED COMPUTING

▲ Rugged SOSA-aligned 6U VPX embedded computing module introduced by Curtiss-Wright

The Curtiss-Wright Corp. Defense Solutions Division in Ashburn, Va., is introducing the CHAMP-XD4 (VPX6-485) security-enhanced 6U OpenVPX embedded computing module for compute-intensive defense, aerospace, and industrial applications. The CHAMP-XD4 features dual Intel Xeon D-2700 processors, and is for demanding intelligence, surveillance and reconnaissance (ISR) system architectures. The module is scalable and can be configured with 12, 16, or 20 cores per device. The CHAMP-XD4 complements the AMD Versal-based CHAMP-FX7 user-programmable adaptive system-on-chip (SoC) field-programmable gate array (FPGA) module. The two modules are 6U VPX form factor members of the Curtiss-Wright Fabric100 family of SOSA aligned processing engines for digital signal processing (DSP) applications like multi-mode radar, synthetic aperture radar, signals intelligence, electro-optical sensor processing, and electronic warfare (EW). The CHAMP-XD4 is a Xeon D-2700 module that support four 100 Gigabit Ethernet fabric connections and 32 lanes of Gen4 PCI Express, as well as four banks of memory per processor. The CHAMP-XD4 also features an AMD MPSoC FPGA device that provides enhanced TrustedCOTS cyber security. An MPSoC FPGA toolkit is available for applications that require security IP. The CHAMP-XD4 supports quad 100 Gigabit Ethernet data plane interfaces, dual 10 Gigabit Ethernet

TEST AND MEASUREMENT

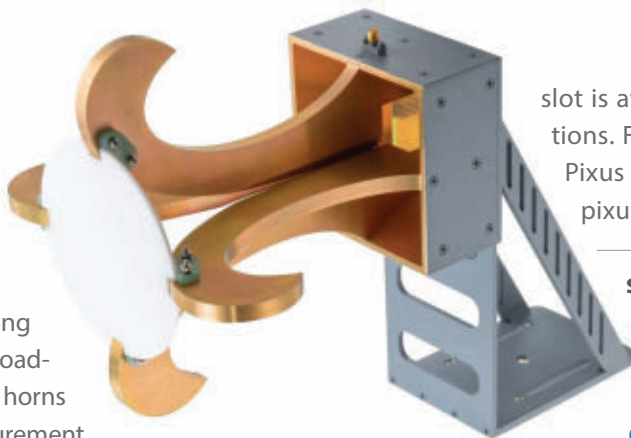
▼ PCI Express 6.0 validation test software introduced by Teledyne LeCroy

Teledyne LeCroy in Chestnut Ridge, N.Y., is introducing support for PCI Express 6.0 electrical base specification testing and validation with QPHY-PCIE6-TX-RX automated test software. This offering includes base and compliance testing for all previous PCI Express generations 5.0, 4.0, 3.0, 2.0, and 1.0; and can measure transmitter equalization (Tx EQ) settings to align results with current SigTest AC fit methods. These test and measurement enhancements can measure signal-to-noise-and-distortion ratio (SNDR) with oscilloscope noise compensation and signal analysis waveform views. This support also can make receiver calibration seamlessly simple and quick by executing several instances of Seasim simultaneously to reduce time to complete calibration. For more information contact Teledyne LeCroy online at www.teledynelecroy.com.



RF AND MICROWAVE**► RF gain horns for broadband test uses introduced by Fairview Microwave**

Fairview Microwave Inc. in Lewisville, Texas, is introducing quad-ridge dual-polarized, broadband RF and microwave gain horns for broadband test and measurement applications. These gain horns range from 0.8 to 95 GHz waveguide and are available in gain varieties of 6, 10, 12, 15, and 20 dBi. These gain horns characterize antennas and wireless systems. Crafted from high-grade aluminum, the RF and microwave gain horns have corrosion-resistant powder coating for durability and performance, and come with popular connector options. Fairview Microwave's new quad-ridge, dual-polarized, broadband gain horns are in stock and available for same-day shipping. For more information contact Fairview Microwave online at www.fairview-microwave.com.



slot is available in several configurations. For more information contact Pixus Technologies online at www.pixustechnologies.com.

SINGLE-BOARD COMPUTERS**▼ FPGA- and Intel-based 3U VPX single-board computer offered by Abaco**

AMETEK Abaco Systems in Huntsville, Ala., is introducing the SBC3513 3U VPX single-board computer for demanding command, control, communications, computers, intelligence, surveillance, reconnaissance (C4ISR) and industrial applications. The SOSA-aligned I/O-intensive SBC3513 features the Intel Xeon W processor, formerly known as Tiger Lake H. With eight cores operating at 2.6 GHz, it offers 64 gigabytes of DDR4 RAM, and as much as 480 gigabytes of nVME solid-state memory. The SBC3513 embedded computing board is designed with a 100 Gigabit Ethernet data plane, 25 Gigabit Ethernet control plane, and PCI Express Gen4 to the backplane. It offers a straightforward upgrade path to SBC3511 users offering many of its features but with enhanced performance and speed capabilities thanks to newer silicon and engineering. The board's general-purpose I/O moves to its field-programmable gate array (FPGA) for latency reduction. Other upgrades are offered to NVRAM and DisplayPort, and the board consumes about 100 Watts of power. The single-board computer offers on-board Xilinx Zynq UltraScale+ MPSoC's built-in security capabilities, including an unclonable function (PUF), user-accessible hardened cryptographic blocks, asymmetric authentication, side channel attack protection, and other silicon-based AT features. Abaco offers several firmware options as well as SDKs and other support for Windows 10/11 and Linux Fedora, Red Hat, and Ubuntu for the SBC3513. For more information contact AMETEK Abaco Systems online at www.abaco.com.

**CHASSIS AND ENCLOSURES****▼ Embedded computing chassis for SpaceVPX and 3U VPX introduced by Pixus**

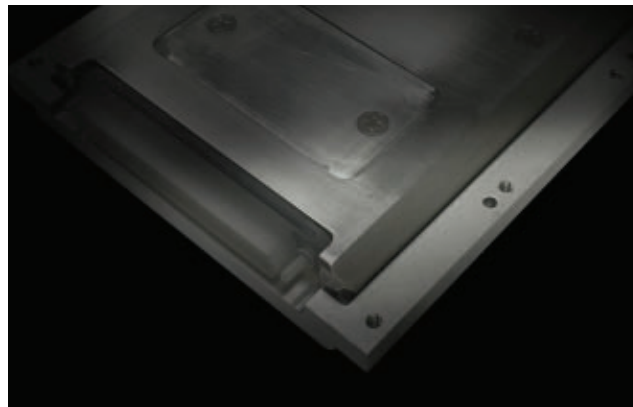
Pixus Technologies in Waterloo, Ontario, is introducing an OpenVPX embedded computing chassis for a variety of military, industrial, and commercial rugged computer applications. The open-frame chassis supports 160-millimeters-deep and 220-millimeters-deep SpaceVPX and OpenVPX 3U boards, and features as many as four slots at 1-inch pitch of each board depth. The modular enclosure has card guide options to support air- and conduction-cooled computer boards. There are also 220-millimeter-deep card guides are wide to support extra-thick SpaceVPX conduction-cooled boards per VITA 78. A wide range of 3U or 6U OpenVPX backplanes are available for this embedded computing chassis, including versions that use the KVPX connector per VITA 63. A modular fixed power supply or a pluggable VITA 62 power supply



ENCRYPTION

► **NSA Type-1 encryption for cyber security applications introduced by Mercury**

Mercury Systems Inc. in Andover, Mass., is introducing the JDAR Type-1 encryptor module for cyber security applications for U.S. military organizations and prime defense contractors. Mercury's JDAR data-at-rest encryptor received trusted computing NSA Type-1 encryption certification in 2022, and it has since been integrated into several of Mercury's data storage systems. Operating in tactical environments increases the vulnerability of sensitive data, and adversaries potentially can gain access to data that is lost or compromised. JDAR's NSA type-1 encryption prevents unauthorized personnel from gaining access to inactive classified mission data. Suitable for many types of manned and unmanned aircraft and ground vehicles, the module protects classified information to ease physically moving mission data during operations without risk of compromise. JDAR offers NSA Certified Type-1 encryptor measures 5.04



by 3.94 by 0.63 inches and weighs less than 1 pound; consumes less than 7 Watts of power; operates in temperature from -40 to 85 degrees Celsius; cold starts in less than 12 seconds; has four lanes to connect SATA hard drives; and offers common open standard interfaces and VNX/3U VPX connectors. For more information contact Mercury Systems online at www.mrcy.com. ◀

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Annapolis Micro Systems Inc.	27
Anritsu America	22
Axiom Electronics	C4
Bartington Instruments Ltd.	13
Coilcraft, Inc.	14
Dawn VME Products	17
Elma Electronic Inc.	7, 23
Extreme Engineering Solutions.....	9, 29
Fairview Microwave	21
General Micro Systems Inc.	C2
Holt Integrated Circuits.....	24
LCR Embedded Systems Inc.....	1
Master Bond Inc.	22, 27
MPG Solutions	11
Pasternack Enterprises.....	3
Pendulum Instruments.....	7
Philpott Ball & Werner.....	25
Phoenix International.....	57
Pico Electronics Inc.....	16
Quantic PMI (Planar Monolithics Industries)	7
RGB Spectrum.....	56
VPT	15

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NASA seeks commercial aircraft technologies and designs with eye on 2050

By Jamie Whitney

WASHINGTON - The U.S. National Aeronautics and Space Administration (NASA) and its Glenn Research Center in Cleveland are turning to industry for subsonic aircraft designs and other technologies to stimulate innovation and advanced designs for entry into service around 2050.

NASA says submissions will help identify key technology areas for investment and will influence the future content of its subsonic transport research and technology portfolio.

The project is a part of NASA's Advanced Aircraft Concepts for Environmental Sustainability (AACES) program, which focuses on eliminating greenhouse gas emissions from commercial aircraft by the middle of the century.

The NASA Research Announcement (NRA) is identify airframe and propulsion considered critical for meeting the environmental goals and remaining commercially viable.

▲ **NASA is collecting subsonic aircraft technologies for service beyond 2050.**

This project is not a traditional request for proposal (RFP) with a defined statement of work (SOW); rather, it seeks to identify concepts and technologies suitable for a traditional solicitation. NASA will weigh technical merit of these concepts

rather than potential costs.

NASA officials are asking for context such as energy availability, infrastructure; emissions estimates; technology roadmaps; and risk analyses. A NASA panel will evaluate each proposal to assess its relevance, technical merit, work plan, and cost realism. ◀

More information, including documentation and project requirements, is available at <https://sam.gov/opp/6922c1158dba4387a6f2208198721312/view>. The primary point of contact for this project is Ashlee Shaw, who can be emailed at ashlee.b.shaw@nasa.gov.

Denver International Airport to trial Liberty Defense HEXWAVE employee-screening technology

DENVER - Denver International Airport in Denver will perform a customer trial of the HEXWAVE system from Liberty Defense Holdings Ltd. in Wilmington, Mass., for use in conducting aviation worker screening.

HEXWAVE uses millimeter wave 3D imaging, and artificial intelligence (AI) to detect concealed metallic and non-metallic

weapons; liquid, plastic, and powder explosives; 3D printed guns; and other prohibited items – without the need to remove common items like cell phones or keys.

The system is for rapid automated screening using a high-throughput contactless walkthrough portal. The system integrates smart internet-of-things (IoT) connectivity to existing security systems.

“Denver International Airport has always been on the forefront of deploying next generation technologies, especially for safety and security applications,” said Bill Frain, CEO of Liberty Defense. “We look forward to working with Denver to enhance the screening requirements and demonstrate an effective and efficient security process utilizing our HEXWAVE technology.”

In October, Liberty Defense announced that Los Alamos National Laboratory received a pair of HEXWAVE screening portals. Located in northern New Mexico, Los Alamos is a multi-program, federally funded research and development center for the National Nuclear Security Administration of the U.S. Department of Energy. It has 900 individual facilities and over 17,000 employees who work on site. ←



The HEXWAVE system from Liberty Defense will see demonstration in Denver to screen airport employees for weapons and other prohibited items.

Airbus Helicopters debuts single-stick controls with eye on eVTOL flight

Airbus Helicopters in Marignane, France, has tested an electric flight control system in preparation of a new human machine interface (HMI) that will equip the CityAirbus NextGen, Airbus's eVTOL prototype. Airbus officials say the pilot controls have been simplified with an enhanced piloting assistance from the electric flight control system. Airbus has accomplished a first in the helicopter industry: one piloting

stick replaces the three conventional pilot controls (cyclic, pedals, collective) and is able to control all aircraft axes. Using the single stick, the pilot is able to perform all maneuvers: take-off and landing, climb, descent, acceleration, deceleration, turn, and approach. The single stick takes up less space, offers improved visibility to the pilot, and is combined with a revised HMI which uses simple displays, providing a selection of information specifically tailored to eVTOLs. After the success of the flight test campaign Airbus Helicopters is

working on finalizing the details of this new system before new tests are conducted in the framework of Vertex, a project conducted in partnership with Airbus UpNext that will advance autonomy even further by managing navigation and simplifying mission preparation.

NASA taps Raytheon for solid-state circuit breaker for hybrid electric aircraft

Raytheon Technologies Corp. (RTX) in Arlington, Va., has demonstrated the operation of a solid-state circuit breaker to support hybrid-electric propulsion systems in future aircraft. The circuit breaker is being developed as part of a collaboration between the RTX Technology Research Center (RTRC), Collins Aerospace and Pratt & Whitney under NASA's Advanced Air Vehicles Program (AAVP). A circuit breaker on an aircraft helps protect the plane by removing power from the system when it senses an electric fault, performing a similar function to those in homes. With future hybrid-electric propulsion systems slated to see increases in voltage and power compared to today's aircraft, they will require new circuit breakers that can handle higher loads. RTX's novel solid-state technology will enable its circuit breaker to handle five times the power of the largest circuit breaker flying today, with the ability to interrupt thousands of amps of current in less than 100 microseconds. Having completed design, functional and altitude testing, RTX expects to further develop and refine the solution through system integration in Collins' new electric power systems lab, dubbed "The Grid," and flight demonstration in the coming years.

NASA selects Mosaic ATM to develop signal strength toolkit for AAM aircraft

The U.S. National Aeronautics and Space Administration (NASA) needed a new solution to utilize deep learning to predict signal strength at low altitude for an advanced air mobility (AAM) aircraft. They selected Mosaic ATM in Leesburg, Va. The machine learning system is trained using high-fidelity physics-based simulated data and actual data recorded from test flights. Using a combination of convolutional neural networks and deep learning systems, the accuracy of the estimation will be high, Mosaic says, with a speed that is about ten times faster than current physics-based algorithms, and will be applied to the low-altitude UAM communications system. Mosaic ATM says its goal is to produce a quick and reliable signal strength estimate for an advanced air mobility vehicle within four minutes. The estimate will consider atmospheric effects, transmitter power, Doppler shifts,

multipath interference, terrain obstructions, and many other effects. This tool is an example of training a machine learning system to understand physics, such as signal propagation. The applications include pre-flight planning, route contingency management, transmitter health status, transmitter location placement, and others. The project's Principal Investigator is Dr. Frederick Wieland, the Chief Research Scientist at Mosaic ATM. Mosaic ATM has provided services to NASA since the earliest days of Mosaic in 2004 through Small Business Innovative Research (SBIR) contracts and NASA Research Announcement (NRA) contracts.

Boeing, NASA, United Airlines to test sustainable aviation fuel benefits

Boeing in Everett, Wash., is partnering with the U.S. National Aeronautics and Space Administration (NASA) and Chicago-based commercial airline United Airlines for in-flight testing to measure how sustainable aviation fuel (SAF) affects contrails and non-carbon emissions, in addition to reducing the fuel's life cycle climate impact. Boeing's second ecoDemonstrator Explorer, a 737-10 destined for United Airlines, will fly with 100 percent SAF and conventional jet fuel in separate tanks and alternate fuels during testing. NASA's DC-8 Airborne Science Lab will fly behind the commercial jet and measure emissions produced by each type of fuel and contrail ice particles. NASA satellites will capture images of contrail formation as part of the testing. The researchers aim to understand how advanced fuels, engine combustor designs and other technologies may reduce atmospheric warming. For example, tests will assess how SAF affects the characteristics of contrails, the persistent condensation trails produced when airplanes fly through cold, humid air. While their full impact is not yet understood, some research has suggested certain contrails can trap heat in the atmosphere. Additional support comes from the U.S. Federal Aviation Administration (FAA), who is providing funding through the ASCENT Center of Excellence; GE Aerospace is providing technical expertise and project funding, and German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt or DLR) is providing experts and instrumentation. The Boeing ecoDemonstrator program was expanded this year to include Explorer airplanes focused on short-term, specific test projects. Boeing and NASA conducted SAF emissions ground testing on an Alaska Airlines 737-9 in 2021 and ecoDemonstrator 777-200ER and 787-10 flight-test jets in 2022. Boeing has committed to deliver commercial airplanes compatible with 100 percent SAF by 2030. ◀



NASA selects CesiumAstro to assess wideband SATCOM capabilities

WASHINGTON - The U.S. National Aeronautics and Space Administration (NASA) in Washington sought a company to perform a wideband satellite communications (SATCOM) study for commercialized communications services for near-Earth users.

The agency selected CesiumAstro in El Segundo, Calif., for this contract. CesiumAstro is a company with expertise in active phased array communications technology for space and airborne systems.

CesiumAstro will design a low-Earth orbit (LEO) space-qualified Ka-band active phased array terminal able to communicate with commercial and government networks.

As part of the study, CesiumAstro will identify the barriers, challenges, and solutions associated with integration of wideband active phased array terminals into NASA's Near Space Network (NSN).

The agency's overarching goal is to create reliable and cost-effective commercial services for space communications and navigation to enable users to 'roam' between space-based and ground-based communications networks.

▲ **CesiumAstro will study commercial satellite communications capabilities for near-Earth users.**

NASA's Space Communications and Navigation (SCaN) program manages the agency's two main networks: the Deep Space Network for distant missions and the NSN for missions operating closer to Earth, operated through a mix of government and commercial entities.

NASA seeks to create an interoperable architecture composed of existing NASA and commercial services. The completion of this study may add to the evolution of NASA's NSN and the agency's vision for a resilient and robust space and ground communications and navigation infrastructure.

"CesiumAstro is honored to provide a commercially available product to advance reliable, secure, and continual space communications for long-term operations," said Shey Sabripour, founder and CEO of CesiumAstro. "We're proud to leverage CesiumAstro's existing expertise in active phased array space communications and explore innovative wideband solutions that can help guide NASA toward the successful commercialization of the Near Space Network." ◀