ARMY TECHNOLOGY

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A publication of science and technology news from the U.S. Army Research, Development and Engineering Command

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SENSORS

+PLUS

INTERVIEW WITH

MARY J. MILLER

DASA(R&T)

GENERAL DYNAMICS
Land Systems

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ACRONYM GUIDE

AMC	U.S. Army Materiel Command
RDECOM	U.S. Army Research, Development and Engineering Command
ARL	Army Research Laboratory
ARDEC	Armament Research, Development and Engineering Center
AMRDEC	Aviation and Missile Research, Development and Engineering Center
CERDEC	Communications-Electronics Research, Development and Engineering Center
ECBC	Edgewood Chemical Biological Center
NSRDEC	Natick Soldier Research, Development and Engineering Center
TARDEC	Tank Automotive Research, Development and Engineering Center
ASA(ALT)	Assistant Secretary of the Army for Acquisition, Logistics and Technology
ARCIC	Army Capabilities Integration Center
DARPA	Defense Advanced Research Projects Agency
DASA(R&T)	Deputy Assistant Secretary of the Army for Research and Technology

Maj. Gen. John F. Wharton, RDECOM commanding general, outlines his priorities for the workforce at an organizational town hall meeting at Aberdeen Proving Ground, Maryland, Nov. 24, 2014. (U.S. Army photo by Conrad Johnson)

Front and back cover designs by Joe Stephens

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http://armytechnology.armylive.dodlive.mil

At RDECOM, we understand how science and technology bring the power of American innovation to everything we do. I am proud that RDECOM researchers, engineers and support personnel provide our nation, both at home and abroad, the technology and capabilities to win anywhere, anytime.

The successful efforts of the Edgewood Chemical Biological Center workforce using their technical skills and knowledge to design and build the Field Hydrolysis Disposal System, and then deploying with it to destroy Syria's declared chemical weapons stockpile, is an example of American innovation.

In this issue of *Army Technology Magazine*, we hope to highlight how sensors are integrating into military gear and vehicles in ways that will empower, unburden and protect our Soldiers.

Greater situational awareness leads to improved threat detection in most battlefield environments. Future smart sensors will give us a decisive edge.

At the Communications-Electronics Research, Development and Engineering Center, our Night Vision and Electronics Sensor Directorate is developing new technologies to provide Soldiers with unprecedented sight. Our researchers have expanded Soldier viewing capability in total darkness, even through battlefield obscurants.

We partner with the Program Executive Offices for Soldier; Intelligence & Electronic Warfare; and Command, Control, Communications-Tactical to transition this research into programs of record that can make an immediate difference in the fight.

RDECOM also works closely with the Defense Advanced Research Projects Agency, or DARPA, to move forward with the Multifunction Radio Frequency technology that will help Soldiers fight effectively in low visibility environments. The MFRF has an onboard sensor system that helps Army aviators cope with brownout or whiteout conditions, thereby giving pilots the ability to prevent collisions with other aircraft, cables and power lines. This is critical research that will save lives and preserve our commanders' combat power.

In the future sensors will be everywhere. Army researchers are working on flexible plastic sensors that could be attached to individuals, gear or vehicles. With this technology, Soldiers will gather information on the chemical-biological environment, troop movements and signal intelligence.

For example, in Army weapon systems, future sensors will allow for pinpoint accuracy and scalable effects lethality in GPS-denied environments.

The Army of 2025 and beyond calls for advanced sensors that can locate and identify threats, enable protection systems to counter those threats and make it less likely an enemy will detect our vehicles.

Developing algorithms and software to manage the next wave of data coming from smart sensors continues to be a scientific challenge. Researchers are developing solutions to introduce a common architecture that our partners in industry will build upon, ultimately for a variety of platforms.

Our science and engineering partners at the U.S. Army Medical Research and Materiel Command foresee the Soldiers of 2025 having sensors that help to detect and prevent threats such as dehydration, elevated blood pressure and cognitive delays from lack of sleep.

The Chief of Staff of the Army vision has mentioned, "Our modernization programs will remain centered on assuring the American Soldier remains the most discriminately lethal force on the battlefield. We will prioritize the procurement of proven technologies that enhance Soldier and unit lethality, their survivability, their mobility, and network functionality and improve our premier ground and air combat systems. Science and technology investments will seek to maximize the potential of emerging game-changing technologies."

Jyuji D. Hewitt
RDECOM Executive Deputy to the Commanding General

The S&T efforts focused on developing and maturing smart sensor technologies enables the Army to continue to be the most versatile, agile, rapidly deployable and sustainable strategic land force in the world.

Editor's note: Jyuji D. Hewitt is the RDECOM executive deputy to the commanding general. He previously served as executive director for support, Office of Security Cooperation-Iraq in Baghdad, Iraq. Also, he was deputy to the commander and executive director for ammunition, U.S. Army Joint Munitions Command, Rock Island Arsenal, Ill. The Army selected him for the Senior Executive Service in January 2007. Read his biography at http://www.army.mil/article/108766.

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Future of Army Sensors

AN EXCLUSIVE INTERVIEW WITH MARY J. MILLER, DEPUTY ASSISTANT SECRETARY OF THE ARMY (RESEARCH AND TECHNOLOGY)

Since February 2013, Mary J. Miller has served as the Deputy Assistant Secretary of the Army for Research and Technology. She is responsible for the entirety of Army research and technology programs, spanning 16 laboratories and research, development and engineering Centers, with more than 12,000 scientists and engineers and a yearly budget of more than $2 billion dedicated to empowering, unburdening and protecting Soldiers. She earned an Army Research and Development Achievement Award in 1988 for her technical achievement in the "Development of Nonlinear Materials for Sensor Protection." She has been awarded four patents for sensor protection designs, with two additional patents pending. Miller has published more than 50 papers and has addressed over 30 major commands and international groups with technical presentations. She holds master of science degrees in business administration from the University of Tennessee and in electrical engineering, electro-physics from the George Washington University. Her undergraduate degree is a bachelor of science in electrical engineering from the University of Washington in Seattle. The Army selected her for the Senior Executive Service in August 2005.

Army Technology: What is the Army's vision for sensors research?

Miller: From my perspective, I think that Army S&T is looking at a broad number of approaches for what sensor capabilities we will need to meet future challenges. We're looking to improve situational awareness, mobility, lethality and even improve the maintainability and effectiveness of our systems.

To achieve these capabilities, we are conducting research in areas such as networked Soldier helmet sensors. For mobility, we have a large effort in establishing Degraded Visual Environment capabilities that will ensure our rotorcraft can fly in any environment such as brownout, snow or just low-light levels. We're also looking at ways to increase lethality. We just recently transitioned the third generation FLIR [short for Forward Looking Infrared], to the Program Executive Office for Intelligence Electronic Warfare and Sensors. This system gives us the ability to do identification at longer ranges than we have ever before. Identification is required for our rules of engagement in the Army. This is an example of a capability that was transitioned from the S&T community and has been very successful in early operational demonstrations.

Regarding maintainability and effectiveness, we've been researching sensors that can be put in the skins of platforms to understand the environment they've been in—measuring vibration, ballistic impact or even thermal cycling. We can even determine battle damage assessment with embedded sensors. We put sensors in our missiles as well to better assess their status. By understanding what they have experienced, we can determine what capacity they have going forward or whether they have been degraded. Finally, sensors can enable better power management by telling us when we need to have more power in a particular sub-system and less in another. We can then divert energy to improve effectiveness overall.

Army Technology: What's the value in this research? How does it empower Soldiers?

Miller: Sensors and situational awareness are the keys to our Soldiers being effective. I think we've all seen the reports that have come out of Afghanistan where unfortunately a majority of the engagements our Soldiers (at the squad and team level) had with the enemy is because they were surprised. That is a situation in which we do not want to put any of our Soldiers. Holistically the work we have been doing in our sensor technology areas is to help ensure that never happens.

Whether the Soldier is dismounted in a squad fighting in Afghanistan, or is a helicopter pilot having to land and pick up Soldiers in an austere environment, or even a ground platform driver traveling unfamiliar roads at night, we want to provide all of these Soldiers the best capabilities that we can—the capability to conduct their mission with full situational awareness in any situation.

Army Technology: In realizing the Army's vision of the future, how critical are S&T investments?

Miller: The Chief of Staff of the Army and the Secretary of the Army have looked at science and technology (S&T) and our portfolios of investments as the enablers for the future.

The Army has been facing significant fiscal challenges and we have had to make tough trades between operational readiness, force structure and modernization. Unfortunately given those three, modernization is the one that suffers.

Since 2012, our modernization accounts have gone down about 40 percent, and that is significant. Modernization accounts are what create the future capability for the Army. The Army stood up and decided to protect its investments in the science and technology world. Why? Because the Army is now looking to us [the S&T Enterprise] to underpin what will become future capability for the Soldier. They have expanded our mission. They've challenged us to go farther than we've gone before, to develop prototypes of new capabilities and do experimentation in conjunction with Soldiers to ensure that's what the Army needs. We're doing this hand-in-hand with our Training and Doctrine Command. It's a collaborative effort where we are aligned more than ever with our program executive offices, with TRADOC—our requirements team—and also the S&T community, to make sure we are doing the right things for the Army of the future.

Army Technology: What about partnerships between Army S&T, industry and academia?

Miller: We need to do more. As our budget reduces, we have to leverage other's technology development. This is both a challenge and an opportunity. It's a challenge because frankly we don't do that very well. It's an opportunity because there are folks out there with good ideas that we should be trying to leverage. We do better with academia because our labs are experienced in working with basic and applied research and we have many opportunities to engage with Universities. If you listen to our Defense Acquisition Executive, Mr. Kendall, and read Better Buying Power 3.0, he talks about the need to better leverage Industry IR&D, or Independent Research and Development, investments. Those are investments that industry makes in what they see as the next technology breakthroughs. Industry focuses their R&D investments on those technologies they believe will provide future returns. By informing industry of Army needs, we hope to encourage industry to align the IR&D to meet these needs. I think there is more to be done there to align and leverage as much as we can out of industry.

It's not just industry and academia [that we need to leverage]. It's also our foreign partners as well. From my office, in conjunction with the Deputy Assistant Secretary of the Army for Defense Exports and Cooperation (who is responsible for international engagement and foreign military sales), we've done a more strategic outreach to our partner nations to figure out the technologies that are out there in our global economy. Other nations may have a slight edge on us or a different approach in certain technology areas. We hope to leverage their expertise by making strategic alliances. Very often in the past our international engagements were bottom-up driven. Our laboratory experts would be talking with fellow foreign laboratory experts and they would come up with a project they wanted to do together. The compliment to this approach is where we are making alliances that are strategically driven—where we go out and target technology areas where we know foreign countries have expertise and bring that expertise in to help the Army go forward.

Army Technology: What's your message to Army researchers and engineers?

Miller: I am optimistic about the future. Those of us that have been in the Army for a while know that we always have budget downfalls and then increases. It's always going to be a roller coaster ride, but at the end of the day the reason we work for the Army is that there are some unique challenges and opportunities for our researchers.

The Army is really relying on our scientists and engineers throughout the S&T Enterprise to step into the breach and basically plot what will be the future for the Army. We are being asked to stand up and deliver, and I fully expect that we will. I have yet to see us fail at being able to solve a problem.

We have some of the world's best scientists and engineers here within the Army and the Department of Defense dedicated to the work they do in helping the Soldier. It is so clear that the Soldier is our customer. We have a good track record of bringing folks in from the outside, not for the pay, not for the great hours, but because we have such a unique problem and the ability to help and to make a difference.

It is a critical role that the S&T Enterprise plays. As I said, the Chief of Staff and the Secretary of the Army have protected the S&T community through the last couple of years of budget downsizing for this very reason. They see us as a key enabler of the future going forward. ■

Sensing the Future

Giving Soldiers the decisive edge

BY DAVID MCNALLY, RDECOM PUBLIC AFFAIRS

Sensors are everywhere in today's technology-driven world. There are sensors in traffic lights, vehicles and smartphones.

Sensors in military applications gather data that U.S. Army researchers hope will give Soldiers the decisive edge.

This technology has broad application across the Army. Medical researchers are investigating how physiological sensors may help Soldiers achieve "superior performance on battlefields of the future," according to Lt. Gen. Joseph Caravalho Jr., former commander of the U.S. Army Medical Research and Materiel Command and Fort Detrick. Caravalho led a panel discussion at the Association of the United States Army's Medical Hot Topics Forum, Sept. 10, 2014.

Soldiers of 2025 and beyond may wear sensors to help detect and prevent threats such as dehydration, elevated blood pressure and cognitive delays from lack of sleep, Caravalho said. Sensors might also detect chemical exposure or extreme environments.

Karen O'Connor, Command, Control, Communications, and Intelligence portfolio director for the Deputy Assistant Secretary of the Army for Research and Technology in the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology, said sensor research exists in all of the portfolios.

"There are sensors in imaging, motion detection, radar, chemical-biological detection and more," she said. "At the end of the day, sensors are all about collecting data."

As we look to the future, sensors will become smarter, smaller and cheaper, she explained.

"Our real goal will be to build in multi-functionality," she said. "How can we sense multiple things with a single, integrated system or sensor?"

Nicole Devitt, the C3I portfolio deputy director, said another challenge is how data collected by sensors will become useful information for Soldiers.

"We need to make sensors smarter to give the Soldier the information to do his or her job," Devitt said. "You can have all of this data that's out there, but if you don't have something that simplifies the data and gets it to the right person on time to act on it."

Researchers need to get the right mix of information to Soldiers at the right time, she said.

"We need to consider the cognitive burden," O'Connor said. "The Soldier is under high stress in potential combat operations. At what point does the Soldier become overwhelmed? We have the capability to provide all kinds of information, but what does the Soldier really need to know?"

Scientists at the Army Research Laboratory Human Research and Engineering Directorate at Aberdeen Proving Ground, Maryland, are conducting cognitive research.

"It comes down to understanding how humans process information," O'Connor said. "We have to look at the application of the information. Does every Infantry squad member need to see the same picture? We need to ensure that the information provided is not a burden. We have to balance that. It's about controlling the data flow."

One of the Army's enduring challenges is to gather timely mission command and tactical intelligence to provide situation awareness and communications in all environments.

The C3I Portfolio ensures that Soldiers have "trusted and responsive sensors, communications, and information adaptable in dynamic, austere environments to support battlefield operations and non-kinetic warfare."

O'Connor's team invests about $129 million annually in sensor research. Army scientists, engineers and researchers are working from many angles:

- Electro-optical
- Infrared
- Non-imaging
- Radio frequency
- Counter sensor/sensor protection
- Sensor integration

"We can do many things, but we want to do many things with a single system or sensor," O'Connor said. "With Force 2025, we will become more expeditionary and reduce our footprint. We will be more mobile and better prepared to deploy. Instead of deploying 10 sensors, we can deploy one. This is what is driving us as we move toward the future."

The investment strategy is focused on where there will be a unique benefit to Soldiers; however, the pace of technology breakthroughs is reducing costs and providing the Army with better sensor opportunities.

"If industry is developing things that we can leverage, we're not going to invest there," O'Connor said. "Instead, we figure out how be a fast follower. Commercial industry is a big driver. We are not going to put our dollars into something that industry is already doing and maybe doing better because they have a big commercial market for it."

"Our sensors are very advanced," Devitt said. "But, there is still work that needs to be done in terms of making sensors lighter, cheaper and more power efficient."

Better integration is the challenge for future technology, Devitt said. Researchers at Communications Electronics Research, Development and Engineering Center Night Vision and Electronic Sensors Directorate are working on an integrated sensor architecture, which will create a common foundation for how sensor data is managed.

"That effort is not developing sensor technology, but it is developing a way for sensors to be more useful," Devitt said.

"It's also about how information is shared," O'Connor said. "It will allow Soldiers to access information that they don't have a sensor for, but because they are on a network or shared architecture, they will be able to get information that they normally wouldn't have."

O'Connor said information sharing will decrease the need for more sensors and result in a smaller footprint.

"In reality, we are reaching technology parity," she said. "Anything we can do to give our Soldiers the edge over someone who has the same capabilities is important. We will develop ways to simplify and process data better. In today's information-based world, sensors are critical. Being able to turn data into useful information will give our Soldiers the decisive edge."

AUTONOMOUS FUTURE

Engineers find keys to autonomous future

BY MATT DECEMBER, TARDEC PUBLIC AFFAIRS

Sensors are making the Army's ground vehicle fleet more intelligent by providing a safer, more agile operating environment for American Soldiers.

Scientists and engineers at the U.S. Army Tank Automotive Research, Development and Engineering Center at Detroit Arsenal, Michigan, are seeking advancements in autonomy-enabled systems and intelligent mobility.

"Sensors, and the interactive connectivity they provide the user, are a crucial component to providing the most intelligent vehicles capable of performing under diverse environmental conditions anywhere in the world," said Jeremy Gray, TARDEC Ground Vehicle Robotics research scientist. "To get to where the Army needs to be, sensors must provide performance input that can be calculated, analyzed and lead to vehicle actuation in fewer than 60 milliseconds."

Army engineers are researching and designing unique high-speed sensors that can be embedded into vehicle platforms and/or vehicle tires and wheels.

"Early development has begun on a wheel-speed sensor that provides readable information about a change of rotational speed during a very, very small time interval," Gray said. "In order to achieve optimal agility, the vehicle needs to react in real-time to these acting forces."

Gray hopes ongoing sensor research will pay dividends for vehicle manned-unmanned teaming by placing continued emphasis on providing Soldiers with equipment that will help reduce their burden.

TARDEC and its partners have conducted several demonstrations of unmanned capabilities, including the recent Multi-Autonomous System Control demo, which allowed several autonomous vehicles to be overseen from a single command center.

"We can aid autonomy-enabled vehicles with off-road mobility through terrain-sensing parameters that can be calculated, analyzed and passed to following vehicles within the convoy for pre-emptive mobility control," Gray said. "Updating and map building for terrain characterization of soil parameters, such as density, moisture, friction coefficient and type, is vital."

TARDEC is also working closely with the U.S. Army Training and Doctrine Command, military users and the acquisition community to advance the development of autonomous appliqué systems for tactical vehicles and make these capabilities available for fleet integration by 2020. Sensors deliver optionally-manned and unmanned ground vehicles require an understanding of the terrain they are attempting to traverse, successfully guiding themselves through a dynamic, complex and environmentally uncertain world.

"Multi-perspective and multi-sensory perception solutions are a growing field of interest to assist in this area as processor computational capabilities increase and processor off-loading techniques, such as use of graphical processing units, are explored," said Phil Frederick, a TARDEC robotics research scientist and engineer.

TARDEC has focused research to use potentially, but differing, sources of information to inform automated decision processes at various levels of system control, Frederick said.

The Army's future will, and must, include advanced autonomy-enabled technologies, according to TARDEC Director Dr. Paul Rogers. The center has made development of optionally-manned and unmanned systems a priority, with continued growth of sensor technology imperative to success.

"We will achieve this not by replacing Soldiers, but by providing a continuum of capabilities that will augment and enable them, while filling some of the Army's most challenging capability gaps," Rogers said. "To prevent, shape and win future conflicts in a changing world, Army S&T must deliver timely and technologically-advanced solutions that address our top priority capability gaps and ensure that our Soldiers have the very best equipment available." ■

TARDEC scientists and engineers are working to increase ground vehicle effectiveness through the use of advanced sensors. (U.S. Army photo by Amanda Dunford)

TARDEC researcher Jeremy Gray leads efforts to develop and design unique high-speed sensors that can be embedded into vehicle platforms. (U.S. Army photo by Matt December)

Own the Weather

Flying in Degraded Visual Environments

BY BILL CRAWFORD, AMRDEC PUBLIC AFFAIRS

Army researchers are going after solutions to help aircraft crews navigate in degraded visual environments, where weather, obscurants or obstacles may prove hazardous and even lethal.

Operations in degraded visual environments, known as DVE, are the primary contributing factor to a vast majority of Army aviation mishaps over the last decade: 80-percent of rotorcraft losses in operations in Iraq and Afghanistan were due to "combat non-hostile or non-combat factors" including DVE, according to U.S. Army Program Executive Office Aviation officials.

At the Aviation and Missile Research, Development and Engineering Center at Redstone Arsenal, Alabama, the Army advances and implements technologies to address DVE safety issues and operational limitations.

"Reduced visibility of potentially varying degree, wherein situational awareness and aircraft control cannot be maintained as comprehensively as they are in normal visual meteorological conditions and can potentially be lost," said Todd Dellert, an experimental test pilot and Acting Project Director, DVE Mitigation, or DVE-M.

DVE includes darkness, snow, rain, blowing sand, dust, fog, smoke, clouds and flat light conditions, which can hamper aviation operations or create scenarios where aircraft control may be lost.

The DVE-M program hopes to exploit DVE as a tactical advantage and to enable safe operations in all conditions, Dellert said.

The team's mantra is "Own the Weather," which aims to expand the capability of commanders to deploy rotorcraft aviation assets when the weather is below condition minimums.

"The AMRDEC Degraded Visual Environment Mitigation Program is oriented toward examining the combinations of technologies required that will give Army rotorcraft pilots the advantage on the battlefield," Dellert said. "This integrated three-pronged approach to a DVE system solution is aimed at increasing air-crew safety and survivability while also helping to provide them every conceivable tactical and operational advantage."

Those three critical and interdependent areas are:

- Aircraft flight control characteristics
- Aircraft state cueing provided to the pilot
- Advanced imaging sensor development

According to Dellert, the principle focus of DVE-M is how the sensors will perform in concert with each other as a part of a sensor fusion concept.

The DVE-M program fuses images of multiple sensor technologies such as radar, infrared, and laser detection and ranging, also known as ladar. Each of these sensor technologies provide unique advantages for operating in various types of DVE conditions, Dellert said.

Military aircraft are vulnerable in conditions of degraded visibility due to pilots' inability to discern obstacles, cables, or other aircraft during flight or while landing. (Photo illustration courtesy DARPA)

"The millimeter wave radar has the greatest obscurant penetration capability in most DVE conditions; though lower visual resolution than either infrared or ladar," said Maj. Joe Davis, an experimental test pilot at Aviation Applied Technology Directorate. "Infrared generally has the best visual resolution at night and in light to medium dust, but has not historically performed well in moisture or extreme dust and does not have the capability of storing images into a data point cloud."

Ladar has significantly greater resolution than radar and enables a see-and-remember capability by storing returns into a data point cloud, which can be rendered as images to the pilot from any eye-point.

Ladar returns are stored into a data point cloud before to a helicopter enters a landing zone with obscured conditions, Davis said. As the helicopter enters degraded visual conditions, high-resolution stored images are rendered to the pilot from his current eye-point, providing the pilot a virtual high resolution near real-time image.

"Successfully fusing the images of radar, IR, and ladar provides the pilot a more accurate, high-resolution picture of the operational environment in all DVE conditions by exploiting the advantages of each sensor technology and compensating for its weaknesses," Davis said.

The DVE-M program is led by AMRDEC's Aviation Development Directorate. The collaborative efforts includes the AMRDEC's Aviation Applied Technology Directorate and Aeroflightdynamics Directorate, the Army Research Laboratory, the U.S. Army Aeromedical Research Lab and the Communications-Electronics Research Development and Engineering Center's Intelligence and Information Warfare Directorate and Night Vision and Electronics Sensors Directorate. ■

INTEGRATING SOLDIER SENSORS

Natick researchers develop a mobile platform to provide shared sensor information

BY JEFF SISTO, NSRDEC PUBLIC AFFAIRS

To the modern dismounted warfighter, the saying "knowledge is power" is true, especially when making quick decisions based on limited information.

Scientists and engineers from the U.S. Army Natick Soldier Research, Development and Engineering Center, or NSRDEC, are working hard to make information assets a fundamental component of the Soldier's kit.

"The ability to collect, process and share battlefield information can greatly improve the chances of mission success and troop survival," said Dr. David Darkow, the Mission Information team leader with NSRDEC's Warfighter Directorate.

Army researchers are developing a fully-integrated, mobile platform that provides dismounted Soldiers at the squad level with organic and shared sensor information to enhance situational awareness on the battlefield.

During a November 2014 experiment at Fort Benning, Georgia, Natick researchers teamed Soldiers with unmanned vehicles and brought Full Motion Video, or FMV, sensing sources to the Nett Warrior system—smartphone-based device that supports advanced navigation, friendly-force tracking, command and control communications, and other sensor-fed information portrayals to Soldiers on the ground.

The Natick team developed the components that integrated with Nett Warrior's software architecture. The system is scheduled to transition to the Army's Project Manager Soldier Warrior where it will be one step closer to fielding.

The Nett Warrior Future Initiatives Team was key to ensuring the experiment resulted in the successful integration and transition of the FMV information portrayal concept into the Nett Warrior system, Darkow said.

"NSRDEC's role is to improve the Soldier experience," he said. "We provided support that helped transition the concept and we continue to support the NWFI team with its development by focusing on the Soldier's perspective of the system."

The team's goal was to achieve full integration of various intelligence surveillance reconnaissance sensor feeds into the Nett Warrior platform to maximize the tactical information available, while supporting the broader objective of getting this capability into the hands of Soldiers at the squad level, he explained.

The NSRDEC Mission Information Team also linked video feeds from squad-organic sensors such as the Dragon Runner 20 Unmanned Ground Vehicle and the Cargo Pocket-Intelligence, Surveillance and Reconnaissance, as well as an overwatch capability from Raven unmanned aerial vehicles.

Natick researcher Dr. David Darkow is working to bring Full Motion Video sensing sources to the Nett Warrior System. (U.S. Army photo by David Kamm)

To do this, Darkow's team developed and incorporated into the Nett Warrior platform a mobile, plug-in software application, called the Tactical Video Viewer, which auto-populates what sensor feeds are available and links users to the source's live video feed.

In this way, Nett Warrior "acted as a full-motion video server that rebroadcast those video streams on demand to other Soldiers in the squad," Darkow said.

"Soldiers see a moving map application that displays blue (friendly)-force tracking, C2 (command and control) information, and full-motion ISR video feeds," Darkow said. "Instead of just following dots on a map, Soldiers at the small unit and company levels can be viewing the same emerging battle space picture."

More work is still needed to expand integration and control of battlefield sensors that will enhance the tactical information portrayal for viewing by dismounted Soldiers in austere environments, Darkow said.

"The team provided the first opportunity to put this emerging NSRDEC technology into a Soldier's hands at the squad level within an operationally relevant context," he said. "It went really well."

The Tactical Video Viewer is scheduled to transition to Nett Warrior and Project Manager Soldier Warrior where the system will be optimized for Soldier performance. ■

VIRTUAL ROUNDTABLE
SENSORS

The U.S. Army Research, Development and Engineering Command feeds the technology pipeline from concept to prototypes with more than 11,000 scientists, researchers and engineers in its six centers and the Army Research Laboratory collaborating and coordinating across many disciplines.

ARL is the Army's corporate lab, which provides basic and applied research for materiel technology to support the Soldier.

The Communications-Electronics Research, Development and Engineering Center, or CERDEC, develops and engineers the technologies for mission command and intelligence, as well as applications and networks designed to connect and protect the Soldier.

The Aviation and Missile Research, Development and Engineering Center, or AMRDEC, provides RD&E technology and services for aviation and missile. AMRDEC engineers focus on game-changing technologies to detect and destroy threats; enhance performance, lethality, survivability and reliability of aviation and missile systems.

In this virtual roundtable discussion, we sit down with three of the Army's top minds who are the driving force behind advanced sensors research.

Dr. Philip Perconti from ARL is director of ARL's Sensors & Electron Devices Directorate at Adelphi, Maryland. He is responsible for leading and transitioning the Army's primary basic and applied research programs in sensors, electronics, signal processing and power and energy component technologies.

Dr. Donald A. Reago Jr., is director of CERDEC's Night Vision and Electronic Sensors Directorate, at Fort Belvoir, Virginia. He is responsible for planning and executing the Army's applied and advanced science and technology investments in Electro-Optical/ Infrared and Countermine/ Counter-Improvised Explosive Device sensors and signal processing and for leading the DoD Sensors Community of Interest, which informs the sensor development strategy for the entire U.S. military.

Dr. Michael S. Richman is AMRDEC's director of Missile Development Division at Redstone Arsenal, Alabama. He is responsible for the execution of all missile science and technology basic research, applied research and advanced technology development programs.

WHAT IS YOUR VISION OF THE SENSORS CAPABILITIES FOR THE SOLDIER OF 2025 AND BEYOND?

Perconti: Sensors must do more than provide data or images. Smart sensors must provide the right information for the right decision, at the right time.

Embedded high-performance computing at the sensor node, combined with innovative algorithms is becoming crucial. This requires an unprecedented level of component and subsystem integration. Interoperability across platforms and networks will also be vital to future sensor capabilities.

In the future, sensors must be reconfigurable and adaptable to enable operation in congested and contested environments.

Regardless of what the sensor looks like, it must be energy efficient. This is particularly true for Soldier-worn sensors With energy efficiency in mind, we are working in two general areas, energy efficient electronics for reducing demand and energy and power for increasing supply.

Even if we invent a new sensor with unmatched capabilities, it may never make it into a Soldier's hands if it is too expensive, too heavy and requires too much power, so we encourage our researchers to think about size, weight, power and cost early.

Reago: Smart sensors are a natural outcome of the individual advancements, miniaturization and integration of sensor elements, signal processing, networks and sensor architectures.

Sensors are redefining our world and how we support our Soldiers. Sensors are no longer considered simple, separate sensing elements that are just components in a standalone weapon system. They are becoming holistic cross-domain solutions unto themselves that provide capabilities greater than the sum of their parts.

As networking and communication technologies have become decentralized and integrated into dynamically aware sensors, the sensor has emerged for the Soldier as the focal point where they are connected into the digital battle space at both the individual and global level

Sensor and sensor architecture advancements at NVESD are enabling Soldiers with unprecedented access to real-time information analysis, allowing them to optimize their limited resources and capabilities to support the mission at hand. These advancements are creating marked improvements in the Size, Weight, Power and Cost constraints that affect the cognitive and physical burden that Soldiers bear.

Richman: Army missile systems employ a full spectrum of sensor and advanced signal processing technologies. The entire kill chain for missile systems depends on advanced sensor and seeker technologies for target acquisition, tracking, navigation and fire control.

The required precision for missile systems, dictated by operational rules of engagement, establishes the need for investments in advanced sensor technologies.

The spectrum of potential conflicts and a dynamic battlefield demand ever-increasing accuracy.

AMRDEC possesses the personnel, institutional experience and facilities to further advance the state-of-the-art in active and passive sensor systems. Areas of investment include infrared, lasers, radar, and acoustic technologies.

The need for future seekers and sensors rests solely in the operational requirements established by the warfighters' representative within the Training and Doctrine Command.

These operational requirements offer challenges to the science and technology community by requiring increases in performance, multi-functionality, cost conservation, size and weight reduction, energy maintenance and freedom from environmental impacts.

WHAT ARE YOUR CHALLENGES?

Perconti: Discovery is not something we control. No one seriously wakes up saying, "Today, I will discover something." However, we can increase the likelihood of discovery through improved collaboration, not only across the engineering and science disciplines, but also across the military science and technology enterprise, and among industry and academic partners. Increased collaboration enables deliberative discussion, critical thinking, and peer review—all of which increase the likelihood of discovery.

As the director of ARL's Sensors and Electron Devices Directorate, my job is to enable an environment conducive to discovery, innovation, and transition. I do this by ensuring our research portfolio is strategically aligned to address future needs and emerging threats as it relates to sensors. Our research

Reago: Sensor development is not about advancement for the sake of the technology but for the effect it represents in the lives of the men and women who wear the uniform. NVESD works hand in hand with the ARL Human Research and Engineering Directorate to better understand how sensor technologies and humans can interface in positive ways and how "Smart Sensors" can develop "Smart Soldiers," supporting data-to-decision on the battlefields of tomorrow.

I am extremely confident in the abilities of Army researchers and engineers in developing an integrated sensor architecture. Our workforce includes many of the finest minds in sensor technology and leads the world in the development of innovative sensor technology solutions. The Integrated Sensor Architecture is an interoperability architecture, developed

Richman: Accuracy within missile systems creates a high return on investment with one-shot, one-kill. To continue this unique lethal contribution on future battlefields the accuracy of missile systems must be advanced consistent with new threats, new environments and new rules of engagement.

AMRDEC is the world leader in missile seeker/sensor and air defense sensor technology development and transitions to programs of record.

We employ the best and brightest engineers and scientists and we're training the next generation of sensor subject matter experts.

AMRDEC has a huge material and intellectual infrastructure that will allow us to continue to advance sensor technology.

The exceptional institutional knowledge and unparallel facilities will be used to

SENSORS PROVIDE FOUNDATION FOR AERIAL INTELLIGENCE

BY CAPT. MICHAEL PEDERSON, 116TH MI BRIGADE (AERIAL INTELLIGENCE)

Global instability remains a constant focus for military intelligence.

Tasking, processing and disseminating intelligence is the job of Army intelligence analysts who go through a series of checks, re-checks and supervisor approvals before their product, composed through a complex data-gathering process, is authorized for release. The Distributed Common Ground System - Army, or DCGS-A, is the backbone of that Army intelligence mission.

One way to develop situational awareness and provide actionable intelligence information is through aerial intelligence. It provides information gathered from aerial images and video to give intelligence analysts visual depictions. This helps the Army determine routes, enemy situational changes, terrain obstacles, target routes and more.

The 116th Military Intelligence Brigade (Aerial Intelligence) at Fort Gordon, Georgia, supports tailored, worldwide aerial intelligence, surveillance and reconnaissance, or ISR, to deployed task forces. The common tools and databases that the 116th MI Brigade uses are within the DCGS-A.

"The 116th MI Brigade conducts 24/7 tasking, collection, processing, exploitation, dissemination and feedback operations, or 'TC-PED-F,' for multiple aerial-ISR systems," said Col. Adam R. Hinsdale, 116th Military Intelligence Brigade commander. "Our capabilities include full-spectrum geospatial intelligence and signals intelligence supporting deployed forces in overseas contingency operations. Most importantly, we are 100-percent powered by the Distributed Common Ground System-Army, on a converged infrastructure -- a first for our Army. In fact, DCGS-A in many cases controls the aerial platform sensor over 8,000 miles away."

The processing, exploitation, dissemination or processing, exploitation, dissemination process drives the intelligence mission. The Army pulls information together to analyze it and then provide intelligence to commanders so they can make command decisions.

A Fort Belvoir, Virginia Soldier from the Army's intelligence community demonstrates a portion of the Distributed Common Ground System-Army. (U.S. Army photo)

DCGS-A has had an impact on the way that both the intelligence analyst and the intelligence user (the warfighter) obtain critical information, Hinsdale said.

At Fort Gordon, DCGS-A is used daily to review sources, analyze information, conduct actual Geospatial Intelligence missions, and share that intelligence to support forward-deployed analysts and commanders from both the U.S. and coalition forces.

is aimed at finding material solutions for the toughest Army problems. It takes highly trained people, who are dedicated to serving the Army and the nation.

We are Army scientists and engineers—a special breed. Recruiting and retaining top notch scientists and engineers with the Army ethos is our toughest ongoing challenge.

in house, which allows users to dynamically discover and leverage other sensor systems on a network without any specific or prior knowledge, utilizing existing assets and optimizing the Army's investment.

This innovative capability is truly a game changer and will greatly increase Soldier situational awareness of the battlespace.

develop future seekers and sensors to support future programs of record missile system block upgrades, advancements in sensor fusion and the development of our most important asset, our employees.

WHAT ARE SOME OF THE SUCCESS STORIES IN ARMY SENSORS RESEARCH?

Perconti: Several successes come to mind that have specifically supported Soldier operations in Iraq and Afghanistan. For instance, we used our expertise in RF sensing to assess numerous Joint Improvised Explosive Device Defeat Organization-sponsored IED detection sensors, which led to a quick-reaction capability for over 10,000 handheld sensors.

Reago: Our greatest success is as the developer of night vision technology. For more than 30 years, the U.S. military has been able to proudly and accurately state that it "owns the night."

We have been developing the next generation of novel new sensor technologies that will provide the next 30 years of military dominance.

Richman: One recent example is the AMRDEC Uncooled Infrared Seeker program. This program advanced the state-of-the-art of extended range, fire and forget missile seeker technology with the successful in-house development and demonstration of new seeker hardware.

The innovation represented a substantial increase in engagement range capability for man portable missiles.

ARL also has world-renown expertise in acoustic sensing. Our research enabled the first modern acoustic sensor for the Army—the Unattended Transient Acoustic Measurement and Signature Intelligence Sensor or UTAMS, which is an affordable mortar and rocket localization sensor that we transitioned to Project Manager Robotics and Unmanned Sensors, and was used during conflicts in Iraq and Afghanistan.

Another big success was Constant Hawk, the first persistent wide-area surveillance capability in Iraq, which we transitioned to CERDEC.

Today, our sensor research is directed toward the Army's technology needs that are beyond 2025.

Through scientific discovery and innovation, we seek to minimize the risk of transitioning emerging technology, and to extend RDECOM "technical bench," by providing government subject-matter expertise and acting as a gateway to the academic research community.

The ARL research portfolio emphasizes new warfighting capabilities and countering emerging threats.

A recent example is the discovery of how to exploit a region of the longwave infrared or LWIR spectrum to image through moderate to heavy brownout degraded visual environment conditions. Brownout conditions occur when rotorcraft land in desert and arid environments and sand and debris greatly reduce the situational awareness of our pilots.

NVESD has developed a flight worthy proof-of-principle demonstrator camera and conducted numerous flight experiments on UH-60 Black Hawk and CH-47 Chinook helicopters under brownout conditions. Test results indicate improved situational awareness under the great majority of brownout conditions. It shows great promise to be part of any future Army material solution for DVE mitigation.

Another success is the NVESD developed Husky Mounted Detection System Ground Penetrating Radar. Deliberate and consistent science and technology investments resulted in breakthrough in integrated sensor algorithms and a system which provides route clearance patrols a higher probability of detection of explosive hazards buried in roads with a lower false alarm rate. More than 220 of these systems have been fielded and have detected over 1,000 improvised explosive devices.

The new seeker employed commercial off-the-shelf uncooled imaging infrared, which offers a 40-percent reduction in missile seeker cost compared to cooled infrared technology.

The program modified an existing fielded design and retained 80 percent of the qualified seekers parts. The new seeker provides warfighters with increased standoff range and decision makers the ability to further reduce cost through competition.

A patent is pending on the government design. Other examples are the Hellfire Semi-Active Laser and Longbow Millimeter Wave tactical missile systems.

These weapons were developed at AMRDEC and provided the main anti-tank capability for combat operations in Iraq and other Southwest Asia theaters of operation.

AMRDEC was the lead agency for integrating Hellfire onto Unmanned Aerial Systems with the results frequency seen on the nightly news.

WHAT ARE SOME OF THE SUCCESS STORIES IN ARMY SENSORS RESEARCH?

Perconti: ARL is adopting an open, collaborative business model to maximize face-to-face interaction with our partners in industry, academia and across government agencies.

What that means is we bring partners here in person to enhance the research potential in areas of particular interest to the Army.

For instance, ARL is forming the Washington Area Battery Center of Excellence to bring together numerous industry, academic, and government partners to solve power and energy problems.

These collaborative endeavors often start with peer-working relationships, formal Cooperative R&D agreements or Multi-Disciplinary University Research that comes as a result of common areas of interest.

We are making the distinction of shared interest more evident with Science and Technology Campaigns that clearly define the technical areas ARL believes are critical to the Army's assured land power dominance into the future.

For more on ARL's Sensors & Electron Devices Directorate, visit http://go.usa.gov/6Z5Y

Reago: Sensor technology development continues to expand at a voracious rate driven by a commercial market that is continuing to push the boundary on what integrated sensor technologies can provide.

As sensors become more ubiquitous globally, NVESD has a unique role to play in helping the US Army retain its overmatch potential and military dominance while shaping strategic technology investment areas.

As sensor technologies have increased in availability and performance, NVESD has had to expand its partnerships with industry, academia, and other federal agencies to ensure that the Army is appropriately leveraging sensor technologies in those areas being driven by external investments and commercial applications.

Our world class expertise in Electro-Optics, Infrared, Lasers and Countermine technology provides a valuable role across the entire Department of Defense, with industry and with academia, as the champions for sensor development, and providing objective and timely input in shaping this dynamic changing technical landscape.

For more on CERDEC's Night Vision and Electronic Sensors Directorate, visit http://www.nvl.army.mil/

Richman: AMRDEC partners with the other RDECOM organizations and industry to leverage unique expertise and facilities. For example, we partner with CERDEC on Radars for Fire Control in support of the Air Defense mission.

RDECOM researchers are working toward a potential sensor-based solution for Global Positioning System-denied environments.

The RDECOM Communities of Practice provide an environment for enhanced awareness of investments for a variety of technologies.

As lead for the Counter-Unmanned Aircraft System COP and Long Range Precision Fires COP, AMRDEC is responsible for collecting information on relevant technologies, providing insight into available sources for collaboration and optimization of limited resources.

For more on AMRDEC's Missile Development Division, visit http://go.usa.gov/6Z5w

SENSORS KEEP THE ENEMY IN SIGHT

A 3rd U.S. Infantry Regiment Soldier aims his weapon using the Thermal Weapon Sight, or TWS. (U.S. Army photo)

Project Manager for Soldier Sensors and Lasers gets high-tech equipment to American troops

BY PEO SOLDIER PUBLIC AFFAIRS

New technology is spawning better sensors and helping the Army of today to dominate the battlefield of tomorrow.

"Our mission is to provide the best equipment for our Soldiers," said Col. Michael E. Sloane, Project Manager for Soldier Sensors and Lasers, or PM SSL. "Success means enabling our Soldiers to maintain combat overmatch on any battlefield anywhere on the globe."

Col. Michael E. Sloane

PM SSL is part of the Program Executive Office Soldier, and has the responsibility for getting high-tech sensors and lasers into the hands of American troops. Enablers, such as the Enhanced Night Vision Goggle, known as the ENVG, Thermal Weapon Sight, known as TWS and Laser Target Locator, or LTL, make it possible for Soldiers to "own their environment" day or night, and through obscurants, Sloane said.

"With these tools, Soldiers can acquire and engage targets well before our adversaries can gain the advantage," he said.

The ENVG I was the first helmet-mounted fused (image intensification and thermal image) goggle, overlaying thermal imagery over traditional night vision into a single display for the Soldier.

"The ENVG continues to receive tremendous feedback from Soldiers who are using this equipment in combat," Sloane said. "The thermal capability makes it useful during all light conditions, day and night. Additionally, this system enables Soldiers to see through obscurants such as smoke, fog, dust or light foliage."

Capabilities are much improved over other night vision devices, such as the PVS-14 or PVS-7, because an ENVG highlights thermal contrast and enables detection and identification of targets that may otherwise be camouflaged.

While developing the ENVG II, the Army and its industry partners continued to apply lessons learned to create a more producible image intensification tube.

"This significantly reduced the logistical burden by using a common image intensification tube and introduced a system that consumed less power, and allowed the system to operate on three batteries instead of four batteries," Sloane said. "This also reduced weight and long-term costs for the system."

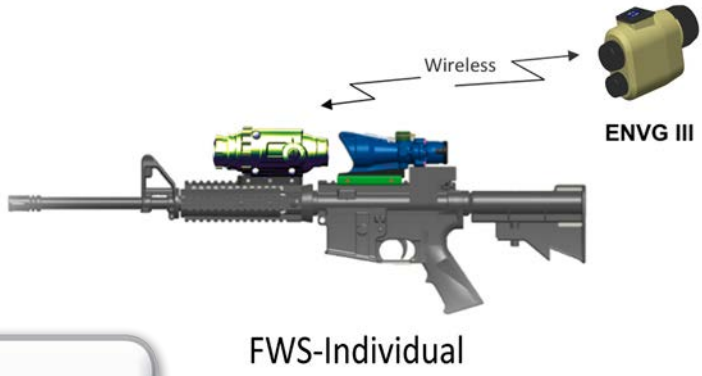
The next generation of ENVG under development is the ENVG III. The significant Soldier improvements with this variant include:

- A wider thermal field of view and higher resolution thermal capability
- Wireless connectivity from the weapon-mounted thermal sight to the ENVG III
- The introduction of a smart battery pack that will provide the wireless capability and image processing from the weapon sight to the ENVG III while simultaneously serving as a battery pack

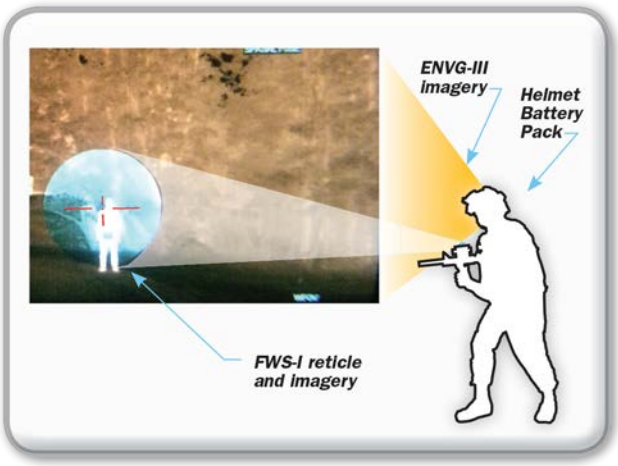
"Soldiers should watch for this battle-changing capability, the ENVG III, in late FY16 or early FY17," Sloane said.

The technology is being developed to work with the Family of Weapon Sights Individual, or FWS-I, variant, also a PM SSL system. The FWS program will have three variants: individual, crew served and sniper. Each system will allow the Soldier to acquire and decisively engage threats faster by decreasing the transition time between using mobility and targeting sensors.

"We're really excited about bringing the next generation of maneuver enablers to Soldiers," Sloane said. "The Army has invested heavily in the Family of Weapon Sights and there will certainly be many companies, countries, and other U.S. organizations that will attempt to achieve the same effects and potentially spend tens of millions of dollars in pursuit of what we are already achieving."



The Family of Weapon Sights Individual, or FWS-I, allows a Soldier to see weapon sight imagery and crosshairs wirelessly on a helmet-mounted display. (U.S. Army illustrations)



The FWS-I is principally a weapon-mounted thermal sight. The weapon sight represents the smallest and lightest thermal sight the Army has ever developed. However, the sight's revolutionary capability lies in its ability to wirelessly transmit weapon sight imagery and reticle (aka cross hairs) to the Soldier's ENVG III or helmet-mounted display.

A wireless communication capability between the weapon-mounted sight and goggle is known as Rapid Target Acquisition, or RTA. When RTA is enabled and a Soldier points his or her weapon in the same general direction observed through the ENVG III, the Soldier sees the weapon sight image and reticle spatially-aligned within the ENVG III display.

"This is hard to believe until you actually see it," Sloane said. "You might expect to see this technology in today's video games, but probably would not believe it's possible with actual night vision devices and weapon systems.

The U.S. Army Communication-Electronics Research, Development and Engineering Center's Night Vision and Electronic Sensor Directorate, along with industry partners, are doing what was only dreamed a few years ago, Sloane explained.

"This capability provides the Soldier with the ability to see, begin to acquire, and engage a target or targets without having to remove his or her mobility night vision device, shoulder the weapon, and then regain target acquisition through the weapon sight," he said. "Not having to shoulder the weapon and re-acquire the target with a different sensor significantly reduces engagement time and provides Soldiers with yet another advantage on the battlefield."

Soldier feedback is vitally important to the equipping process..

"We always involve the Warfighter in the designing, developing and testing of systems for our Soldiers," he said. "We must do this from the very first day we develop capabilities. The PM teams plan for and then develop new equipment training programs to ensure Soldiers receiving this equipment are properly trained on how to put it into operation and maintain it, and how to best employ it on the battlefield."

One example of gathering feedback from Soldiers is a recent success story from the field. Soldiers continue to be impressed with the detection capabilities of the TWS, or AN/PAS-13.

"We were coming back one time from a counter-IED [improvised explosive device] mission," said Sgt. Joshua Cowan, 3rd U.S. Infantry Regiment, relaying his story using the TWS at night in theater. "My gunner called up and said, 'Sergeant, I think I see something.' We pulled over and stopped. We went up for a look. And from a good 600 meters out, we could see very clearly two individuals digging a hole for an IED while two more armed men pulled security for the diggers. I don't think we would have seen those people—at that distance—with just the night vision goggles."

Sloane said the Army proactively develops technologies for unpredictable and complex challenges.

"We clearly recognize the importance of our industrial base, as well as both government and industry science and technology laboratories," Sloane said. "We rely heavily on these laboratories, academia and our industry partners to work very closely with us in developing cutting-edge technology that can either become a part of our materiel solutions or represent an innovative approach toward meeting a capability gap.

The Army's strategy of staying ahead of emerging technologies pays off by maintaining overmatch capabilities against ever-evolving threats and enemies, Sloane said.

"Success includes Soldiers safely returning from combat, hearing success stories from Soldiers and achieving unprecedented results from a team of professionals," he said.

The PM SSL team works closely with the Army's communities of science and technology; research, development, testing and evaluation; and capability development, as well as the U.S. industrial base and the professional acquisition workforce.

"To continue this trend of success, PM SSL will maintain strong and productive relationships with the Army Centers of Excellence (Maneuver, Fires, and Aviation) teams who identify requirements to fill existing capability gaps through material solutions," Sloane said. "Collectively, we will continue to do what has never been done before by developing revolutionary capabilities to best enable our Soldiers for victory on any battlefield." ■

COMMON OPERATING ENVIRONMENT

Sensors move the Army one step closer

BY EDRIC THOMPSON, CERDEC PUBLIC AFFAIRS

The Army envisions a future where sensors dynamically interact with each other while sharing information with Soldiers. Its researchers are now one step closer to enabling this common operating environment through the development of a foundational software architecture.

The Integrated Sensor Architecture establishes standards that bring together sensors within an area of operation so they can talk without requiring physical integration.

"You have this fundamental architecture enabling sensors to not only recognize the systems they want to interact with, but to also broker the information exchanges," said Joe Durek, deputy director for the Modeling and Simulation Division of the Communications-Electronics Research, Development and Engineering Center's Night Vision and Electronic Sensors Directorate.

As Army researchers and engineers develop ISA, they hope to put together fundamental interoperability so future sensors can come online to a network, register and communicate its capabilities to the network and other assets and sensors on the network can subscribe to the types of information they need.

ISA uses dynamic discovery to find other ISA-compliant systems, regardless of platform, on a tactical network. It understands the capabilities of those sensors and shares their information with operators.

"Dynamic discovery will improve the mobile Soldier's situational awareness by enabling him to query different sensors as he moves through an area and access information that was previously 'invisible' to him, such as event messages or spot reports," said Christine Moulton, ISA project lead for CERDEC NVESD.

However, the architecture has built-in rules so there's no "free-for-all" when it comes to Soldiers tasking sensors, she said.

ISA also addresses the challenges of how emerging sensor technologies can communicate with fielded legacy systems.

"We want these different sensor systems to collaborate instead of working in stove pipes," Moulton said. "The Army has a lot of legacy systems that can speak only to other specific systems, and we have server racks of computers and multiple monitors to do simple things in theater."

Moulton said a Soldier shouldn't have to have a doctorate to configure the equipment.

"He just needs to be able to bring up a sensor, control it and understand its data," she said.

CERDEC NVESD developed ISA under the Deployable Force Protection program, which seeks to provide the critical capabilities needed for a forward operating base to defend itself.

During the past four years, all DFP projects have been ISA enabled, ISA compliant and communicating over the ISA network.

"The thing that makes the ISA stand apart from other interoperability architectures is that it is designed to work in the tactical environment. We assumed you'd have bad communications, small bandwidth and intermediate communications, so we designed it to handle those situations and recover," Moulton said.

"We have a working prototype that we've tested in the field, so the [Program Executive Office] PEO is really getting a jump start," she said.

CERDEC NVESD has a formal technology transition agreement with Program Executive Office Intelligence, Electronic Warfare and Sensors under its Sensor Computing Environment program, or Sensor CE.

Sensor CE is a component of the PEO IEW&S mission, which has a portfolio that covers a broad range of capabilities across the Reconnaissance, Surveillance and Target Acquisition gamut. ISA will be the PEO's first use of middleware associated with Sensor CE efforts to achieve discovery.

"We're looking at ease of use and an integrated package that provides a common operating picture—in other words, an intuitive construct where a Soldier can look at one screen and get all the sensor information that he needs," said Stephen D. Kreider, PEO IEW&S director. "The ISA takes all the different sensors and puts them on a common interface."

During the summer of 2014, NVESD and PEO IEW&S demonstrated how dynamic discovery will work during CERDEC's integrated capabilities experiment at the CERDEC C4ISR Ground Activity's field laboratories at Joint Base McGuire-Dix-Lakehurst, New Jersey.

The experiment centered on common standards for secure, interoperable applications across computing environments and emerging S&T technologies designed to automate, simplify and secure network operations.

"We demonstrated it to show that dynamic discovery is doable now, and from what I've seen, it's ready for transition; we really don't have to wait," said Tom Conway, Sensor CE lead and acting technical director for Project Manager Terrestrial Sensor.

"Sensor discovery is a cross-cutting capability within COE, which means it will touch pretty much all the CEs," Conway said. "This demonstration was an important first step so folks can start thinking about concept of operations and tactics, techniques and procedures. TRADOC is currently writing requirements for COE; hopefully, demonstrations like these can help with the requirements generation process."

PEO IEW&S will implement lessons learned before bringing the next iteration to the planned 2015 integrated capabilities event. The PEO eventually plans to grow the capability by incorporating other sensor types such as chem-bio and radar, he said.

Researchers and engineers from CERDEC NVESD, have worked closely with PEO IEW&S on multiple ISA integrations, and plan to continue supporting PEO IEW&S throughout the transition.

"With the ISA program, we've been able to execute a classic development activity where we start with a blank slate, look at the art of the possible, do some functional allocation and try different prototypes, get figures of merit to what works and what doesn't, and then implement it," said Dr. Michael Grove, CERDEC NVESD principal deputy for Technology and Countermine. "This is the first step in a continuing process. Sensor CE is not finished by any stretch; in fact, it's just started, so we need to continue growing and continue supporting the PEO in developing additional technology alternatives to make Sensor CE a reality." ■

EARLY BIO-THREAT DETECTION

Army Scientists improve early bio-threat detection

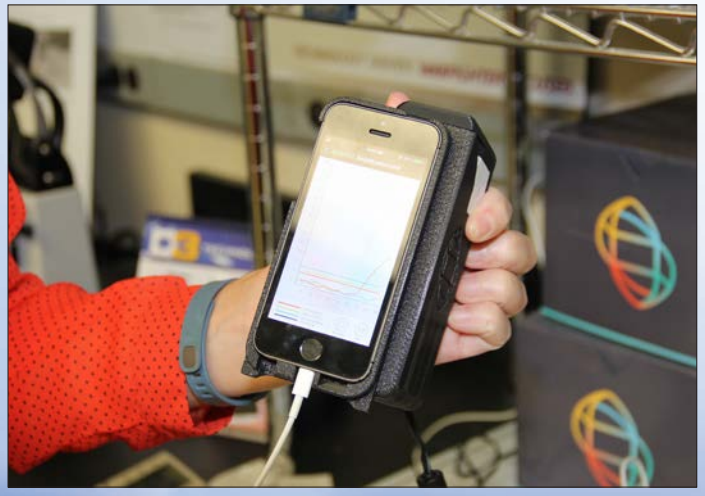
BY ECBC PUBLIC AFFAIRS

Army researchers are looking at novel ways to test the latest technologies, including a systems-approach to sensor installation and compatibility.

Advanced sensor technology is making its way into the hands of Soldiers through the Distance Detection Devices, or D3 program. Army scientists and engineers from the Edgewood Chemical Biological Center, part of the U.S. Army Research, Development and Engineering Command at Aberdeen Proving Ground, Maryland, work with Soldiers and other end-users and provide the most effective handheld biological detectors needed for a given mission.

"Handheld biological detection is critical for warfighters today and in the future," said Janet Betters, ECBC's D3 lead. "These users are out in the field, and away from the laboratories. They need to be able to tell if they are in danger or not, and quickly."

The D3 program is part of the broader Joint U.S. Forces Korea Portal and Integrated Threat Reduction Advanced Technology Demonstration program, known as JUPITR ATD. The multi-year program provides the Republic of Korea and others in the Asia-Pacific region with improved biosurveillance capabilities.



An ECBC scientist shows how a cell phone-adaptable detector provides easy to read data. (U.S. Army photo)

Army researchers traveled to Korea with a suite of equipment, including nine commercial detector systems. Some of the systems are cell phone-adaptable detectors that Soldiers will be able to hold and operate. Testers provide real-time feedback during the scenarios.

End-users such as the U.S. Navy disaster preparedness operations and training specialists, U.S. Air Force bioenvironmental engineers and U.S. Army chemical, biological, radiological and nuclear defense specialists evaluate the systems in concert with other chem-bio research projects.

Feedback regarding overall effectiveness and ease of use will help ECBC scientists determine the limitations of each device and recommend the necessary changes that will help keep warfighters safe. The team will also evaluate security considerations for these systems. For example, smart phone technology requires a secure network to ensure the safe transfer of information.

"Biosurveillance is about recognizing situations early on so the commander can use accurate data to make informed decisions about force protection," said Dr. Peter Emanuel, ECBC BioSciences Division chief and JUPITR ATD lead. "When the ATD is over, we'll leave behind a capability that leaves the USFK better prepared to deal with a chemical or biological attack. We recognize that an outbreak of a disease is an important threat to national security."

The Joint United States Forces Korea Portal and Integrated Threat Recognition, or JUPITR, provides unique biological detection capabilities for stronger biosurveillance capabilities on the Korean Peninsula. (U.S. Army photo)

JUPITR, a program led by the Joint Program Executive Office for Chemical and Biological Defense, or JPEO-CBD, and supported by ECBC, provides unique biological detection capabilities to address the demand for stronger biosurveillance capabilities on the Korean Peninsula.

JUPITR combines advanced communications with cutting-edge sensor capabilities that results in rapid and efficient biosurveillance. The program uses an information portal similar to a health surveillance web management tool. The portal houses a library of identified biological substances in a cloud library that authorized personnel can access.

ECBC researchers travel to Korea to work alongside USFK representatives to improve laboratory capabilities.

The program tests a number of biological detectors, and sends the best one to Korea. Finally the Integrated Base Defense is a large multifunctional, all-seeing sensor that can rapidly design a defensive perimeter.

JUPITR forms a dynamic, multifaceted program to advance biological detection capabilities of the Korean Peninsula.

The D3 component is part of a multi-year effort designed to introduce warfighters to new chemical and biological detection technologies that are relatively inexpensive, produce rapid results and are easy to operate. It also integrates equipment to form a complete system of systems that can automate and correlate data for improved detection insights.

Cell phone-based biological detectors provide Soldiers with relatively inexpensive technology that can be effective with any given mission. (U.S. Army photo)

Taking a systems-approach to problem solving not only allows researchers to improve the functionality of detectors through integrated means, but also cuts down on individual costs during the design. For example, ECBC scientists have saved production time for the TAC-BIO II, a next generation tactical biological detector that now costs 80-percent less, weighs three times less than its predecessor and uses an energy efficient power source.

"The entire creation of this detector is a paradigm shift for the Army," said David Sickenberger, a former supervisory chemist at ECBC. Since the original TAC-BIO was introduced in 2010, the technology has been named on the Maneuver Support Center of Excellence Top 10 List. Four years later, it was redesigned to meet new performance goals that could improve aerosolized bio-threat detection in austere conditions using advanced algorithms to reduce false alarms.

TAC-BIO II exploits a scientific principle that biological aerosols will fluoresce and scatter light when exposed to ultraviolet light. These signals can be used to detect the existence of a threat by using a light-emitting diode developed under the Defense Advanced Research Projects Agency that replaces the larger and more costly UV lasers previously used.

"With the cost per detector cheaper in bulk, it helps the Army and others be able to perform a rapid detection where they can set out multiple detectors in a space," said Aime Goad, acting branch chief of ECBC's Sensors, Signatures and Aerosol Technologies Branch. "More detectors mean less false positives with biological detection, ensuring that users can make accurate and fast decisions based on the detector results."

ECBC transitioned the TAC-BIO II to private industry through a patent licensing agreement and a cooperative research and development agreement for large-scale distribution and fielding. TACBIO has already won ECBC the 2012 Federal Laboratory Consortium Award for Outstanding Technology Transfer. To date, the TAC-BIO and TAC-BIO II have earned two patents.

ECBC said they continue to design products that are to simpler, more durable in all weather conditions and more capable within a suite of detector systems.

"Researchers and engineers at the Center continue to pursue novel applications that improve detection accuracy and keep the warfighter safe," Betters said. ■

BIOSENSORS

Lab seeks to replace antibodies

BY JOYCE P. BRAYBOY, ARL PUBLIC AFFAIRS

Just as the human immune system deploys antibodies to destroy bacteria that have infiltrated the body to cause harm, Army scientists may deploy biosensors to detect harmful microorganisms.

Scientists who specialize in biosensing at the U.S. Army Research Laboratory at Adelphi, Maryland, want to mimic the behavior of antibodies by using alternative, artificial peptide material to detect harmful particles that could threaten Soldiers.

Peptides are the building blocks of the natural world, said Dr. Dimitra Stratis-Cullum, who started the program at the laboratory about 10 years ago.

Waves of antibodies are at work in the human body looking for tiny single-celled organisms called bacteria. These antibodies can also sense viruses, which are even smaller than bacteria.

"Biosensing technology is not currently capable of widespread use outside of a laboratory environment due to significant limitations in bioreceptor function and production, as well as in the overall size, weight and cost of the sensing platform," Stratis-Cullum said. "As technology continues to advance, biosensors could truly become ubiquitous, employing social media and personal electronic devices for mundane yet powerful capabilities."

In the near future, point-of-care diagnostics could save millions of lives and revolutionize the healthcare industry worldwide, she said.

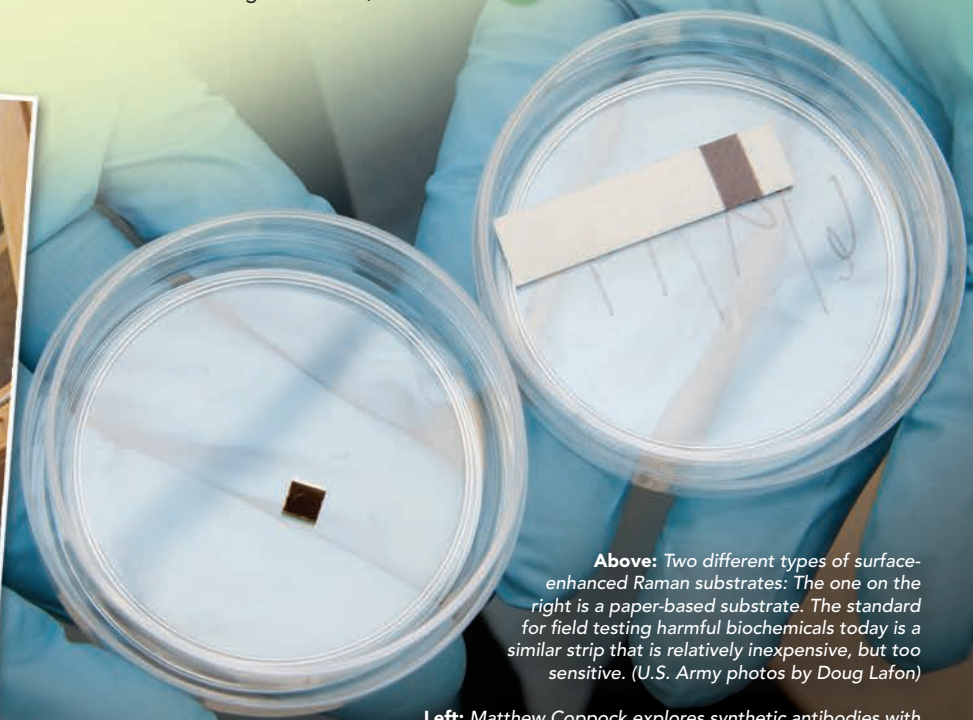
"I would like to see the Army's capacity for biosensing expanded," Stratis-Cullum said.

For years, scientists like Stratis-Cullum have grappled with the question: "How do you take the power of antibodies and translate that to a synthetic, robust stable solution without compromising performance?"

Mikella Farrell, an ARL research chemist who typically works with chemicals, wants to extend to biological targets. She said scientists can identify biological targets, but are still seeking to do so outside of a laboratory environment. Army researchers have a handheld device that uses Raman spectroscopy, but it is very limited, especially in shelf-life and storage, she said.

Raman spectroscopy is used to understand the make-up of materials, down to the chemical bonds. A sample is illuminated using a single color of light and the way the light interacts with the sample tells us information about it.

Farrell explores surface-enhanced Raman scattering as a way to more sensitively detect a host of hazardous material from explosive residues, to much less likely detected substances, like biological hazards, she said.



Above: *Two different types of surface-enhanced Raman substrates: The one on the right is a paper-based substrate. The standard for field testing harmful biochemicals today is a similar strip that is relatively inexpensive, but too sensitive. (U.S. Army photos by Doug Lafon)*

Left: *Matthew Coppock explores synthetic antibodies with biotechnology experts at the U.S. Army Research Laboratory, and in collaboration with partners at the Institute for Biotechnology at the University of California,Santa Barbara.*

If the laboratory could develop a prototype platform capable of detecting threats, then Farrell's work may rely on the material-binding peptides for selective capture of harmful chemicals from a complex mixture.

Another challenge is devising the right tools to controllably, reproducibly discover materials, while also meeting Army requirements.

There are many alternatives to antibodies under investigation by the scientific community, Stratis-Cullum said.

"The Army needs an alternative that is first of all, thermostable, or maintains its properties under extreme temperatures; and second of all is able to perform well under austere battlefield conditions," she said.

Other alternatives have one or the other but not both thermostability and binding performance.

During DARPA Antibody Technology Program testing in 2012, the program showed an increased antibody affinity by a factor of 400, which opened the door to vastly more sensitive, multiplexed biosensors. Temperature stability was increased to 70 degrees Celsius for 48 hours, a dramatic improvement from the previous limit of five to 10 minutes, said Mildred Donlon, DARPA program manager.

"By removing temperature stability as a limiting factor, troops will now be able to carry sensors with them without worrying about refrigeration or wondering if the sensor will return an accurate reading," she said. "The new stability also means antibodies can be attached to new materials to potentially make more practical sensors."

In the most recent round of testing, the ARL material showed no loss of performance after one week at 70 degrees Celsius, and retention of the majority of performance after an hour at 90 degrees Celsius, which is an improvement from two years ago.

"While exciting, it is one thing to say we could get a device to work once, but we need the technology to yield the same results every time," Stratis-Cullum said.

Troops ultimately need something durable and dependable that functions like a library, detecting any number of hazardous combinations, not just the more obvious threats, she said.

Although ARL researchers have made great progress in the past 10 years, there is more work to be done before there a viable prototype could be used in the larger platform, Stratis-Cullum said.

The next step is to determine the peptide's sensitivity limits and demonstrate results on sensing platforms.

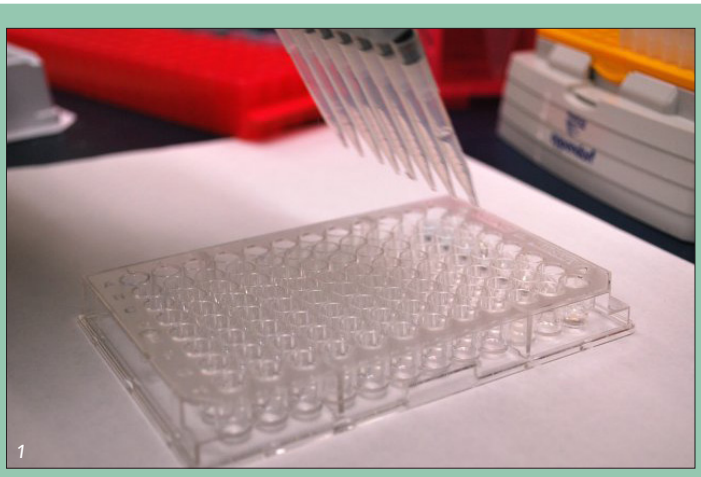
ARL partners with Edgewood Chemical Biological Center at Aberdeen Proving Ground, Maryland, to improve simple handheld biosensors Soldiers use in the field, among other sensing platforms.

ECBC supports the foundational work at ARL by testing and evaluating the new materials.

1. U.S. Army Research Laboratory chemists test up to 96 sample compounds at a time as part of a research project to find synthetic antibodies to counter the threat on Soldiers from synthetic viruses.

2. The U.S. Army Research Laboratory biotechnology group is exploring ways that synthetic antibodies could expand the Army's capabilities to sense viral and bacterial threats to Soldiers into the future.

3. Postdoctoral fellows have been working with biotechnology experts at U.S. Army Research Laboratory for more than two years on a project, Peptide Catalyzed Capture Agent that allows them to perform applied research under the Institute for Biotechnology research team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"We have partnered with ECBC very early in the process to continuously benchmark along with the current standard," Stratis-Cullum said.

The biotechnology team hopes to further the Army's ability to develop the next generation of synthetic biology tools, and discover and study biointerfaces, she said.

"We are working to enable autonomous organization and bottom-up assembly through fundamental research," she said. "The goal to understand and control biointerfaces will be key to unlocking a whole new generation of biotechnologies that exploit the programmable nature of living biological materials. It is an honor to be at the forefront of harnessing the power of biosciences for beyond next generation smart sensor technology." ■

DARPA'S EXOSUIT

Army evaluates DARPA's futuristic soft exosuit

BY DAVID MCNALLY, RDECOM PUBLIC AFFAIRS

Army researchers are evaluating prototype devices developed for the Defense Advanced Research Projects Agency.

The Defense Advanced Research Projects Agency, known as DARPA, Warrior Web program's goal is to create a soft, lightweight undersuit to help reduce injuries and fatigue, while improving mission performance. DARPA is responsible for the development of new technologies for the U.S. military.

Researchers from Harvard University's Wyss Institute for Biologically Inspired Engineering spent the past two years developing a biologically inspired smart suit that aims to boost efficiency through a new approach. A series of webbing straps contain a microprocessor and a network of strain sensors.

"The suit mimics the action of leg muscles and tendons so a Soldier's muscles expend less energy," said Dr. Ignacio Galiana, a robotics engineer working on the project.

Galiana said the team looked to nature for inspiration in developing cables and pulleys that interact with small motors to provide carefully timed assistance without restricting movement.

DARPA selected the U.S. Army Research Laboratory to evaluate several Warrior Web prototypes at the Soldier Performance and Equipment Advanced Research facility, or SPEAR, at Aberdeen Proving Ground, Maryland.

"DARPA was looking for an organization that had experience collecting biomechanics and physiological data on Soldiers in the field, and evaluating Soldier performance for various equipment items," said Dr. Angela Boynton, a mechanical engineer with Army Research Laboratory's Human Research and Engineering Directorate. "We have a unique capability in that we have a biomechanics lab co-located with an obstacle course and a cross-country course, so we're able to collect both lab-based data and field data for the systems."

During testing, Soldiers wear the prototype while carrying battle gear. Researchers capture data as the Soldier walks on an instrumented treadmill that measures how hard the feet hit the ground with each stride.

"We're also looking at how they're walking in terms of time and space," Boynton said. "We get things like stride length and stride frequency, and the time that their feet are in contact with the ground. We are also capturing energy expenditure data so we know how many calories they're burning while they're walking on the treadmill with the different conditions. We're also looking at muscle activity, specifically the leg muscles, to look at the amount of muscle work that they're doing while they're performing that task."

Army evaluators and the Harvard researchers walked alongside Spc. Rafael Boza, a Soldier from the 1st Infantry Division at Fort Riley, Kansas. Boza tested the prototype Oct. 2, 2014, on a three-mile course of paved roads and rough terrain at APG.

DARPA also turned to Army researchers during the first phase of Warrior Web prototype development last year. The Army Research Laboratory tested nine devices on Soldiers over a 21-week period.

"Most of the devices that they've brought us have been really interesting, and in many cases, did seem to help the Soldiers to some extent," Boynton said. "The level of development from the first round of evaluations to the second round of evaluations has been really impressive, so far. They've addressed a lot of the human factors issues in terms of comfort and fit that we identified in the first round of evaluations, and a lot of the system functionality has been much more streamlined and it's starting to look like a field-ready device, rather than a prototype."

Harvard researchers said they hope to help Soldiers to "walk longer distances, keep fatigue at bay and minimize the risk of injury when carrying heavy loads."

The Army plans to continue to gather high-resolution, highly controlled data during the prototype evaluation. Another device from the University of Delaware is scheduled to soon be tested here.

DARPA's goal is to integrate "multiple mature component technologies into a system potentially wearable by 90 percent of the U.S. Army population, both male and female."

LIGHTWEIGHT ANTENNA

Lightweight antenna increases Army agility

BY AMY WALKER, PEO C3T

Inflatable ground satellite antennas are aiding in the expeditionary nature of U.S. and coalition forces, enabling them to achieve high-bandwidth network connectivity anywhere in the world from small deployable packages.

"Many of the conventional satellite terminals previously fielded aren't suitable for some of the more agile transportation requirements of today's deployed Joint Forces," said Lt. Col. Leonard Newman, Army product manager for Satellite Communications, which is assigned to Project Manager Warfighter Information Network-Tactical, known as WIN-T. "The inflatable satellite antenna is transforming how Special Operations forces and now airborne and other conventional forces deploy high-bandwidth SATCOM around the world."

Future Joint contingencies and support operations are expected to require rapid deployment of smaller sized elements to a wide variety of austere environments, with Soldiers needing to fight on arrival. The lightweight, easily transportable Ground Antenna Transmit & Receive, or GATR, inflatable antenna reduces size, weight and power requirements over current capability, enabling

Ground to Air Transmit and Receive Inflatable Satellite Antennas are increasing agility and expeditionary nature of U.S. forces. (U.S. Army photo)

A 2.4-meter Ground Antenna Transmit & Receive inflatable antenna reduces size, weight and power requirements over traditional military satellite terminals and can connect Soldiers in remote locations to the Army's tactical communication Warfighter Information Network-Tactical network backbone, as well as support other services and first responders. (Photo courtesy GATR Technologies)

smaller units to quickly deploy anywhere in the world and achieve high-bandwidth connectivity. The antenna can connect Soldiers in remote locations to the Army's tactical communication WIN-T network backbone, as well as support other services and first responders.

For WIN-T users needing at-the-halt access to the tactical communications network backbone, the GATR provides Secure Internet Protocol Router and Non-secure Internet Protocol Router access at the company echelon and small combat outposts. It also uses the same modems, baseband, encryption and networks as traditional terminals so they can leverage the existing network and services.

The Marine Corps established contracts to procure and certify the GATR terminal for military Ka and X band use. As the Army evaluates its SATCOM terminal portfolio to prepare for future contingencies, it is leveraging the Marine's previous efforts to add these versatile terminals to its own portfolio.

"Gaining access to the full complement of net-centric warfare applications earlier in operations is critical to establishing and maintaining effective command and control," said Jim Sawall, assistant product manager for the Commercial Satellite Terminal Program. "The inflatable antenna technology provides commanders with battalion-strength communications and data links earlier and with significantly reduced logistics burden—and in situations where previously only company-level communications would have been possible."

Fitting in just two transit cases, the GATR antenna provides the same robust data links as conventional, rigid satellite dishes, but weighs up to 80 percent less. Its unique ultra-portable design can provide high-bandwidth communications for transmission of classified and unclassified data, voice and video, all in a compact, highly survivable package. The flexible ball and dish weigh only 25 pounds, making the entire system small and light enough to be transported as checked baggage on commercial aircraft, and once on-site, it can be set-up in less than 30 minutes.

The system features a dynamic inflation mechanism that is easy to turn on and off and provides immediate, automatic adjustment to pressure changes caused by environmental factors. The GATR antenna system also contains a battery back-up system to ensure continuity of operations for at least six hours in the event of power loss. Although satellite acquisition is manual, a brief introductory course makes it easy to point and prepares the operators to successfully deploy it anywhere.

The spherical shape greatly reduces the effect of wind, and a unique cable anchoring system assures stability in winds exceeding 40 mph, and survivability up to 60 mph—wind speeds that can interrupt connectivity in all other terminals. Moreover, it is suited to perform in the field, with all elements passing environmental testing requirements, Newman said.

The GATR antenna is designed to support the same networks as traditional 2.4 meter dishes that require a trailer, vehicle and four people to lift the transit cases. The Army is also looking to introduce a larger four meter version of the inflatable antenna for data transport both within and beyond theater. By deploying a four meter antenna in as few as three cases, Soldiers can augment, or in some cases replace, existing vehicle-size infrastructure to enable more nimble operations from the hub level down to the tactical user.

Instead of requiring a cargo pallet or vehicle-sized transport container, Soldiers can move critical, large aperture communications gear to or around the battlefield in a High Mobility Multipurpose Wheeled Vehicle, light tactical vehicle, small helicopter, etc.—greatly increasing the expeditionary nature of today's forces, Newman said.

"The GATR allows you to deploy high-bandwidth communications anywhere in the smallest possible package," he said. ■

QUICKER MORE ACCURATE MORTARS

Picatinny engineers use advanced sensor technologies

BY ERIC KOWAL, ARDEC PUBLIC AFFAIRS

By integrating many small sensors into light mortar systems, Picatinny engineers are developing a technology for use on all U.S. military mortar systems to give Soldiers faster, more accurate mortar fire.

The Weaponized Universal Lightweight Fire-Control, known as WULF, couples many small sensors together to create a robust, lightweight pointing device that will increase mortar fire.

How much faster?

An average gun crew is expected to have the 81mm system aimed on target from a dismantled state in four minutes 30 seconds. With WULF, the setup time for the 81mm mortar systems is cut to one minute. The time between shots is reduced from 20 seconds to one or two seconds, increasing the repeatability of shots.

Fire control involves a computer, a pointing device, and gunner's display to assist in aiming the weapon system.

The WULF allows Soldiers to fire on a target rapidly, up to the full range of the weapon. However, fire-control systems were previously limited to the 120mm tube because the sensor box is too large and heavy for the 60mm and 81mm mortar systems.

Picatinny engineers Michael Wright and Ralph Tillinghast from the Armament Research, Development and Engineering Center, saw a solution with WULF. They created a fire control using a sensor that can perform like the larger fire-control systems, yet small enough to work on all three mortar platforms.

This smaller sensor is consistent with the Army's strategic goal of lightening Soldier load.

Soldiers currently use man portable mortar systems with the Lightweight Handheld Mortar Ballistic Computer, which allows Soldiers to calculate ballistic solutions, where the weapon needs to be pointed to hit the target, but uses World War II-era optical sight components for aiming.

WULF modernizes aiming by digitizing the weapon system to increase response time and repeat fires while decreasing the chance for error.

The 150-pound fire-control system on the 120mm system is now reduced to 10 pounds overall, according to Tillinghast. He is the lab director of the Collaboration Innovation Lab, Mortar Common Fire Control Systems Division of the ARDEC Fire Control Systems and Technology Directorate.

Tillinghast and Wright have worked on WULF for about five years. They discovered that a combination of several technologies would make the system work with smaller mortar systems.

"When we started to approach the problem of developing a small, lighter fire control

system it became clear early on that the current methods for pointing the weapon system (Laser Ring Gyro) could not be reduced in size enough to be practical," said Wright, ARDEC Project Officer for WULF.

"With WULF we started from the ground up, by coupling many small sensors together to create a small, robust, lightweight pointing device," Wright said. "As we would add one sensor we would see a flaw in that sensor (magnetic instability, gyro drift, sensor saturation) and add another sensor to correct for that problem."

Five technologies come together to make WULF's pointing device work: a magnetic compass, a forward facing optical camera, Micro-Electro-Mechanical (MEM)s gyroscope, MEMs accelerometer, and a celestial compass. A celestial compass is expected in the next generation of WULF, which will significantly increase an accuracy rate that is already high.

"The problem with magnetic compasses is that they will point at anything magnetic, so changes in the environment would throw off the reading, sometimes completely unknown to the user," Wright said.

"To combat this flaw, the MEMs gyro's and accelerometers were integrated into the system to detect whether a change in heading was caused by tube movement or magnetic influence, allowing us to detect a magnetically anomaly," he said. "The optical camera was added to stabilize and correct for drift that is inherent to accelerometers and gyroscopes of such a small size. By integrating all the sensors together we were able to create a pointing device that rivals the bigger units, but at a tenth the cost and size."

Soldiers will use a hand-held computer to digitize the mortar weapon system, calculating ballistic solutions, determining where the weapon needs to be pointed to hit the target, and will see an increase response time and repeat fires while decreasing the chance for error. (U.S. Army photo by Todd Mozes)

The most significant advance of the sensor system was optical tracking. Using technology and algorithms designed by a commercial company, Inertial Labs, during a Small Business Innovation Research effort, the optical tracking not only corrected for drift in the gyroscopes and accelerometers, but to also allow tracking after a firing event when other sensors may not function for a second or two.

The optical system works by dynamically creating known features in a reference image. When these features are seen again, the system knows the heading at which that image was taken, and can realign all sensors back to an accurate reference. As the system is used, hundreds of reference frames are created, allowing the system to track almost purely on optics, if needed, for a short time.

"Setting up the first shot and the time between shots will decrease significantly," Tillinghast said.

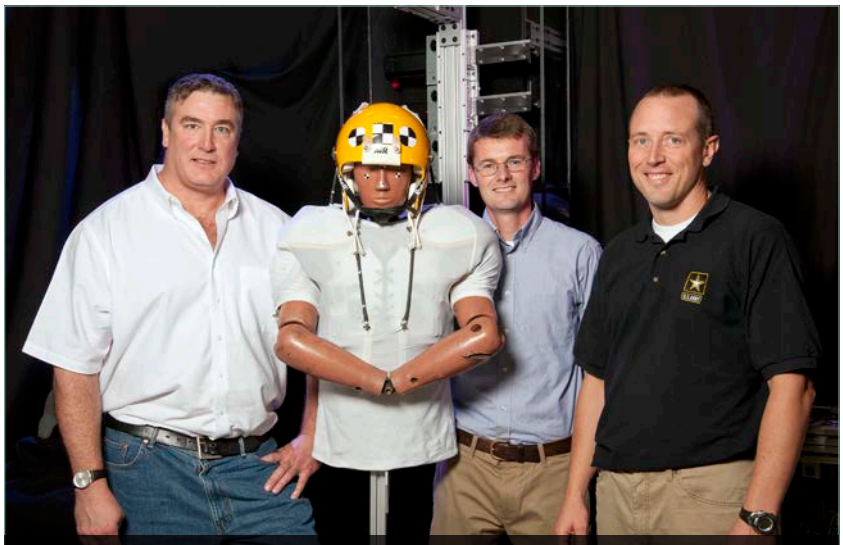
WULF started as a concept in the Collabortaion Innovation Lab and was awarded funding through ARDEC's Technology Exploitation, Exploration and Examination program and then evolved into a Systems Concept and Technology project. WULF's transition to a U.S. Army project manager is expected in fiscal 2017. ■

ARL researchers receive $500K NFL grant

Army Soldier-protection experts at the U.S. Army Research Laboratory have received a $500,000 grant from the NFL, Under Armour and GE's Head Health Challenge II initiative that will assist its research to protect against brain injury.

Head Health Challenge II awards up to $10 million to encourage researchers to identify and mitigate the mechanics and consequences of brain trauma.

"Because there is so much overlap between our concerns with Soldier brain injury and the NFL's interest in maintaining the head health of athletes, this partnership is of mutual benefit," said Eric Wetzel, Ph.D., who is the technical area manager for Materials for Soldier Protection at the Army Research Laboratory, referred to as ARL. "By leveraging resources and pooling expertise, we can expand our understanding of brain injury and accelerate the development of new technologies that will hopefully reduce the probability and severity of these injuries for both Soldiers and athletes."

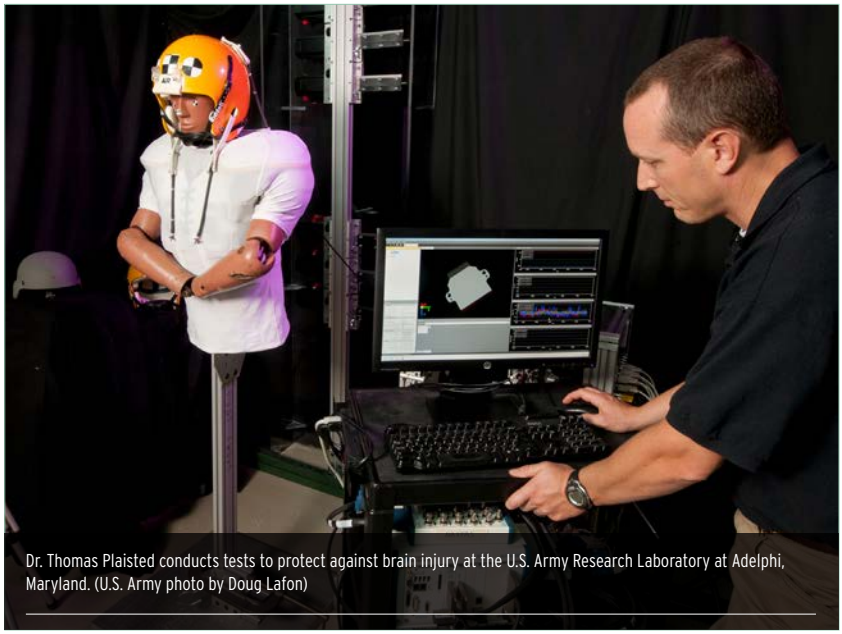


Drs. Shawn Walsh (left), Eric D. Wetzel and Thomas Plaisted conceptualize a new paradigm for sports and military head protection that has been awarded a Head Health Challenge II research grant. (U.S. Army photo by Doug Lafon)

ARL has been a leader in the development of new materials and designs for improved ballistic helmets. In this new program, ARL scientists will explore a new paradigm for head protection: "rate-actuated tethers." These tethers stretch and relax easily at low speeds, but provide dramatically increased resistance force when pulled quickly. A paper describing these tethers was recently published in the journal, Smart Materials and Structures.

The ARL's head protection concept calls for using these rate-actuated tethers to couple the head to the body. Voluntary head motion is not restricted but rapid, uncontrolled, jerking head motions are constrained.

Wetzel envisioned the concept for using the novel rate-actuated tethers for mitigating head accelerations in collaboration with head-protection expert Shawn Walsh, D. Eng., and computational modeling expert Thomas Plaisted, Ph.D. There will be a half dozen researchers assisting the multidisciplinary team over the course of the next year.



Dr. Thomas Plaisted conducts tests to protect against brain injury at the U.S. Army Research Laboratory at Adelphi, Maryland. (U.S. Army photo by Doug Lafon)

"The Army is focused on exploiting game-changing technology and the art-of-the-possible in support of the military force of 2025 and beyond," said Thomas Russell, ARL's director. "In the case of mitigating head impact, there is an advantage of using the Army-inspired technology for athletes playing competitive sports, whether they are playing profession or playing on a Pee Wee league."

ARL's head-protection advances demonstrate the importance of investing in science and technology to ensure not only the Army's readiness, but for the greater good of the nation, he said.

"This is a perfect example of creating technology for the Soldier that could provide a huge benefit for another group: athletes on a playing field. It is exactly the dual-use benefit we want in the technology- transfer arena," said Tom Mulkern, ARL's technology-transfer office.

The researchers will work aggressively over the next 12 months to turn their basic concept into a suitable prototype of a protection device that is functional and robust.

Alan Gilbert, director of global government and nongovernmental-organization strategy for GE Healthymagination, said, "This challenge is a call to action to advance head-health research and innovation. The breakthrough ideas submitted will help us better understand brain injuries and the brain overall. We are excited to see the award going to the ARL to advance its important work in gear that could mitigate the impact of head injuries for Soldiers and athletes.

"Groundbreaking research, like the rate-dependent tethers from the Army Research Lab are going to protect soldiers, athletes and others from head injuries," said Jeff Miller, NFL Senior Vice President of Health and Safety Policy. "It is exactly this type of disruptive creativity that, along with GE and Under Armour, the NFL is seeking. This innovation, and others like them, will have a profound impact."

Picatinny engineers win Army's top research award

PICATINNY ARSENAL, N.J. (Dec. 4, 2014) -- Seventeen Picatinny Arsenal scientists and engineers have won the Army's top award for science and technology.

The Army presents the Research and Development Achievement Award to a select group of scientists and engineers whose outstanding achievements have "significantly advanced capabilities and contributed to the national defense." The Picatinny awardees represent five different R&D programs.

"Each year these awards recognize those scientists and engineers who have made a significant contribution to advance the Army's technical capability," said John Hedderich, III, acting director of Picatinny's Armament Research, Development and Engineering Center, or ARDEC.

"Our mission at Picatinny is to take care of our service members through the technology we develop and manage," Hedderich said. "Every innovation, advancement and improvement is an opportunity to save Soldiers lives."

Approximately one percent of all eligible Army scientists and engineers (S&Es) receive the awards each year.

"These S&E (science and engineering) personnel have distinguished themselves through their proven scientific and technical excellence or leadership," according to a Nov. 5, memo by Mary Miller, deputy assistant secretary of the Army for research and technology, announcing the award winners.

WINNNERS

Dr. Jared D. Moretti, Dr. Jesse J. Sabatini, Dr. Anthony P. Shaw, Robert Gilbert, Jr, and Gary Chen received the award for their work developing a more environmentally-friendly yellow smoke formulation for the M194 hand held signal. Sabatini now works for the Army Research Laboratory.

Sgt. Paul Rava, a combat medic with the 3rd Infantry Division, and a native of Huntington Beach, Calif., runs through smoke he used to conceal his movement over an obstacle during Expert Field Medical Badge testing on Fort Stewart, Georgia, June 11, 2014. (U.S. Army photo by Sgt. Joshua Laidacker)

Gordon Cooke, Robert DeMarco, Michael Dokachev, Marc Federico, Elizabeth Mezzacappa, and Dana Perriello were recognized for their work on analysis of gunner protection kit configurations.

The team created the Virtual Employment Test Bed (VETB), a low-cost simulator that measures and analyzes how well systems perform in the hands of experienced Soldiers in order to improve the technology. In his former position as an ARDEC Military Deputy, Lt. Col. John Thane, now at the Munitions Center of Excellence at Fort Benning, Georgia, also contributed to the project.

Read more at: http://www.army.mil/article/139373

SECDEF thanks team for Syria stockpile elimination

Secretary of Defense Chuck Hagel presented members of the U.S. Army Edgewood Chemical Biological Center the Office of the Secretary of Defense Group Achievement Award Nov. 12, for their service during the international effort to safely eliminate Syria's chemical weapons stockpile.

The ECBC civilians were recognized as part of the Syrian Chemical Weapons Elimination Team from Feb. 1, 2013 through Aug. 31, 2014, including the 39 personnel who manned the Field Deployable Hydrolysis System, known as FDHS, that destroyed 19.8 tons of sulfur mustard and 581 tons of sarin precursor in just 42 days while at sea aboard the Motor Vessel Cape Ray. The elimination team was also awarded the Navy Meritorious Unit Commendation during the Pentagon ceremony.

"To the DoD personnel that we are honoring today: Thank you. Your accomplishment is a model for the entire Department of Defense," Hagel said during the ceremony.

More than 1,300 tons of chemical weapons material was removed from Syria thanks to an international coalition of partners, including the Organisation for the Prohibition of Chemical Weapons and the United Nations. ECBC was part of a multi-agency team called upon by the Department of Defense to identify and fill critical U.S. capability gaps in WMD elimination and define requirements in order to design, manufacture and rapidly field the transportable technical solution that the FDHS offered.

According to OSD, the agency collaboration saved billions of dollars when compared to chemical weapons destruction efforts that often take years to execute.

"This is an example of how Army science and technology, combined with a world-class workforce and the great teamwork of all you players out there, can deliver unique capabilities to our nation," said Maj. Gen. John F. Wharton, commanding general of the U.S. Army Research, Development and Engineering Command. "It's another great example of the rapid acquisition process meeting the operational needs of our nation."

Secretary of Defense Chuck Hagel makes remarks during an awards ceremony commemorating the Department of Defense's role in the international mission to destroy Syria's chemical weapons at the Pentagon in Washington D.C., Nov. 12, 2014. (DOD photo by Master Sgt. Adrian Cadiz)

ECBC's operational expertise ensured that an appropriate environment was recreated on the MV Cape Ray. Safety protocols were implemented. The FHDS was technologically sound, the neutralization process was chemically proven, and communications among leaders was paramount. Each of these pieces was necessary for mission success.

As a result, the Syrian people, their neighbors and the global community no longer face the threat that a Syrian chemical weapons program once posed.

"I could not be more proud of the ECBC volunteers who successfully completed this first-of-its-kind destruction mission. Destroying Syria's declared stockpile of chemical weapons on behalf of the international community has not only made the world a safer place, but has shown that the United States can lead unprecedented efforts to eliminate threats as they emerge," said Tim Blades, deputy director of ECBC's Program Integration and on-board Director of Operations on the Cape Ray.

Army engineer receives research scholars award

ARL electronics engineer Dr. Adrienne Raglin, who was recently recognized by the Dr. John H. Hopps Jr. Defense Research Scholars Program for her continuing support of the program and its scholars (U.S. Army photo by Jenna Brady)

ADELPHI, Md. (Dec. 10, 2014) -- In addition to hard work and dedication inside the laboratory to further the mission of discovering, innovating and transitioning science and technology to ensure dominate strategic land power, many U.S. Army Research Laboratory scientists and engineers provide significant support to programs that focus on the future of science, technology, engineering and mathematics research careers and the students who hope to one day fill those positions.

ARL electronics engineer Dr. Adrienne Raglin is no exception, as she was recently recognized by the Dr. John H. Hopps Jr. Defense Research Scholars Program for her continuing support of the program and its scholars.

Established in 2006, the Dr. John H. Hopps Jr. Defense Research Scholars Program is designed to advance federal objectives to increase minority participation in scientific research, in math and science education, and in emerging technological fields.

Raglin received the award during the 6th Annual Hopps Research Training Symposium and Recruitment Fair in Atlanta, Georgia.

The theme of this year's fair was "Reevaluating, Revitalizing, and Reaffirming our Commitment to Undergraduate Under-Represented Minorities Preparing for Science, Technology, Engineering, and Mathematics Research Careers."

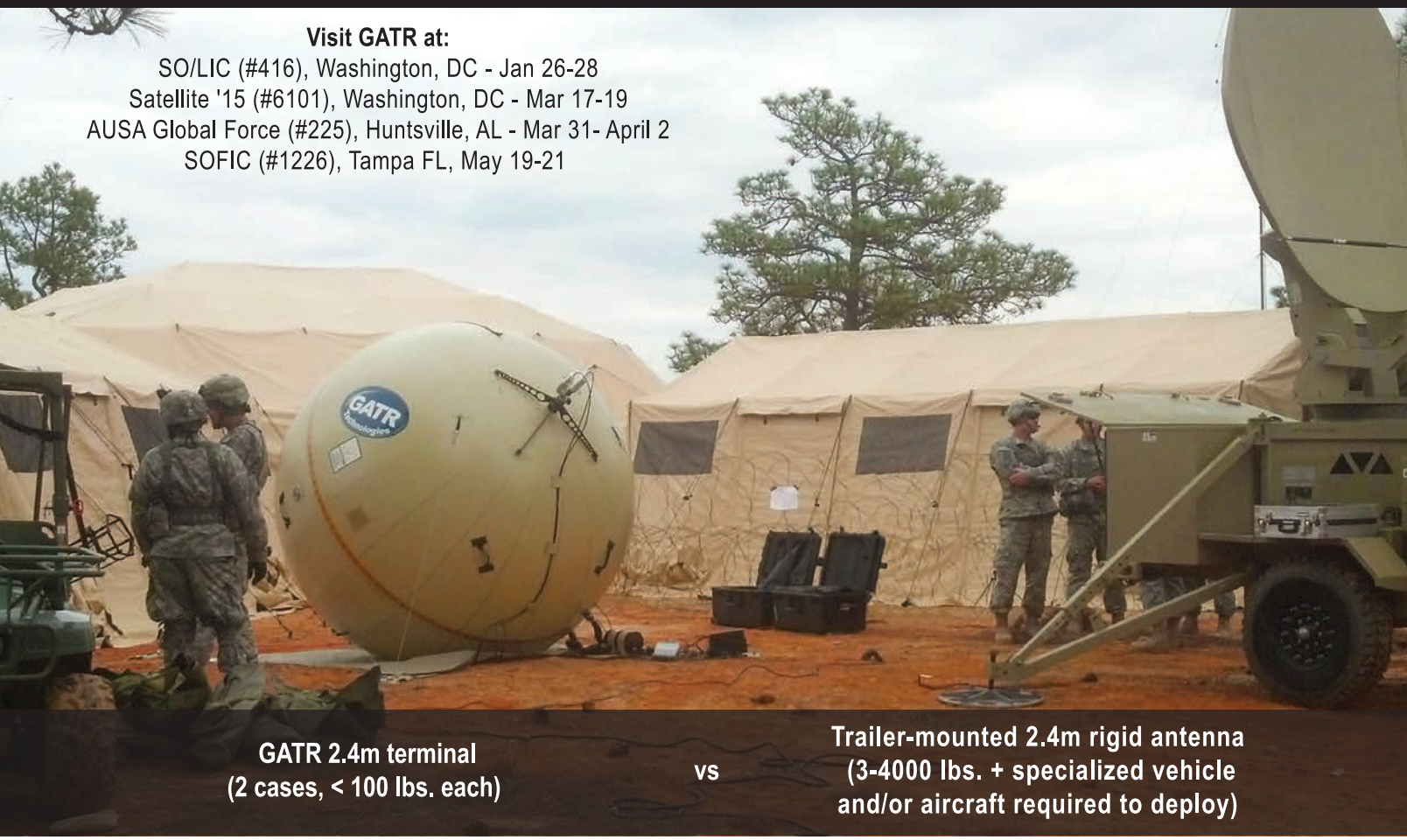
The program supports incoming freshman throughout their four years at Morehouse College. Many of the students then go on to attend top STEM graduate programs throughout the country.

"It is a great honor to have been recognized with this award," Raglin said. "One of the Hopps Scholars, Bernard Dickens, worked with our research project group here at ARL to develop software that will enable us to perform additional analysis and expand various tasks in the field of image processing and atmospheric sensing. Bernard is currently pursuing his doctorate in computer science under a fellowship at University of Chicago."

Read more at: http://www.army.mil/ article/139616

CHANGING THE SHAPE OF SATCOM

Visit GATR at:
SO/LIC (#416), Washington, DC - Jan 26-28
Satellite '15 (#6101), Washington, DC - Mar 17-19
AUSA Global Force (#225), Huntsville, AL - Mar 31- April 2
SOFIC (#1226), Tampa FL, May 19-21



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More stable in high winds and performs well in extreme temperatures

Ease of Set Up
Link established < 30 minutes

2.4m in as few as two cases < 100 lbs. ea.

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CHRISTINE MOULTON

COMMUNICATIONS-ELECTRONICS RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Christine Moulton, a mechanical engineer at CERDEC's Night Vision and Electronic Sensors Directorate at Fort Belvoir, Virginia, serves as project lead for the research, development and implementation of sensor networking interoperability solutions for Army applications, and specifically for the CERDEC NVESD Integrated Sensor Architecture Project.

The Army needed the ability to share sensor information in a more cohesive way. Under Moulton's leadership, the project aims to provide Soldiers a cost-effective, cross-cutting solution that facilitates the dynamic sharing of information between sensors and systems in a tactical environment. The ISA created an architecture that defines common standards and protocols that enable real-time recognition and integration of legacy and future sensor systems into a Soldier's tactical network.