ARMY TECHNOLOGY

U.S. ARMY RDECOM

MARCH 2014 | VOLUME 2, ISSUE 2

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MARCH 2014 | VOLUME 2, ISSUE 2

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DEPARTMENTS

ACRONYM GUIDE

RDECOM	U.S. Army Research, Development and Engineering Command
AFRICOM	Africa Command
AMC	Army Materiel Command
AMRDEC	Aviation and Missile Research, Development and Engineering Center
ARL	Army Research Laboratory
ARDEC	Armament Research, Development and Engineering Center
ARNORTH	U.S. Army North
ARSOUTH	U.S. Army South
ASA(ALT)	Assistant Secretary of the Army for Acquisition, Logistics and Technology
CERDEC	Communications-Electronics Research, Development and Engineering Center
DARPA	Defense Advanced Research Projects Agency
DASA DE&C	Deputy Assistant Secretary of the Army for Defense Exports and Cooperation
DASA R/T	Deputy Assistant Secretary of the Army for Research and Technology
DTRA	Defense Threat Reduction Agency
ECBC	Edgewood Chemical Biological Center
EUCOM	European Command
NORTHCOM	Northern Command
NSRDEC	Natick Soldier Research, Development and Engineering Center
PACOM	Pacific Command
PEO M&S	Program Executive Office Missile & Space
PEO Soldier	Program Executive Office Soldier
SOCOM	Special Operations Command
SOUTHCOM	Southern Command
TARDEC	Tank Automotive Research, Development and Engineering Center
USAREUR	U.S. Army Europe

Front cover design by Joe Stephens; photo by Conrad Johnson

Download the magazine, view online or read each individual story with additional content and links at Army Technology Live: **http://armytechnology.armylive.dodlive.mil**

RDECOM depends on partnerships to develop world-class technology and engineering solutions. Our mission is only achievable if we continue to reach out and build partnerships across all of our core competencies.

The automotive industry, for example, is very interested in collaborating with us. Our tank and automotive research center recently signed a formal research agreement with General Motors for hydrogen fuel research. Partnering with America's automakers gives us tremendous opportunities to leverage their technology development while contributing to the industry knowledge base. Also, we partner with the University of Michigan and Michigan State to help develop the next generation of automotive engineers who are working on our most challenging problems. All of this gives us direct engagement with the leading edge of technology.

The engineers at our aviation and missile center collaborate with NASA scientists on areas of mutual interest such as logistics, engineering, safety, quality and assurance. We face many of the same issues, and when we share best practices with each other, both organizations benefit.

RDECOM scientists also perform basic research support for many DARPA projects. The more we partner with DARPA on its visionary work at the leading edge of scientific discovery, the more we can anticipate transitions of potentially leap-ahead capabilities. So I would love to see our scientists and engineers doing even more work with DARPA to augment our S&T activities. DARPA would be able to take advantage of our knowledge and expertise of Soldier and land combat challenges. An enhanced partnership would help us better prepare to transition technologies, upgrade current programs and develop new programs.

Working with visionary partners like DARPA enables us to better support our other partners, for example in our growing partnership with the Special Operations Command. Technology plays a major role in the Army's vision for the Soldier of the Future. SOCOM has turned to our organization to provide unique solutions in the area of lighter batteries, more flexible and stronger body armor, enhanced situational awareness, secure communications and increased lethality. We have a great partnership with SOCOM to test out new ideas, get feedback, make improvements and then look for opportunities to transition technologies. That means as we create new ideas, capabilities and technologies for special-operations forces, we can present new capabilities to the general force. We're trying to be a better partner by making sure we're bringing the right people, the right expertise and the right imagination to solve their materiel gaps.

The importance of these partnerships only increases as budgets decrease. We must leverage the work of others as it only makes sense to maximize our access to the intellectual capability, capacity and capital of our partners to fill the gaps. Hunkering down in our own foxhole will just make our work less effective and be more expensive.

We are even considering game-changing ideas to create a more open environment at our research centers and laboratories. What if we were to take the fence down and allow universities and civilian researchers to build laboratories and centers right next to ours? How would this accelerate collaboration and cooperation? Perhaps joint research parks would exponentially advance our efforts. Consider what NASA has done at the Ames Research Center. They have expanded public and private partnerships by inviting researchers to co-locate and collaborate. This has resulted in an increase in innovative, high-performance and reliable space exploration technologies. We can learn from this. We are exploring new ideas to get more people with ideas together to come up with more innovative solutions.

Our Army Chief of Staff, Gen. Ray Odierno, has called for a globally responsive and regionally engaged Army that is ready and modern. The vision is for smaller brigade combat teams by 2025 with the same or increased lethality. The chief is relying on the S&T community to provide technologies that can be developed and fielded to meet that time line. We are an integral team member. I have every confidence that our proactive approach to partnering combined with the creative RDECOM workforce, we can do what the Army needs us to do—with fewer resources. That's what we're all about: enabling Soldiers to execute their mission in an increasingly complex and contested battlefield.

To be a ready and modern Army, the Army research and development community will step up, innovate and deliver groundbreaking solutions. I am confident that RDECOM, with our partners, will accomplish this task.

Dale A. Ormond, Director, RDECOM

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ARMY TECHNOLOGY

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Driving Advances in Decisive Edge Technologies

Assistant Secretary of the Army for Acquisition, Logistics and Technology Heidi Shyu serves as the Army acquisition executive, the senior procurement executive, science advisor to the Secretary of the Army, and the Army's senior research and development official. She also has principal responsibility for all Department of the Army matters related to logistics. She appoints and manages program executive officers and manages the Army Acquisition Corps and Army Acquisition Workforce.

What is your vision for ASA(ALT) collaboration with industry, academia and other organizations?

I think collaboration is really essential. No single person or organization possesses a monopoly on innovative ideas. It is critical for us to collaborate with industry, academia, federally funded R&D centers and other government organizations to solve difficult problems. So my vision is that we will collaborate across the board to spur innovation.

In the S&T arena, we work closely with academia. We also have the Broad Agency Announcement, small business forums, cross-service collaboration on Research, Development, Test and Evaluation. We collaborate with DARPA and university affiliated research centers. We have individual investigator grants and collaborations with partner nations. Defense companies are willing to invest their R&D dollars to help solve the Army's challenges, so we need to dialogue with them to inform them of our challenges and stay abreast of their ideas, design and development activities. The goal is to get a multitude of ideas to figure out how to solve problems. Collaboration is critical.

How do you see technology providing Soldiers with the decisive edge?

There are many technologies that can provide Soldiers with the decisive edge. One of our key goals is to develop lighter and stronger armor. Why? Because it will enhance survivability and improve mobility. We're also developing initiatives like continuous soldier health sensing and monitoring, disruptive energetic materials that could provide increased lethality, bio-inspired sensing to eliminate tactical surprise, and energy harvesting to reduce our dependence on fuel.

How do budget concerns affect your vision?

The Army has by and large protected its S&T budget. The rest of the budget has faced double-digit reductions. The American Soldier is the best equipped in the world—thanks to our materiel enterprise. We must continue to invest in S&T in order to equip our Soldier of the future.

We have focused on a 30-year plan, called the long-range investment requirements analysis, or LIRA, which is

Daniel R. McGauley (left), then-executive officer of the RDECOM Field Assistance in Science and Technology Center, describes a Common Remotely Operated Weapons Station thermal imager protective cover design and fabricated by his team at Bagram Airfield, Afghanistan, Jan. 15, 2013, during a visit from Maj. Gen. Harold Greene, deputy fo acquisition and systems management at ASA(ALT); Heidi Shyu, assistant secretary of the Army for Acquisition, Logistics and Technology: and Gen. Dennis L. Via, commanding general, U.S. Army Materiel Command. (U.S. Army photo)

enabling us to link S&T efforts to programs of record. This will allow us to focus our research activities to address capability shortfalls.

How does ASA(ALT) partner with RDECOM, its centers and laboratories?

The partnership we have with RDECOM is critical. RDECOM plays a very important role across all of the PEOs and the acquisition community by providing critical functions and skill sets such as research, development, systems engineering, design, performance analysis, modeling and simulation, software, reliability analysis, prototyping, integration and test, and more. For example:

- CERDEC Night Vision and Electronic Sensors Directorate S&T provided our Soldiers the ability to dominate the night
- NSRDEC has provided transportable high-energy efficient shower units, kitchen units and shelters
- AMRDEC has provided critical missile expertise to PEO Missile & Space
- TARDEC has provided high-fidelity modeling and simulation capabilities that accurately predict blast effects on our vehicles and enable us to design more survivable vehicles to reduce injuries to our Soldiers
- All of CERDEC has provided technical assessment of the effectiveness of our tactical radios

What are your expectations from Army researchers, scientists and engineers?

It's important for our Army researchers, scientists and engineers to stay fully abreast of the latest technologies and where the research is going. They really have to be masters of their domain to solve the Army's difficult problems. We rely on them to give us the next generation of capabilities.

I'd like to see tighter linkages between the S&T community with the PMs, PEOs and the requirements community to ensure relevance, especially in this fiscally challenged environment. Ultimately we must understand the art of the possible and how to structure that for the future. As we look at the S&T capabilities we need to develop, I think it is critical for our researchers to tie into our 30-year roadmap.

One of the key things I think the Army needs to do is ensure we provide our people with a research environment where they can innovate. We have world-class scientists and engineers in their field, and they are highly motivated to solve the most difficult problems for our Soldiers. I've had the pleasure of meeting many of our outstanding researchers, scientists and engineers, and I really admire their dedication, passion for their work and innovation. I'm very impressed with our caliber of researchers, and they are the critical enablers for us to develop the next generation of capabilities for our Soldiers. ■

Biography: http://go.usa.gov/Z7mV

RDECOM Partnerships

Extending its reach with agreements, alliances and collaborative efforts, RDECOM ensures success

BY RDECOM PUBLIC AFFAIRS

Army researchers, scientists and engineers offer technology solutions to complex problems. But, they don't do it alone. Through an intricate web of agreements, alliances and collaborative efforts, RDECOM extends its reach, expands its potential and gets the job done.

RDECOM has six research centers and the Army Research Laboratory. There are three forward element commands conducting technology searches across the globe and providing combatant commanders with science advisors.

Ten years ago, the Army established RDECOM to improve integration. The goal was to reduce the time for technology to transition from laboratories to Soldiers. Since then, the command has worked to increase agility and take advantage of technology opportunities to solve immediate operational problems.

"RDECOM is the Army's go-to organization for scientific and engineering expertise that defines the space between the state of the art and the art of the possible," said RDECOM Director Dale A. Ormond. "We deliver innovative technology solutions to ensure the United States maintains global battlefield dominance."

Ormond said his organization provides engineering services and support to program executive offices, program managers, the Army's Life Cycle Management Commands, known as LCMCs, and other customers.

"We develop technical specifications, administer contractual efforts, provide technical oversight of programs, engineer configuration management and much more," he said. "Our largest mission is engineering. RDECOM has a strategic approach to identify, prioritize and resource critical engineering requirements.

Rapid prototyping is another engineering service provided by RDECOM. Prototype Integration Facilities, known as PIFs, develop concepts and engineering designs for rapid conversion into prototypes for immediate use by Soldiers, or for transition to full-scale production.

Most of RDECOM's research centers have either a special facility that is designated as a PIF or have the capability. The PIFs focus on the development and fabrication of prototypes in limited quantities rather than mass production.

"Predominately funded by customer reimbursable dollars, the goal of each PIF is to produce results as quickly as possible at the lowest possible cost," Ormond explained.

Providing these engineering services and prototyping capabilities from a workforce that has developed technical expertise through hands on bench work and development of cutting edge technologies allows the Army materiel acquisition community to be a Smart Buyer, as defined in the Weapons Systems Acquisition Reform Act of 2009.

RDECOM BUSINESS MODEL

RDECOM operates in the Army acquisition process in three distinct areas:

- Science and technology development
- Program engineering and acquisition
- Sustainment engineering

ARL researchers lead the process through discovery and innovation. At this stage, RDECOM partners with industry and academia to form Collaborative Technology Alliances.

One example is the Flexible Display Center at Arizona State University. More than 10 years ago, U.S. Army researchers saw potential in flexible displays. With nothing in the marketplace, the Army decided to partner with industry and academia to create the Flexible Display Center.

Industry partners, such as Raytheon, Corning, HP and LG, work with academic partners, such as Oregon State University, Lehigh University and ASU and RDECOM research centers to achieve a leadership position in the emerging flexible electronics industry.

Once technology solutions have matured they enter an advanced development stage and transition to one of RDECOM's six research centers. The centers cover all the bases with research in lethality, Soldier systems, ground vehicles, chemical-biological, aviation and missile, and communications-electronics. Researchers and engineers work with PEOs and PMs to move technology solutions to the engineering and production phase.

Finally as products are fielded to the force, RDECOM engineers work with LCMCs to provide sustainment engineering. One example would be providing upgrades to fielded equipment, like the AH-64E Apache Guardian attack helicopter, which was delivered to Soldiers in January 2013. ■

NSRDEC biomechanics research engineer Karen Gregorczyk (right) assesses the effects of the Ruggedized Human Universal Load Carriage, a lower-body exoskeleton, on the load carriage performance of a Soldier.

Global Relationships

International partnering creates a win-win propositions for RDECOM

BY RDECOM PUBLIC AFFAIRS

RDECOM scientists and engineers are stationed around the globe to explore international collaboration opportunities in scientific research and technology development, opportunities that will potentially close capability gaps for the U.S. Army.

From basic science to insights on maturing technology, foreign research contributes to the development of U.S. products and provides solutions that improve American capabilities.

WORLDWIDE COVERAGE

Three regional RDECOM Forward Element Commands, known as RFECs, represent this international endeavor:

- RFEC Atlantic
- RFEC Americas
- RFEC Pacific

The RFECs are the Army's eyes and ears in the international science and technology community. Military and civilian employees at the RFECs establish long-term relationships with American allies and foreign entities. They initiate cooperative research opportunities and identify leading-edge research.

Joint research projects, workshops, visits, exchanges and formal bilateral agreements are the tools used to grow collaborative, relevant S&T for the Army.

The RFECs have a hybrid mission of scientific discovery, warfighter support and allied interoperability. Their goals are to promote cooperation between RDECOM and international researchers in areas relevant to the Army mission; provide support to combatant commands and component commands for battlefield-generated requirements; and advance Army Theater Security Cooperation initiatives with partner nations.

RFEC employees work at International Technology Centers, known as ITCs, or on Field Assistance in Science and Technology, or FAST, staffs. ITCs vary in size, but their basic mission is the same: discover leading-edge scientific research, establish collaborative research relationships and promote the development of technology useful to the Army.

Each ITC's short-term and strategic engagement is influenced by the region's maturity in S&T, as well as the maturity of relationships and cultural factors that support collaborations that are facilitated through grants and data exchange agreements.

FAST teams extend RDECOM's expertise to combatant commanders. S&T advisors who understand the operational needs of each major Army command are co-located with the commands they serve. They help the command identify and document capability gaps, codify urgent requirements, provide reach back to RDECOM, and find and exploit game-changing technologies that resolve or fill these needs.

FAST members are true force multipliers, finding solutions for battlefield requirements, testing and evaluating new equipment in live training exercises, and contributing to humanitarian and peacekeeping missions.

RFEC ATLANTIC

RFEC Atlantic's FAST teams support two combatant commands: EUCOM and AFRICOM.

In Stuttgart, Germany, FAST members assigned to AFRICOM have helped solve capability gaps ranging from man-portable water solutions to providing solar power for remote outposts. Their efforts at AFRICOM aim to solve long-range, long-endurance intelligence, surveillance and reconnaissance challenges inherent in a vast area of operation.

The AFRICOM FAST advisor coordinates with the Air Force Research Laboratory, the Joint IED Defeat Organization, CERDEC and SOCOM in support of Special Operations Forces Africa and AFRICOM.

FAST members at EUCOM have a strategic focus and represent EUCOM in Joint Concept Technology Demonstration and Coalition Warfare Program initiatives. The EUCOM FAST advisor and staff provide input and endorsement support, and some case management support, to JCTD programs that support command priorities and objectives.

They also maintain a close relationship with the JCTD office. The EUCOM FAST office reviews and provides support and endorsement of CWPs that address EUCOM priorities and objectives.

The USAREUR FAST advisor supports the Army Service

Component Command by providing immediate access to the research and development enterprise to expedite technology solutions to Soldiers.

The Joint Multinational Readiness Command FAST advisor and Joint Multinational Readiness Center noncommissioned officer provide S&T support to U.S. and multinational training and exercises at Grafenwoehr and Hohenfels, Germany, working directly with Soldiers to improve training, interoperability and equipment.

ITCs in England, France and Germany are the European scouts for U.S.-based RDECOM research centers and laboratories and provide direct support to ASA(ALT), DASA DE&C and DASA R/T in international cooperation missions. This includes developing opportunities for the Army's Engineer and Scientist Exchange Program, Foreign Technology & Science Assessment Support, and Foreign Comparative Testing initiatives.

More on RFEC Atlantic here: http://go.usa.gov/ZSww

RFEC AMERICAS

Founded in 2004, RFEC Americas, headquartered in Santiago, Chile, is the newest and smallest of the three forward element commands.

Like RFEC-Atlantic and Pacific, RFEC-Americas has direct roots in the Standardization Program, specifically with its Ottawa, Canada, office.

RFEC-Americas has 12 people assigned: four in Santiago; two in Buenos Aires and two in Ottawa; and one person each at NORTHCOM, SOUTHCOM, ARNORTH and ARSOUTH.

"We are part of the U.S. mission and execute our program to meet Army goals in the context of broader U.S. government goals as articulated in the U.S. Embassy strategy," said the RFEC-Americas commander, Col. Julian R. Williams Jr.

The three offices in partner nations are located within the U.S. mission, which ties its activities tightly with those of other executive-branch agencies (including the Air Force Office of Aerospace Research and Development and the Office of Naval Research-Global, which also have regional offices in Santiago).

Williams said the relationship is strong, makes for better programs and is somewhat unique among the RFECs.

"Our strategy and implementation plans incorporate guidance from not only the Departments of Defense and the Army, the combatant commands and Army service component commands, but also from the Department of State," he said.

Venues for synchronization include joint commission meetings (executive agency level bi-lateral meetings organized by the State Department and the partner nation Ministry of Foreign Affairs), bi-lateral working groups (high level meetings between the Office of the Secretary of Defense, COCOMs, and partner nation equivalents), and staff talks (U.S. Army Component Commands and partner nation armies).

"We are scientists and engineers working in subject areas of universal importance such as alternative power and energy, disaster relief technologies, mitigating environmental impact of operations and manufacturing, and water purification," Williams said. "For a combatant command or Army component command, we are a smart and soft power tool that can be used to meet their goals in a benign manner."

Williams said their "sweet spot" is when a project or workshop meets the requirements of many stakeholders.

"Our portfolio consists of visitor and subject matter expert visits and exchanges, workshops, and seed projects," he said. "The portfolio is balanced across subject areas and partner nations in a manner similar to that of a venture capitalist."

More on RFEC Americas here: http://go.usa.gov/ZSAm

RFEC PACIFIC

RFEC Pacific facilitates the Army's S&T collaboration efforts throughout the Asia-Pacific region, which spans 36 countries.

In support of the Administration's rebalance to the Pacific, RFEC Pacific is uniquely postured to capitalize on the dramatic increase in Asia's R&D investments, which collectively have exceeded those of Europe, the Americas, and the United States and continue to trend upward, according to Battelle R&D Magazine 2013.

"In past years, RFEC Pacific has established an exceptional working relationship with Japan, Korea, Australia, and Singapore," said RFEC Pacific Commander Col. Ernest "Lee" Dunlap. "In 2014, RFEC Pacific will seek opportunities to expand engagements in India as well as countries in the Association of Southeast Asian Nations, such as Vietnam, Thailand and the Philippines."

Forward presence and persistent engagement are cornerstones of the Army's strategy in the Asia-Pacific region. RFEC Pacific headquarters is in Tokyo and task organized into the Field Assistance in Science & Technology-Pacific and the International Technology Center-Pacific.

ITC-PAC conducts technology search and facilitates government-to-government engagements with people assigned to Japan, Singapore and Australia.

FAST-PAC provides S&T direct warfighter support for USPACOM, USFK, SOCPAC/SOCKOR, and USARPAC with science advisors assigned to Alaska, Hawaii, Washington, Japan and Korea.

"Building partnerships and leveraging resources for mutual benefit are a top priority for RFEC Pacific," Dunlap said. "Cultivating relationships is vital to our success and this includes our allied countries, fellow AMC equities, and other U.S. international outreach partners."

ITC Pacific works collaboratively with the broader DoD S&T community, to include the Office of Naval Research Global, the Asian Office of Aerospace Research and Development, DARPA and DTRA.

FAST Pacific seeks to maintain a single face to the warfighter by partnering with the Army Field Support Brigades.

"There are clear lines of synergy we can capitalize on with the 403rd and 404th AFSBs to optimize our S&T support to the warfighter, and we're working with them today toward that goal," said Dunlap. FAST Pacific also works closely with the MARFORPAC Experimentation Center, Army Contracting Support Brigades and the Army Reserve Sustainment Command's Detachment-8.

"Our international engagement activities cutting across all mission areas are synchronized with Asia-Pacific Theater Objectives, Technology Needs of the Army, and what we call the S&T Landscape," Dunlap said. "This undertaking requires close coordination with the PACOM J4/J8 staff and Security Cooperation Offices from each country." ■

More on RFEC Pacific here: http://go.usa.gov/ZS6k

ADVANCING Science and Engineering

RDECOM research agreements yield results

BY RDECOM PUBLIC AFFAIRS

Cooperative research and development agreements advance scientific and engineering knowledge through partnerships.

RDECOM has more than 250 of these agreements, known as CRADAs, with industry, universities and other government agencies to help expedite research goals.

"These CRADAs are with small businesses, large businesses and entities across the globe on matters of interest to Army research and development," said Kendra Meggett-Karr, RDECOM Technology Transfer program manager.

CRADAs are formal agreements between one or more federal laboratories or research centers and one or more non-federal organizations. The government, through its laboratories, provides personnel, facilities, equipment or other resources with reimbursement from the partnering entity.

Non-federal partners also provide personnel, funds, services, facilities, equipment or other resources to conduct specific research and development that is consistent with the RDECOM mission.

"CRADAs provide an easy way to collaborate with us," said ARL spokesman Tom Moyer. "CRADAs allow ARL researchers to exchange technical expertise with non-federal partners and to accept reimbursement for research conducted under the CRADA."

CRADAs also protect a researcher's rights and those of ARL to a researcher's inventions. CRADAs work best when ideas, staff, materials and equipment are to be exchanged over a period of time for the purpose of collaboration and/or an invention may result, he said.

Of the 262 active CRADAs, 48 are with small businesses and 68 are with large businesses, Meggett-Carr said. There are also 19 active agreements with universities and many more with other government agencies.

RDECOM recently stood up a Technology Transfer Office.

"As dollars dwindle, we all realize the need to be more creative in how we go about developing technologies. CRADAs provide a means to leverage research budgets and optimize resources," Meggett-Carr said. "Partnering with industry also helps us all on an economic level. Part of the mandate of the T2 mission from the president is to stimulate economic growth. CRADAs allow private industry to provide funds as well as other resources to assist with the commercialization of technology."

Technology transfer also allows industry to take military technology and market it for commercial use. This can also be accomplished with the use of the Patent License Agreement.

"The commercial sector is able to build successful businesses and stimulate the economy," she said. "This has happened with GPS this was a military application in the beginning, that found its way into commercial markets. That's part of the overall T2 mission at a very high level."

"We are in the business of partnering with outside entities to do exploratory studies and basic research," Meggett-Carr said. "We attend conferences and scientific talks with the goal of getting our name out there. We are actively seeking partnerships. RDECOM can develop what is known as a master CRADA and help industry or academia to find the particular research area within our organization."

There are test service agreements where industry wants to use Army facilities, goods, services and its knowledge base. Industry is required to pay for that.

"If people are looking to do a CRADA because it will be profitable for them, in the sense that a contract might be profitable, that is not the case," Meggett-Carr said. "It is a true partnership where the organizations come to the table with a shared interest and common goal."

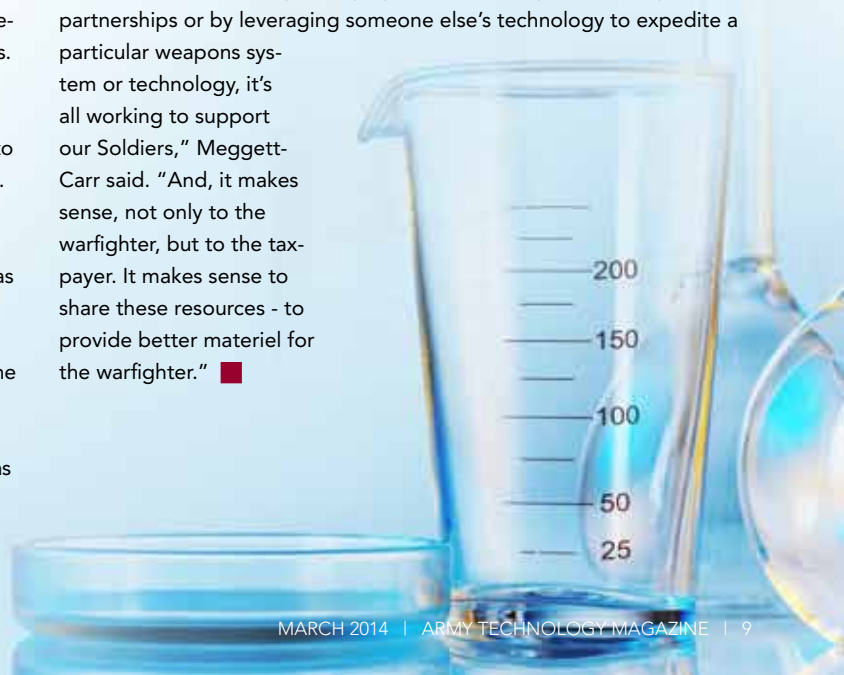
CRADAs are generally three years in with an option to extend.

"Many universities continue to extend because they want to keep the partnership going. I know they get a lot of our scientists to come and work with them, and vice versa," Meggett-Carr said.

RDECOM maintains a database of the partnerships for record keeping. Meggett-Carr said her office intends to expand the capability of the database. "That way we can keep a better handle on who's partnering with specific entities."

"What RDECOM is trying to do to streamline the process for our partners and provide a master CRADA," Meggett-Carr said. "CRADAs speed up scientific research efforts that enhance the entire Army acquisition program."

"Whether it's through bringing the experts together through partnerships or by leveraging someone else's technology to expedite a particular weapons system or technology, it's all working to support our Soldiers," Meggett-Carr said. "And, it makes sense, not only to the warfighter, but to the taxpayer. It makes sense to share these resources - to provide better materiel for the warfighter." ■



Medal of Honor recipient Staff Sgt. Ty Carter gets scanned in ICT's Light Stage 6, a 9-meter diameter sphere with more than 6,000 LED lights capable of recreating a person under any lighting condition. (USC Institute for Creative Technologies)

BACK TO THE FUTURE

USC Institute for Creative Technologies brings training of tomorrow to Soldiers

BY ORLI BELMAN, USC INSTITUTE FOR CREATIVE TECHNOLOGIES

At the University of Southern California Institute for Creative Technologies, researchers specializing in the art and science of creating an immersive experience work with ARL to advance interactive simulation-based solutions for training Soldiers, teaching students, treating patients and more.

In 1999, the Army and USC joined together to establish ICT as a University Affiliated Research Center, or UARC, that would combine the creative talents of the film and game industries with world-class university research in engineering, education and cinematic arts. The goal: to make simulations more effective through the study and development of emerging digital technologies and engaging narrative-driven experiences.

Today, transitioned prototypes from this forward-looking lab can be seen throughout the Army, including video games designed to prepare Soldiers in negotiations and stability operations, virtual role players programmed to provide practice in conducting sensitive interviews and virtual reality systems developed to enhance therapies for post-traumatic stress and traumatic brain injuries.

"The missions we ask our Warriors to perform put them in extreme circumstances. It is vital that we bring the best capabilities, based on the best science to them in training, on the battlefield, and as they reset for the next mission—or for the return to family," said Dr. Laurel Allender, director of ARL Human Research and Engineering Directorate. "The research conducted at the ICT in collaboration with the Army is critical for building the strong scientific basis for simulation and training technologies and for the strategic application of those technologies to address the needs of Soldiers today and tomorrow."

ICT scientists are leaders in the fields of artificial intelligence, graphics, virtual reality and computer and story-based learning. Los Angeles, a hub of high-tech and creative industries, inspires problem-solving research that draws from and contributes to the region's innovation and provides powerful techniques and technologies to enhance Army training and education.

Current ICT and ARL collaborations expand how scientific breakthroughs can bolster Army efforts to empower, unburden and strengthen Soldiers. They include studying new uses for ICT-developed virtual humans, head-mounted displays and photo-real digital characters.

ICT's Skip Rizzo (foreground) and Bradley Newman demonstrate Bravemind, ICT's virtual reality exposure therapy system for treating post-traumatic stress. (Photo courtesy Branimir Kvartuc, USC Institute for Creative Technologies)

"We want to make sure that our innovations help save time, resources and lives," said Dr. Randall W. Hill Jr., ICT executive director. "Our partnership with ARL provides an essential sounding board and test bed for making sure our investigations are relevant to current and future Army needs. Also, our status as a UARC allows us to serve as a strategic resource that can be easily tasked by DoD organizations seeking to solve problems with immersive experiences."

ICT's projects span basic and applied research and advanced prototype development. Discoveries made in the lab can be quickly leveraged for training. For example, ICT developed the Virtual Human Project, widely regarded as the most comprehensive effort devoted to creating computer-generated characters that look, behave and communicate like real people.

Basic research leads to insights into how people relate to one another and to their virtual counterparts. Applied research leads to capabilities that improve software functionality, including sensing systems that can infer a user's emotional state. Advanced prototype development requires experimenting and assessing training system value and impact. ICT virtual humans have deployed across the country, getting young people excited about science, providing information on Army careers and supporting veterans reintegrating to civilian life. Additional characters will be soon used in efforts to address depression, suicide and sexual harassment and assault prevention.

A new effort is also exploring how ICT's natural language, nonverbal behavior recognition, cognition and emotion modeling research can help further ARL's human-robot interaction research programs and enhance future connections between virtual human and HRI research.

"Human-robot teams are beginning to emerge across a range of potentially high-stakes situations including military operations, first-responders and caring for vulnerable populations," said Dr. Jonathan Gratch, ICT associate director for virtual humans research. "We are excited to explore whether imbuing machines with some of the virtual human capabilities developed in our lab can help support the vision of improving performance in Soldier-robot teams."

ICT's Mixed Reality Lab, known as MxR, works with ARL HRED's Simulation and Training Technology Center to investigate how ICT's head-mounted displays can be incorporated to reduce the costs and increase realism in the Dismounted Soldier Training System.

ICT computer artists demonstrate the ELITE system potential in developing leadership basic counseling training through a virtual character. (USC Institute for Creative Technologies)

Personality Profile: Peter Khooshabeh

BY ORLI BELMAN

When ICT's Peter Khooshabeh was an undergraduate at the University of California at Berkeley he worked on developing a virtual practice tool for surgeons. The idea was that an individual interacting in this simulated scenario would show improved outcomes in the operating room. But when Khooshabeh spent time in a real hospital, he observed that technical skill was just one aspect of surgical success. Any useful virtual environment would also need to capture the interpersonal dynamics of such a high-stress, multi-person setting.

"At first we were focused on putting just one person in this virtual environment but there are many players involved in any given surgery," Khooshabeh said, a research fellow in ICT's virtual humans research group. "I came to understand that the key to improving performance may not be in the quality of the technology, but in how much you understand about people and how they perceive one another."

Khooshabeh went on to earn a Ph.D. in cognitive psychology from UC Santa Barbara and continues to leverage technology as a tool to better understand people.

Read about Dr. Khooshabeh at http://go.usa.gov/Zh3W

Army-funded research from MxR contributed to the development of the Oculus Rift, a new virtual reality headset poised to transform the landscape of virtual reality entertainment and training with low-cost, high fidelity virtual reality displays. The MxR group's work in this area is ongoing with the continued development of a suite of open-source immersive viewers.

ICT's graphics lab works closely with the entertainment industry. Paul Debevec, the lab's director, received a Scientific and Engineering Academy Award in 2010 for the development of the Light Stage systems, which can relight and recreate a digital face down to level of individual pores and fine wrinkles. The Light Stage technologies have contributed to films like "Gravity" and "Avatar" and are also used to create realistic characters for ICT's Army training prototypes, like the Emergent Leader Immersive Training Experience, which was installed at the Maneuver Center of Excellence in Fort Benning, Ga. A laptop version will soon be available at the Army's MilGaming web portal.

"We are in an exciting time and place to develop and deliver engaging training," Hill said. "I look forward to continued work with the Army and seeing what the next 15 years will bring."

Bio-Technological Advances

ARO extends University of California at Santa Barbara at the Institute for Collaborative Biotechnologies research

BY ARL PUBLIC AFFAIRS

Army experts, along with leading university professors and industry partners have been collaborating over the last decade to explore biological systems that have the potential to drive sweeping bio-technological advances for Soldiers.

The research is led by the University of California at Santa Barbara at the Institute for Collaborative Biotechnologies, or ICB, a university affiliated research center.

The Army Research Office extended the contract in December 2013, providing an additional $48 million over three years to study high-performance biological systems and the translation of these to engineering systems of benefit to Soldiers.

"Looking ahead, the value first and foremost will be a more comprehensive integration between the ICB and partners in Army and industry," said Robert J. Kokoska, who manages the relationship with the center for ARO. The institute researchers have unique insight about bio-inspired technology.

"The Army has complementary capabilities and understanding of the military operating environment that the academic researchers could leverage," Kokoska said. "For example, in 2014, the ICB will start to look toward integrating some of their materials research into ARL's cross-directorate enterprise in the multiscale modeling of materials."

One of the hallmarks of UARCs is the collaboration between the Army scientists and engineers directly with university researchers throughout the research process, he said.

"We've been able to gain a basic understanding of a number of biological systems to the extent that bio-inspired materials can be synthesized and studied," Kokoska said. "For example, the characteristics of a moth's eye are being mimicked toward the development of anti-reflective coatings. With an understanding of the physics underlying reverse adhesion of the gecko foot, we could create fascinating robotic technology. Biological systems offer endless possibilities for the military to model synthetic materials."

"The ICB also includes a channel to transition an idea from basic discovery toward technologies that address specific Army needs," he said.

The projects apply science to more specific military needs through collaborative efforts involving research contributions from academic, Army and industrial partners.

"The Army-academic-industry partnership at ICB is a win-win-win proposition, Kokosaka said.

"We're looking forward to a number of technologies from the program to further mature down the pipeline," Kokoska said. "We expect further advances in power and energy; battery and fuel cell research; and field-expedient sensors."

ICB teams have already developed revolutionary technological innovations in bio-inspired materials and energy, biomolecular sensors, bio-inspired network science and biotechnological tools. Several scientists at ARL are now working with ICB counterparts on projects that have the potential for future Army applications, Kokoska said.

Research chemist James Sumner of the BioTechnology Branch, ARL Sensors and Electron Devices Directorate, was first introduced to the ICB at its inception and has collaborated in both programs. Recently named the ICB's associate program manager, Sumner's first ICB collaboration was an example of the synergy that is possible.

Sumner met Professor Gui Bazan years ago at an ICB Academic/Army Collaboration Conference. Bazan was giving a keynote address explaining a new class of molecules designed to fluorescently label cell membranes. While Bazan and Sumner had different backgrounds, they discovered their research goals could be reached through mutual collaboration. This interaction has led to multiple peer-reviewed journal publications and a patent on enhanced electron transfer through cell membranes.

"These advances have shown how it is feasible to enhance and control microbial metabolism for applications such as microbial fuel cells and waste mitigation," Sumner said.

"The professors we interact with in the ICB are world renowned experts in their fields of specialty. To gain access to the knowledge that they possess and to be able to collaborate with them to provide new technologies for our Soldiers is a great feeling," he said.

The leading institution, UCSB, works in collaboration with the Massachusetts Institute of Technology and the California Institute of Technology. As part of the contract renewal, about 60 world-class investigators form teams to explore research in the areas of systems and synthetic biology, control and dynamical systems, biotechnology tools, photonic and electronic materials, cellular structural materials and cognitive neuroscience, Kokoska said.

UARCs like ICB conduct basic and applied research to ultimately develop technology. The lead university for a given UARC, considered at the forefront of innovation in a specific area, provides dedicated facilities and share space with Army and industry partners. The emphasis is to conduct research where breakthroughs are likely to enable revolutionary capabilities for the warfighter.

The Army has two other active UARCs that extend the lab's capability to develop revolutionary capabilities for Soldiers: the Institute for Creative Technologies at the University of Southern California; and the Institute for Soldier Nanotechnologies at the Massachusetts Institute of Technology. ■

For more information about the Institute for Collaborative Biotechnologies, visit www.icb.ucsb.edu. For information about UARCs, visit http://go.usa.gov/ZHKY.

ARL and University Partnerships

Bringing together research and development talent to improve the ability of the Army's Future Force

BY JENNA BRADY, ARL PUBLIC AFFAIRS

To develop revolutionary capabilities for Soldiers on the battlefield, ARL brings together world-class research and development talent by leveraging the vast intellectual capital of the nation's universities.

The lab makes this possible through programs and alliances including University Affiliated Research Centers, Collaborative Technology Alliances and Collaborative Research Alliances.

UARCs are university-led collaborations among universities, industry and Army laboratories that conduct basic, applied and technology demonstration research.

Universities at the forefront of science and innovation provide dedicated facilities and share space with Army and industrial participants.

ARL UARCs include the Institute for Collaborative Biotechnologies, with the lead university host, the University of California at Santa Barbara, whose researchers work in collaboration with the California Institute of Technology and the Massachusetts Institute of Technology and its industrial and Army partners; the Institute for Creative Technologies at the University of Southern California; the Institute for Soldier Nanotechnologies centered at MIT; and the Institute for Advanced Technology at the University of Texas (Austin).

CTAs and CRAs are partnerships between Army laboratories and centers, private industry and academia that focus on the rapid transition of innovative technologies to our Soldiers.

There are four active ARL CTAs:

- Micro Autonomous Systems and Technology
- Network Science
- Robotics
- Cognition and Neuroergonomics

There are two CRAs:

- Electronic Materials
- Materials in Extreme Dynamic Environments

According to Dr. Thomas Doligalski, director of Engineering Sciences at ARL's Army Research Office, the lab has 1,200 grants spread across the country with various universities.

ARO's mission is to serve as the Army's premier extramural basic research agency in the engineering, physical, information and life sciences, where basic research proposals from educational institutions, nonprofit organizations and private industry are competitively selected and funded.

The main goals of ARO include creating and exploiting scientific opportunities for revolutionary new Army capabilities, driving science to develop solutions to existing Army technology needs, accelerating transition of basic research, educating and training the future S&E workforce for the Army, and preventing technological surprises.

The research that has been conducted through ARO funded programs ranges from atom optics for underground bunker/tunnel detection to nano-energetics for more powerful and insensitive munitions and propellants.

All academic research programs and efforts funded by ARO are formulated in consultation with the ARL directorates, RDECOM and its centers, the Army Medical Research and Material Command; the Army Corps of Engineers; and the Army Research Institute for the Behavioral and Social Sciences.

The programs are also jointly coordinated and planned through the Defense Science and Technology Reliance process under the Basic Research Panel.

"ARL partners with universities and leverages their expertise in order to bring new, leading-edge ideas and techniques in to the lab in order to better serve the Army," Doligalski said.

Doligalski noted that partnering with universities brings more than just fresh and innovative ideas to the table.

"From these partnerships, ARL has been able to hire young individuals from these universities to come and work at the lab," Doligalski said.

Doligalski added that ARL will continuously strive to significantly increase its ability to collaborate with universities as the organization heads in to the future.

With ARL teaming up with universities at the forefront of science and innovation, revolutionary ideas and knowledge of Army-related needs are brought together and turned into useful realities for America's warfighters. ■

Industry, academia and government collaboration highlights different approaches

BY JOYCE BRAYBOY, ARL PUBLIC AFFAIRS

Collaborative Technology and Research Alliances are partnerships between the Army, industry and academia that are focusing on the rapid transition of innovative technologies for the Army's future force.

The collaboration between industry, academia and the government is a key element of the alliance concept as each member brings with it a distinctly different approach to research.

ARL researchers pull from the expertise of Research Development and Engineering Command organizations to keep the program oriented toward solving the Army's technology challenges. Academia is instrumental for its cutting-edge innovation; the industrial partners are able to leverage existing research results for transition and to deal with technology bottlenecks.

The multidisciplinary research teams bring together world class research and development talent and focus it on the Soldier.

ARL has a history of successful collaborations bringing together the triad of industry, academia and government, dating back to the 1990s.

There are currently four active CTAs:

- Micro Autonomous Systems and Technology, awarded in 2008
- Network Science, awarded in 2009
- Robotics, awarded in 2010
- Cognition and Neuroergonomics, awarded in 2010

Two Collaborative Research Alliances, or CRAs, were awarded in 2012: Electronic Materials, and Materials in Extreme Dynamic Environments. Finally, the most recent Collaborative Research Alliance in the area of Cyber Security was announced last year.

Each CTA and CRA has a distinctive mission and focus.

The MAST CTA conducts research and transitions technology that will enhance warfighter's tactical situational awareness in urban and complex terrain through the autonomous systems.

The Network Science CTA performs cross-cutting research of common underlying science among social and cognitive, information, and communications networks to enhance effectiveness in network-enabled warfare.

The Robotics CTA enables the creation of future highly autonomous unmanned systems and permits those systems to conduct military operations in mixed environments.

The Cognition and Neuroergonomics CTA conducts research leading to fundamental translational principles of the application of neuroscience-based research and theory to complex operational settings.

The Multi-Scale Multidisciplinary Modeling of Electronic Materials CRA is developing a quantitative understanding of materials from the atomic scales to advance the state of the art in electronic, optoelectronic and electrochemical materials and devices.

The Materials in Extreme Dynamic Environments CRA is establishing the capability to design materials for use in specific dynamic environments, especially high strain-rate applications.

The most recent CRA came about when ARL established a group led by Pennsylvania State University last year. The alliance includes ARL, CERDEC, academia and industry researchers to explore the basic foundations of cyber-science issues in the context of Army networks. ■

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ENGINEERS FORGE PARTNERSHIP

Training and preparing for Capability Set 13

BY NANCY JONES-BONBREST,
PEO C3T AND EDRIC THOMPSON,
CERDEC PUBLIC AFFAIRS

As the first units recently prepared for deployment with an array of new communications technologies, the Army's acquisition and research and development communities teamed up to train a new breed of "super" engineers to support these advanced capabilities.

PEO C3T and CERDEC used a combination of classroom instruction, research facility exercises and hands-on experience to prepare more than 30 engineers to support and troubleshoot an integrated package of tactical communications systems the Army fielded to select brigade combat teams known as Capability Set 13. The team also trained units on how to configure, employ and maintain it.

The brigade combat teams using CS 13 have deployed or are preparing to deploy to Afghanistan. CS 13 spans from the tactical operations center to the dismounted Soldier, providing mobile satellite and robust radio capability so commanders and Soldiers can take the network with them anywhere on the battlefield. It allows deployed units to cover increased distance while expediting decision-making and information sharing across more echelons than was previously possible in today's operational force.

PEO C3T and CERDEC developed a systematic approach to support the Army's shift to a system-of-systems network that is integrated across the brigade combat team formation.

"We can no longer afford to live in a system-specific, stove pipe construct," said Joseph Chen, CERDEC engineer.

The May and November 2013 sessions at Aberdeen Proving Ground, Md., stressed an understanding of CS 13 capabilities and architecture, a base system-of-systems understanding, methodologies, significant findings from previous CS 13 assessments and the way forward for continued support and resourcing for future CS fieldings.

The engineers also got hands-on experience with CS 13 equipped vehicles at CERDEC's field laboratories located at Joint Base McGuire-Dix-Lakehurst, N.J., where PD C4ISR Network Modernization stood up a comprehensive portion of the architecture in its deployed configuration, including Warfighter Information Network-Tactical—or WIN-T – Increment 2 communications nodes, Mine Resistant Ambush Protected—or MRAP—variant Key Leader Vehicles, voice and data radio networks, and Nett Warrior handheld devices.

"As a digital systems engineer, we kind of sit above and look at all the systems to make sure they're talking to each other and working properly," said Jeff Bierman, PEO C3T engineer. "If there are issues ... we work to coordinate with different field service representatives and project managers."

CERDEC's PD C4ISR & Network Modernization played a pivotal role throughout the CS 13 network verification process, providing facilities and infrastructure to enable the assessment and serving as the assessment director and executor for CS 13 vehicles.

Engineers supporting the assessment identified and helped to resolve issues by providing recommendations on techniques and procedures for successful deployment and operation of CS 13 equipment and network.

"Time is of the essence in the field, so it's paramount to share lessons-learned with those who are going to support these systems," said Dax Cadet, CERDEC engineer. "Knowing how a system is supposed to work and actually working on a system of systems are different things."

Designed for testing and solution proving in a realistic field environment, PD C4ISR and Network Modernization focuses on the future network, near term and several years out, providing the Army with a relevant venue to assess next generation technologies and to facilitate technology maturation and transition in a system-of-systems context.

Engineers will continue to provide the venue and expertise to ensure S&T efforts are mature and are a viable solution for transition, Chen said.

"If we are to ensure that emerging products from the S&T community provide increased capabilities, they will need to be assessed in a relevant environment on representative platforms," Chen said. "We've got a unique infrastructure that allows us to draw out the battlefield for the current and future fight."

With two CS 13-equipped BCTs of the 10th Mountain Division deployed to Afghanistan and two from the 101st Airborne Division preparing for deployment, PEO C3T is now working to put forward a formalized training Program of Instruction for engineers as more units are fielded with the follow-on CS 14. The units themselves are also now receiving new SoS training PEO C3T developed based on feedback from the 10th Mountain Division. The new curriculum uses a 'train the trainer' method to give Signal Soldiers and select leaders more time to become confident on all the system pieces and increase brigade awareness of CS 13 capability.

"The reality now is that everything is integrated. To have one person go and look at the vehicle and be able to troubleshoot it as a whole, we don't have that today," said Chad Claussen, network integration branch chief for PEO C3T TMD. "That's what we're trying to get to. We want to put them in a better position to understand how everything ties together." ■

More on CS 13 here: http://go.usa.gov/BbAe

New General Motors Partnership

Agreement seeks to evaluate and demonstrate hydrogen fuel cell technology

BY TARDEC PUBLIC AFFAIRS

Army officials formalized a major new research partnership with General Motors in a Dec. 16, 2013, ceremony near Detroit.

U.S. Sen. Carl Levin and U.S. Rep. Sander Levin, both of Michigan, joined TARDEC Director Dr. Paul Rogers and Charlie Freese, General Motors global fuel cell activities executive director, in a ribbon-cutting ceremony in the Ground Systems Power and Energy Laboratory at the Detroit Arsenal.

GM and TARDEC will share three Fuel Cell Automated Testing Systems to evaluate and demonstrate hydrogen fuel cell technology. Sen. Levin emphasized the importance of these two respected partners working toward a common goal—clean energy.

"All across the world, companies and governments are hoping to build the next 'Detroit'—the next international center of innovation and middle-class prosperity," Levin said. "This [agreement] is about assuring that the next 'Detroit' stays right here in Michigan. This is a competition we cannot afford to lose for the sake of our troops, our economy, our security and the environment."

Speakers at the ceremony reflected on the long-term impact of CRADAs, which have aligned government, private sector and academic partners to optimize resources and accelerate advancements for at least 20 years. Levin was instrumental in the creation of the U.S. Federal Technology Transfer Act of 1986—the law that established the Federal Laboratory Consortium and enabled federal labs to enter into CRADAs and negotiate licenses for patented inventions made in the lab.

Rogers pointed out that TARDEC has entered into 327 CRADAs since its first blanket agreement to work with the GM, Ford and Chrysler in 1993, and has 64 active agreements with industry and academic sources today.

"This agreement with GM offers the U.S. Army a unique opportunity to collaborate with a phenomenal partner—a partner that is a world innovator in automotive technologies," Rogers said.

These dual-use arrangements make sense for the region's economy, Levin said.

"Twenty years ago, an engineer here told me, 'engineering is a contact sport.' It's not enough to share data and information through technical papers, conferences and word of mouth," Levin said. "Engineers are hands-on folks. They want to bounce ideas off each other. They need to work next to each other to discuss and debate the best approaches to tough problems. Many of us have been working to bring together players in this contact sport, here in Southeast Michigan—the most important hub of vehicle innovation on earth."

GROWING THE TECHNOLOGY

Hydrogen fuel cells are a dual-use technology with benefits for both partners. GM plans to use the research results to build its portfolio of alternative energy vehicles for the automotive market. The automaker began its Project Driveway demonstration in 2007, when it released 119 fuel-cell powered Chevrolet Equinox vehicles on the road. Those vehicles have collectively driven nearly 3 million miles, saved 157,894 gallons of gasoline and avoided more than $552,631 in fuel costs, according to GM estimates.

In the military domain, engineers are developing fuel cell technology to use for auxiliary power units that reformulate JP-8 fuel into hydrogen, which can then be converted into electricity. TARDEC engineers are working on a hydrogen fuel cell demonstrator to assess its readiness level for insertion in an Abrams tank.

TARDEC engineers say that conversion would lead to a projected 33 percent savings in fuel use and provide quieter operation.

"These fuel cell test stands are capable of testing a 10-kilowatt system, which is about one-tenth the size of a fuel-cell system that goes into a car," explained TARDEC engineer Herbert Dobbs. "It helps us understand the military potential of fuel cell technology."

Hydrogen fuel-cell technology has already been propelled by joint research.

"On a morning like today, with single-digit temperatures, you can turn the key in one of those vehicles and it will start in the cold—just 10 years ago, that was impossible," Freese said. "Through CRADAs like this one, we learn as partners how to advance these important technologies."

The TARDEC-GM CRADA will be in effect until February 2016. ■

More on AGREEMENT here: http://go.usa.gov/Bb7J

TARDEC Director Dr. Paul Rogers, U.S. Sen. Carl Levin, GM's Charlie Freese and U.S. Rep. Sander Levin cut the ribbon on the three Fuel Cell Automated Testing Systems that will be shared by TARDEC and GM through a CRADA.

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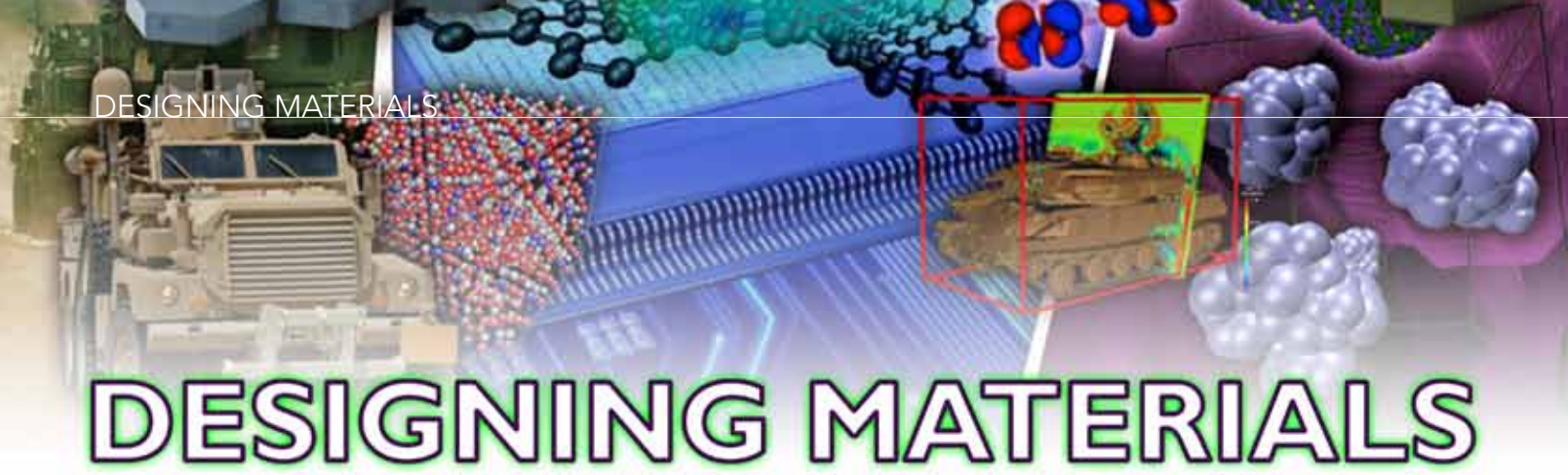


DESIGNING MATERIALS

ARL teams with university partners to transform future materials

BY T'JAE GIBSON, ARL, PUBLIC AFFAIRS

Army researchers are forging new paths in material development to bring to Soldiers equipment and supplies tougher than steel, from materials that don't yet exist.

As part of a 10-year program involving partners from universities and industry, scientists are investigating novel approaches that may result in the development of new classes of materials. Building upon expertise in coupling materials together to arrive at the best solutions like ballistic vests and helmets, the team is forging a new path by taking unprecedented approaches to examine materials. They will design atomic-level structures down to the crystal and molecular level to create transformational materials for use in future uniforms, electronic devices, armored vehicles and almost anything else a Soldier may touch.

Researchers imagine Soldiers with 30 percent lighter weight, more robust but less cumbersome protection equipment; weapon systems with five to 10 times current energy output; 30 percent more battlefield power; and electronics with 30 percent longer battlefield lifetimes.

"To make things harder, we want to see them (the materials) while they are exploding, or being blasted, or being hit by armor piercing projectiles, or being used as a battery—not an easy task but an exciting one," said Dr. John Beatty, who manages ARL's Materials in Extreme Dynamic Environments Collaborative Research Alliance. "No longer will we take materials 'off the shelf' to put into armor systems. Instead materials will become an integral part of the design process itself."

Johns Hopkins University is the lead research organization on the team. Its external collaborative research team looks at materials in extreme environments. Major partner institutions include the California Institute of Technology, the University of Delaware and Rutgers University.

This approach is also being developed by ARL to facilitate transformational electro-optical, electrochemical and electronic materials for enhanced battlefield sensors and power applications.

"By developing validated multiscale models across the relevant scales, we gain new insight into which combination of atoms within a material result in the desired electronic properties," said Dr. Meredith Reed, who manages ARL's Multiscale Modeling of Electronic Materials Collaborative Research Alliance. The Army named the University of Utah as the Lead Research Organization of this external collaborative research team that's researching Multiscale Modeling of Electronic Materials. Major partner institutions include Boston University, and Rensselaer Polytechnic Institute.

Recent significant advances in experimental and computational capabilities and technology are helping them "address this challenge with an exceptional likelihood of success," said Dr. Peter Plostins, ARL's former director of Enterprise for Multiscale Research in Materials. "The key is to be able to model large problems at and across material scales as well as experimentally interrogate those scales to discover new phenomena and material behavior and validate the modeling effectively."

Plostins retired from ARL in December 2013.

Last spring, ARL's supercomputing capability topped 1.1 petaflop capability, meaning it can crunch a quadrillion floating points per second. By fiscal 2016, it will have more than four times that capability. Real-time nuclear magnetic resonance imaging during surgery or even astrophysical simulation can be performed with this kind of capacity, for example.

"New and sophisticated experimental methods have been brought on line by the Department of Energy such as the Advanced Photon Source at Argonne National Laboratory which will enable real time dynamic interrogation of material phenomena at the nano second time scale at micron and below length scales. Advances like these have opened the door to realizing a materials modeling and interrogation capability that is unprecedented and is the key to realizing a true ability to design materials," Plostins said.

Under the Enterprise for Multiscale Research of Materials effort, researchers will demonstrate a comprehensive "materials-by-design" capability for protection, electronic and energetic materials that start with multidisciplinary and multiscale modeling. "I need to model the material with the correct physics to optimize it."

All of these models must be validated at each scale, through detailed and complex experiments.

"In the end, the Army needs to make what it desires to have for the Soldier," Plostins said.

EXPERIMENTS MATTER

Experiments will help Army researchers discover what should be modeled and at what scale, and eventually prove those models work and reflect reality.

"We have an experimental technique called a diamond anvil cell, where we take a small amount of a material and subject it to very high pressures squeezing it between two diamonds," said Beatty. He said the pressure they exert is at 300 gigapascals and above, which is in the range of pressures seen when a high explosive material detonates, or when an armor system gets hit in the field.

"At the bottom of the Marianna's trench, the deepest part of the ocean, the pressure is about 0.1GPA so we're 3,000 times more than that. But it's not enough to expose it to the pressure," Beatty said. "We use several methods to examine the material while it is under such high pressure, such as Raman spectroscopy and various forms of X-ray spectroscopy. From this we can figure out quite a bit about what is changing in the material at these high pressures. We can use this information to validate models

that are built up from quantum mechanics to describe these materials. It's a very important step in our quest to design materials for these extreme environments."

ARL is also using a specialized apparatus known as a Kolsky bar to examine materials loaded up really fast with lots of mechanical energy.

"In armor systems, protection materials are struck with a lot on energy in a small spot. Our enemies hope that that energy can basically go right through the armor system and damage the innards, and yes, that also means wounding or killing our Soldiers inside. So we need to be able to examine materials when we load them up with energy real fast!"

"We send a high stress pulse down a solid metal bar, then smash a sample between that bar and another one, and then examine the stress pulses that result. And those stress pulses tell us a lot about what happened to the material we were smashing," said Beatty.

An ARL team led by Dr. Dan Casem has worked to modify instrumentation used on the bars, which are typically as big around as the handle on a baseball bat. With the new optical instrumentation, the bars can now be made as thin as some human hairs. Researchers can actually smash them in a way to get even higher deformation rates, at orders of magnitude greater than before, making the extreme environment during the test much more realistic.

ARL's work with Johns Hopkins University and Argonne National Lab is also using similar high strain-rate tests with even more advanced diagnostics. They use the Department of Energy's beam line to produce short pulse, high-energy X-rays during these experiments.

"These X-rays will allow us to take snapshots of many things going on inside the materials we are testing, such as phase changes, defect changes, etc.," Beatty said.

These experiments peer inside materials during the experiments to validate the multiscale models that the team is building from the atomic level up.

"We need these advanced techniques to both discover what we need to model, as well as to validate those models, to make sure they are real. Experiments matter and are critical to expanding our abilities to design materials," Beatty said.

PROTECTION MATERIALS GO INVISIBLE

The bottom-up design and fabrication of highly complex multifunctional materials with new and unprecedented properties has researchers looking at negative index composites with optical cloaking properties, which could one day mean rendering certain materials invisible.

The Army is only a couple of years away from developing technology that essentially will lead to making things, even people, invisible. Groundbreaking research in transformational optics leveraged by the Army Research Office, based in Triangle Research Park, N.C., and a team of university collaborators has already proven that metamaterials have cloaking effects, or the ability to hide objects when viewed from a wide range of directions and in visible light.

But the Army is not ready to put invisible Soldiers or systems on the battle space, said Dr. Richard Hammond, a theoretical physicist in Optical Physics and Imaging Science Divisions—at least, not yet.

More promising though are less superhero-like scientific applications of metamaterials that will undoubtedly grow America's military superiority by leaps and bounds, said Dr. David Smith, associate professor and Augustine scholar with Duke University's Electrical and Computer Engineering Department. He's also the director of Duke's Center for Metamaterials and Integrated Plasmonics.

Scientists in the ARL Sensors and Electron Devices Directorate use a range of computational tools in the laboratory, but there are not currently any predictive models for designing advanced materials. The Enterprise for Multiscale Research of Materials will address challenges for computational research. (U.S. Army photo by Doug Lafon)

Smith said those applications include creating microscopic lenses out of meta-materials that can zoom to the micron level, making it possible to spot germs, chemical agents and even DNA using basically a pair of binoculars. Similar lenses could focus even a tiny amount of ambient light and use it as a power source. This would be great for the battlefield; a Soldier could see a cloud coming and suspect chemical or biological warfare agent threats but with the new meta materials being developed, that Soldier will have the ability to see things smaller than the wavelength of light and can pick up on signs of pathogens and viruses with any visual device like night vision goggles or sensors.

"Metamaterials are artificial materials engineered to provide properties which may not be readily available in nature. These manufactured properties are versatile and can be tailored to fit almost any practical need, enabling them to go beyond the capabilities of natural materials, including control of the light at an unprecedented level," Smith said.

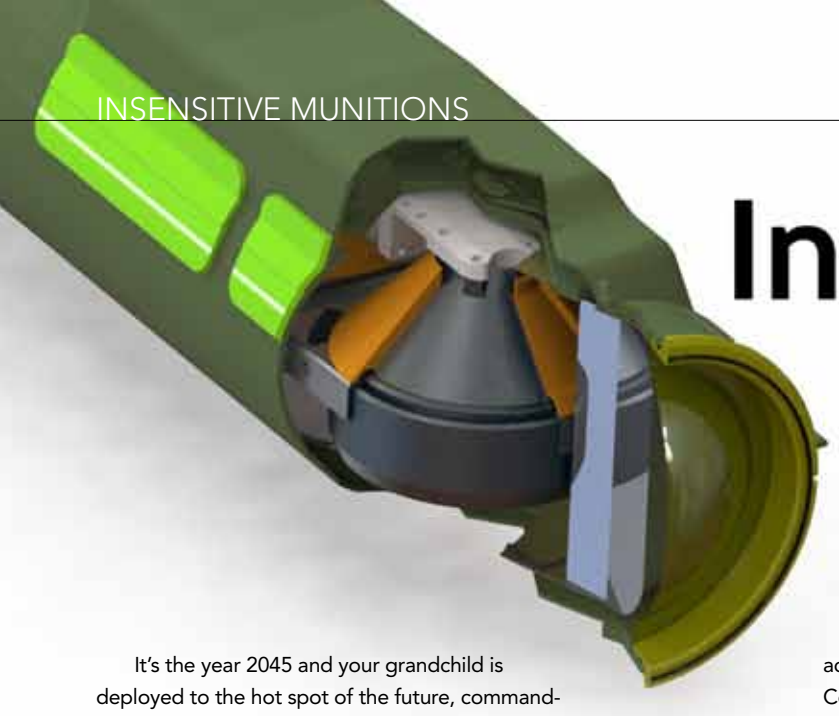
The primary research in metamaterials investigates materials with negative refractive index, or a ratio of the speed of light as it passes from one medium to another. Negative refractive index materials appear to permit the creation of superlenses, which resolve images having dimensions less than that of the wavelength of light used.

Army computational scientists play a part in this research as well. High-performing computers like those housed within the Defense Supercomputing Resource Center that ARL manages on APG, Md., get the Army closer to solving the hard-to-solve mysteries of our time.

The proof of principle was managed and funded by the Army Research Office, who oversees the initiative involving Purdue University, the University of Colorado, the University of California-Berkley, Princeton University and Norfolk State University.

"We are re-writing the books on optics, who knows what we will see in the future," Hammond said. ■

More on DESIGNING here: http://go.usa.gov/BDwm



Insensitive Munitions

Working to improve the safety of munitions

BY WILLIAM H. RUPPERT, IV, P.E., PROGRAM MANAGER, JOINT INSENSITIVE MUNITIONS TECHNOLOGY PROGRAM

It's the year 2045 and your grandchild is deployed to the hot spot of the future, commanding a ground unit combating the latest terrorist group. The vehicle he is riding in is suddenly struck by two rocket propelled grenades. The vehicle interior is breached and the ammunition inside sustains a direct hit, but none of them explode and the crew has only minor injuries. They quickly assume their respective defensive positions from inside the vehicle and return fire on the aggressors, decisively defeating them. Their training and their equipment have not failed them. They will live to fight another day.

This may sound too farfetched or even impossible, but ARL researchers who lead and support the Joint Insensitive Munitions Technology Program, or JIMTP, are developing safer munitions with the goal of ensuring the safety of future warfighters. The JIMTP is a unique partnership of government, industry and academia. The DoD has oversight, but it's managed by ARL, and laboratories within the Air Force and Navy provide technical management. The partnership is essential to ensure the maximum return on investment in a time of increasing fiscal constraint.

These partners are reinventing the way munitions work—making them almost impossible to 'go off' when the warfighter doesn't want them to—while at the same time improving the lethality, reliability, safety and survivability of munitions.

The ideas behind Insensitive Munitions, or IM, are not new; DoD has been working to improve the safety of munitions since their inception. After several incidents during peacetime and combat operations that destroyed entire depots of vehicles and munitions, and heavily damaged several aircraft carriers, military leaders approved research dedicated to developing less sensitive munitions. Ultimately, as a result, Congress passed the 'Insensitive Munitions Law' in 2001 that specifically requires "The Secretary of Defense [to] ensure, to the extent practicable, that insensitive munitions under development or procurement are safe throughout development and fielding when subject to unplanned stimuli."

These unplanned stimuli take the form of rapid or slow heating events, such as a fuel fire on a vehicle or aircraft, or an adjacent fire in a vehicle or storage magazine; impact by fragments or bullets due to shrapnel from nearby explosions or small arms fire from combat or terrorist events; sympathetic reaction due to the detonation of adjacent munitions; and shaped-charge jet attack from rocket-propelled grenade or similar weapons used by enemy and friendly forces.

However, it was not until 2007 that the department focused its efforts on developing joint solutions through a centrally-managed program. The JIMTP Program Office funds projects led by investigators across the Services, the Department of Energy laboratories, as well as industry and academia through the National Armaments Consortium. This partnership has been extremely fruitful in the pooling of knowledge from scientists and engineers who otherwise would never have worked together. As an example, the primary candidate explosive fill for the insensitive 500-pound general purpose bomb was developed under JIMTP leadership. The fill was developed at an Army laboratory, specifically ARDEC, tested at a Navy facility, the Naval Surface Warfare Center in China Lake, Calif., and supplied by industry, BAE-managed Holston Army Ammunition Plant in Tenn., with project management by Air Force personnel at Eglin AFB, Fla. JIMTP also led the effort to ensure smooth transition once the fill is proved out by assembling the acquisition personnel from the Army, Navy and Air Force as part of a Joint team to plan testing and transition in a synchronized fashion.

William H. Rupert

INSENSITIVE AIR-TO-GROUND MISSILE PROPELLANTS

The path to developing stockpiles of insensitive munitions is a long, slow, deliberate journey of incremental improvement, whereby one or two IM attributes are addressed in a new formulation or mechanism. One example of this work is being conducted at AMRDEC in Huntsville, Ala. Rob Esslinger leads the Tactical Minimum Smoke Phase I IM Demonstration project. Esslinger is aiming to develop and demonstrate rocket motors for air-to-ground missile systems that are less sensitive to fragment impact and slow cookoff threats. Throughout the last six years, Esslinger's team from AMRDEC, Redstone Arsenal Test Center, and the Naval Air Warfare Center at China Lake have joined with industry partners ATK and Aerojet-Rocketdyne and the Joint Attack Munition System Program Management offices to research various rocket motor configurations, seeking to improve the threat responses. Using several venting technologies and rocket motor formulations in composite and metal rocket motor cases, the team has successfully demonstrated that various formulations and venting configurations combined with composite motorcases enable the rocket motor designs to pass the initial fragment impact and slow cookoff tests.

This year, the team plans to conduct rocket motor test firings on articles that have undergone temperature and shock extremes to simulate the environments of the real world, such as transportation and handling, captive carriage loads, and thermal shock resulting from altitude fluctuations. If these tests are successful, they will prove that the performance

of IM rocket motors can match or exceed those of the currently fielded motors. These new, safer motors will be qualified for future air to ground missile system applications.

Although the work was initially focused on air-to-ground missiles, it has also gained the interest of the Close Combat Weapon Systems Project Office for application on the tube-launched, optically-tracked, wireless-guided, Javelin and Griffin missile systems. With CCWS support, JIMTP has provided additional funding to have the team conduct testing that will serve as risk reduction efforts for the transition of technologies to system development efforts and planned product improvements. The specific technologies of interest are a low-cost composite motor case, less shock-sensitive propellant, and cookoff venting devices. While it sounds simple to have two programs interested in similar technologies under development, each has their own unique challenges. The differences in motor diameter, propellant mass, and performance parameters, such as the presence of a launch motor in the ground launched systems and flight weight considerations for the air launched systems, resulted in significant propellant formulation tailoring and careful attention to the venting considerations in order to provide solutions to the two very different operating regimes.

The leveraging of funds and assets between the JAMS and CCWS Program Management offices and the JIMTP-led project has resulted in real financial savings for each organization. This key collaboration has enabled all parties with a vested interest in the technology development and demonstration efforts to have input into the final designs and products. Final full scale IM and static testing of the various motor configurations for AGMS, TOW, Hellfire and Javelin are scheduled to be completed by the end of fiscal 2014.

ROCKET AND MISSILE WARHEADS

JIMTP also works to improve the IM properties of the TOW 2B and Tomahawk Missiles in the project "Anti-Armor Warhead IM Technology Integrated Demonstration and Transition," led by Nausheen Al-Shehab, from ARDEC), at Picatinny Arsenal, N.J. Al-Sehab's effort focuses on improving the warhead response to impact, sympathetic reaction, and cook-off threats. The team is composed of scientists and engineers from ARDEC, Naval Air Warfare Center at China Lake, AMRDEC, Naval Postgraduate School, Program Manager Air-280, PM CCWS, and industry partners (General Dynamics-Ordnance and Tactical Systems, Dynetics and CGI Federal) that have worked to integrate, demonstrate, and eventually transition multiple IM technologies into new anti-armor warhead designs that increase operational survivability of the munition. For the TOW 2B warhead, the primary areas of focus are cook-off (both fast and slow) and impact (both bullet and fragment) through multiple shotlines; while sympathetic detonation and fragment impact are the primary and secondary focus areas for the Tomahawk warhead.

JIMTP is developing a TOW 2B warhead using proven venting technology and a particle impact mitigation sleeve to improve the IM response while still meeting the performance requirements. JIMTP has successfully demonstrated the TOW 2B warhead to pass the initial fragment impact tests at high and low velocities using a composite PIMS. JIMTP has also shown that venting technology successfully mitigates the fast cook-off threat.

Integrating these technologies is not simple. It requires significant design, analysis, and test and evaluation, to ensure an improvement in one IM aspect does not negatively impact the performance or reaction in another IM threat aspect.

Modeling and simulation was used extensively to evaluate the various PIMS designs, by determining the pressure reduction within the explosive as a result of using the PIMS designs, with lower pressures providing increased shock protection. This design tool has enabled the review and revision of the PIMS liner thickness and optimization prior to testing. Modeling was also used to determine the effect of the PIMS design on the location of the pre-ignition hot spots within the explosive formulation of the warhead during exposure to slow heating in order to address any concerns. This year, the team plans to conduct IM tests to reduce the overall weight impact of the PIMS for the lower velocity fragment impact test.

Modeling and simulation was also used to predict the result of the Tomahawk warhead responses to a sympathetic reaction threat. The modeling results lead to the selection of a new PIMS technology and insensitive main fill explosive to be pursued to reduce the response to a sympathetic detonation. The shaped-charge liner was also modified for the explosive fill and reactive liner. One-quarter scale warhead configurations integrating the new technology were built and tested, to compare the models predicted performance and reaction severity with the actual results. The scaled warheads performance validated the model, enabling the team to move to the final phase of the project—down selecting the best configuration and moving to full-scale asset production and testing. The production of full-scale assets has begun and testing is scheduled to be conducted in early fiscal 2014.

THE FUTURE

The DoD will continue to develop new munitions to meet increased performance requirements to respond to various threats and enable lethality overmatch in any scenario. Using today's available technology to obtain higher performance typically translates to a worse IM response. As a result, the JIMTP has its work cut out to try to both improve performance and IM. Novel, high-risk approaches will have to be investigated. This may include 'tunable' munition response through materials that become propulsive or explosive by stimulating them with lasers, microwaves, electricity, or magnets, or it might include out-of-the-box concepts for initiating explosives or significant overall munition design changes. To optimize our limited financial resources and increase our chances of success, we must develop solutions utilizing a joint approach, tapping into the knowledge and skills of the scientists and engineers in all services, DOE, industry and academia.

Less sensitive munitions have been in development for many years, with each technology breakthrough increasing our ability to keep Soldiers, Sailors, Airmen and Marines safer. The incremental improvements we are making today as evidenced by the on-going work at the major Army, Navy, Air Force, DOE and industry facilities for various weapon systems will improve the safety of future weapons as well. The JIMTP is committed to developing and transitioning these incremental improvements so our future warfighters, our children, grandchildren, and beyond, operate in an environment where their own munitions are not their worst enemy. ■

Editor's note: Rob Esslinger of AMRDEC, Nausheen of Al-Shehab of ARDEC and Jeff Brock of ARL contributed to this article.

More on MUNITIONS here: http://go.usa.gov/BDwJ

PROPULSION COLLABORATION

AMRDEC and NASA work together of propulsion research

BY HEATHER R. SMITH, AMRDEC PUBLIC AFFAIRS

Collaboration between AMRDEC and NASA is almost a no-brainer. NASA's Marshall Space Flight Center is just two miles from the Army's aviation and missile research facilities.

Dr. Jaime Neidert, AMRDEC chief scientist for energetics said the organizations share much more than just proximity.

Several years ago, Neidert recalled a briefing about the kind of propulsion research going on at the NASA center.

"We realized that we in the DoD and in propulsion have a lot of common interests with NASA, although our payloads are different," Neidert said. "When it comes to propulsion, both energetic components—the oxidizer—as well as the inert components, such as fuels, adhesives and insulators, have a lot of commonalities."

Both the Army and NASA benefit from shared knowledge and facilities. As the space shuttle program ended in 2011, Neidert said the Army and DoD became the largest users for ammonium perchlorate, the solid oxidizer that is the key ingredient in most solid rocket motors, simply because NASA was using less. NASA's use of the chemical had dwarfed the DoD's use during the shuttle program. The Army now uses more, but still at a much lower rate than in past years.

The has led to price increases and concerns about a stable supply of this critical material. There was also increased risk that production of the material could end because of lack of demand. Ammonium perchlorate is produced by only one U.S. supplier.

It was critical that NASA and DoD work together on this, Neidert said.

In 2011, the organizations formed the National Institute for Rocket Propulsion Systems, or NIRPS, with Marshall Associate Director Dale Thomas at the helm and Neidert representing the Army and AMRDEC.

NIPRS is the nation's integration point for matters pertaining to rocket propulsion systems. Its mission is to help preserve and align government and private rocket propulsion capabilities to meet present and future U.S. commercial, civil and defense space needs, while providing authoritative insight and recommendations to American leadership.

"MSFC is looking to increased collaboration as a strategy to help us do more with less," Thomas said. "We don't want to compromise our mission."

Thomas said in today's challenging fiscal environment, government agencies are faced with the choice of doing less or find ways to do more with less.

"Toward that end, we established the NIRPS as a collaboration vehicle for propulsion, which is vital to almost everything NASA does," he said. "One of the first organizations that we approached to join us in the NIRPS was AMRDEC, and to our delight, they engaged from day one."

Neidert said the dialogue among Marshall, NASA's Space Launch System, AMRDEC and PEO Missiles and Space was much needed. By working with NASA, he said the Army has increased its capability to produce larger amounts of solid rocket propellant and has also helped to train the next generation of chemists and chemical engineers.

"We're beginning the fiscal year to put some of out young engineers into the rapid prototyping facility and the additive manufacturing area of NASA," Neidert said. "We're going to put engineers in those positions for six months to train and collaborate."

Neidert said the collaboration will continue because, "It's absolutely necessary and vital for national defense, but as well as for the mission at NASA."

For his leadership in the joint effort, Neidert received a 2013 Director's Commandation Certificate from the Marshall Center.

"Dr. Neidert brought energy, engagement and professionalism to the effort from day one," Thomas said. "We know collaboration is hard. Invariably it's easier to do something either by yourself or within your own house, your own company, or within your own agency. To reach out or go outside your team or your boundaries takes calories." ■

Innovation from the Inside Out

U.S. Army photo by Tom Faulkner — but, if possible the cutline for that photo is ECBC chemists Jennifer Exelby and Chris Druyor work in the Chemical Transfer Facility, which was designated as the United States' only single small-scale facility under the Chemical Weapons Convention.n (U.S. Army photo by Tom Faulkner)

Critical missions inspire teamwork, collaboration

BY ECBC COMMUNICATIONS

For nearly 100 years, ECBC has served the warfighter with latest protection, detection and decontamination technology and equipment. The evolution of the center, from developing the nation's first protective mask to producing the technology set to destroy Syria's chemical weapons stockpile in the coming months, has enabled ECBC to become the premier resource for research, engineering and operations solutions.

In December 2013, ECBC put the future first by investing in applied science proposals through its 219 Innovative Project Program. The program provides a platform for ideas that generates increased business from external customers and create a transition to the warfighter. In fiscal year 2013, the ECBC workforce submitted 34 proposals, nine of which were funded for the first Innovative Project Program.

"I am so proud that we are able to provide the means to host this type of program," said Dr. Joseph Corriveau, ECBC Research and Technology Directorate director. "It's a unique opportunity for our researchers and engineers to collaborate across the center and combine their creativity, skills and ECBC facilities to address a chemical and biological defense gap. There has not been a similar program at the center before."

The opportunity is made possible through Section 219 funding, which provides mechanism for DoD laboratories to invest in infrastructure, training or research and development. Section 219 funding originated from the National Defense Authorization Act of 2009, enabling military and government research laboratories to generate revenue as an indirect fee to help finance the overall cost of a given project.

Many teams that participated in the program began their work in early 2013, and several of them have generated interests from industry and partners, resulting in continued research for their projects.

"The 219 program allowed us to utilize unique center-wide assets in an innovative way that otherwise would not have been explored. Reaching across the center to tap into the many distinct and diverse capabilities was a win for us," said Deborah Menking, Fiscal 2013 Rapid-Detect-Identify Decontamination Kit team leader.

The project was designed for the decontamination of suspected areas where spore-forming bacteria may be present inside a military or commercial aircraft. The kit contains hand-held detector assays, personnel protective gear and decontamination materials. ECBC used its resources to test the effectiveness of the kit, including test beds and biological decontamination methodologies, C-130 cargo aircraft and barcoded spore technology. Conceptual model design and animation was also used for the kit prototype, which offers a developing solution for the hazard mitigation arena.

"It was exciting to experience the vitality and creativity generated as talented scientists and engineers came to the table energized by a common goal. We brainstormed and fed off each others ideas to make a better product in the end," she said.

This kind of internal teamwork across ECBC directorates pays dividends on the latest projects seeking funding from outside organizations. Many of the technologies developed result in partnerships with industry, academia or other government agencies.

ECBC received the George Linsteadt Technology Transfer Achievement Award Dec. 3, 2013, for demonstrating significant accomplishments to the DoD Technology Transfer Program.

"It is a tremendous honor to be recognized by the Department of Defense for our efforts in technology transfer, said ECBC Director Joseph D. Wienand. "During a time of declining federal budgets, technology transfer is more important than ever, allowing ECBC to capitalize on our vast research and development infrastructure to establish mutually beneficial partnerships that stimulate the economy and further our mission in chemical and biological defense."

ECBC has accomplished this by consistently leveraging the speed and agility of industry to

transition Army-developed technology directly to the warfighter and first responders. The 2013 George Linsteadt Award recognizes ECBC's outstanding contributions made to the T2 process, which resulted in mutually beneficial partnerships with federal and state agencies, private industry and academia. A record-breaking 105 agreements were executed in fiscal 2012, of which 65 were new cooperative research and development agreements and technology support agreements.

The Field Deployable Hydrolysis System, known as FDHS, is one of the latest innovative technologies to benefit from ECBC's technology transfer program. The weapons of mass destruction-elimination technology designed to neutralize bulk amounts of chemical warfare agents and their precursors at a 99.9 percent destruction efficiency rate was transferred to the Joint Program Executive Office for Chemical and Biological Defense June 27, 2013. This agreement signified transition for advanced development and future integration into the Chemical Biological Defense Program Portfolio. In the six months prior to the transition, ECBC worked closely with the Joint Project Manager for Elimination, formerly known as the Chemical Materials Activity, which greatly enhanced the in-house capabilities required to produce an operational model of the new transportable elimination technology. This collaborative effort across multiple government organizations has enabled the DoD to outfit the FDHS with proven hydrolysis processed that has been used for decades in U.S. chemical demilitarization operations. As a result, the DoD addressed a transportable CW capability gap while also capitalizing on an opportunity to prepare for emerging threats around the world.

"The process was a rare opportunity for CBARR to work collaboratively with a large number of organizations within and outside of ECBC. Once lesson learned from this project is that ECBC can greatly enhance its capabilities by working collaboratively with other organizations that have complementary skill sets," Baker said.

There are currently two FDHS units installed on the MV Cape Ray, which is set to depart for international waters to support a joint mission between the Organisation for the Prohibition of Chemical Weapons and United Nations in destroying Syria's chemical weapons stockpile. ECBC and JPEO-CBD personnel will be conducting the technical operations during several months of deployment.

ECBC has also partnered with JPM-E to develop a new personnel decontamination training course for technicians who participate in chemical demilitarization operations such as the FDHS mission and are required to wear Level C personnel protective equipment.

ECBC biologist Crystal Harris works in the Environmental Monitoring Lab, a full-service laboratory for processing a high volume of samples, including soil, liquid, air, wipes, biological tissues and food for chemical or biological warfare material. (U.S. Army photo by Conrad Johnson)

"The training program is very comprehensive and uses the standard operating procedures from ECBC and the 20th Support Command's subordinate element, the CBRNE (Chemical, Biological, Radiological, Nuclear and Explosives) Analytical and Remediation Activity," said Chris Wilson, an industrial equipment mechanic for ECBC's Chemical Biological Application and Risk Reduction Business Unit.

"Wearing gear like the mask and equipment is something that you get used to over time. There are many people who have trouble getting acclimated to the weight of the suit," he said. "The new training program is great, especially for newcomers because the hands-on exercises require you to don the full PPE gear. It gives you the actual feeling of being in the suit and mask as you simulate the entire 45-minute decon process."

In 2012, JPM-E identified a number of courses that chemical workers are required to take on an annually retain their qualifications. According to the Occupational Safety and Health Administration standards, operators must learn new techniques and methodologies for reacting to hazards. The training course got a recent upgrade after a partnership with JPM-E turned the annual required training into a robust three-day program of classroom instruction, hands-on exercises and scenario-based simulations.

ECBC's CBARR Business Unit supports numerous government agencies and field operations, including the upcoming FDHS mission, demolition of former chemical and biological process facilities, the remediation of formerly used defense sites, non-proliferation activities and environmental investigations. These missions have an element of risk and danger associated with them, making safety not only the number on priority for all personnel, but a necessary component that ensures the project mission is successful.

In addition to training and chemical disposal operations, ECBC provides expertise in mission-critical food inspection efforts. A team of ECBC researchers recently received the U.S. Department of Agriculture Secretary's Honor Award at the 65th Annual Secretary Honor Awards Ceremony in December 2013. The team was recognized for partnering with the USDA to conduct critical chemical threat agent research to ensure the nation's food supply remains safe and reliable for consumption.

Led by principal investigators Dr. Sue Bae and Dr. Mark Winemiller of the Agent Chemistry Branch, the ECBC team made significant contributions to meeting a USDA goal to protect public health and ensure food safety, a goal set by the USDA to identify and ensure it can respond to new and emerging sources of food contamination. Through a partnership with ECBC, whose expertise and infrastructure provided the USDA with capabilities and state-of-the-art facilities, the team gained valuable insight regarding the concentrations of chemical threat agents that have the potential to result in adverse health effects. The research contributed to the USDA's ability to determine what food source is safe and to make sure the supply chain is available to feed Americans and nations around the world. Through its memorandum of agreement with the USDA, ECBC will continue to provide support in the event of an international food contamination crisis involving chemical threat agents.

Sixty Years of Partnering

Natick harnesses the benefits of partnerships and collaboration

BY NSRDEC PUBLIC AFFAIRS

NSRDEC has a long history of partnership and collaboration. Since the Natick Soldier Systems Center opened in 1954, scientists and researchers have worked with a partners from prestigious colleges and universities, industry and other Army and Department of Defense organizations.

More than 700 NSRDEC scientists, engineers, researchers and equipment designers work with their counterparts to provide a wide range of capabilities. There are nearly 90 people who are matrixed from NSRDEC to critical partner organizations. The agreements result in personnel assigned to NSRDEC, but who work for other organizations such as PEO Soldier and PM Force Sustainment Systems.

"Partnering is the cornerstone of acquisition. As we apply science and technology to change the art of the possible, partnerships enable us to turn the possible into the real....real military and defense capability," said Dr. Jack Obusek, NSRDEC technical director. "No single organization can do that alone."

Among the many partnerships, several stand out as being critical to NSRDEC's successful mission accomplishment.

NSRDEC's close collaboration with PEO Soldier results in a force multiplier for the Army. There are nearly 40 NSRDEC employees matrixed to PEO Soldier working in areas from Soldier protection to load carriage.

"It is a team effort. We remain absolutely committed to, and dependent on, both our organic research and development facilities and our industry partners," said Brig. Gen. Paul A. Ostrowski, PEO Soldier. "Together we push the limits of technology to provide dominate force protection to Soldiers."

The collaborative efforts result in innovative Soldier protection concepts like female body armor—body armor specifically designed for females and smaller Soldiers. The project's goal was to create a sizing system and body armor design offering improved fit, comfort and performance of the body armor system (vest, front/back plates and side plates). Hailed as one of Time Magazine's Best Inventions of the Year in 2012, the innovation is being used in Afghanistan and has proven to be popular with female Soldiers.

Another recent innovation is the Individual First Aid Kit. The IFAK improved previous first aid kits by enabling the Soldier to carry double the amount of supplies while improving access.

NSRDEC also works closely with PM Force Sustainment Systems with aerial delivery capabilities and improved quality of life while deployed. To demonstrate the commitment to improving personnel and cargo parachute systems, better field feeding, and making living conditions better for Soldiers in the field, there are 50 people matrixed to PM FSS from NSRDEC.

An important capability being used in Afghanistan developed through the NSRDEC/PM-FSS partnership is the Joint Precision Air Drop System, a self-guided parafoil system primarily for Container Delivery Systems payloads. Using GPS, the cargo parachute can fly to a pre-determined location on the ground with an accuracy of 150 meters or less. This system increases the capacity for delivering critical resupply to remote areas of the battlefield while keeping aircraft and air crews safe while reducing the dependence on ground convoys that expose Soldiers and vehicles to enemy threats.

The JPADS 2K (700 to 2,200 pounds) is certified on C-130 and C-17 aircraft and recently fielded improvements to enhance accuracy with terrain avoidance software, a one-time use parafoil and modular Airborne Guidance Unit in response to urgent requests from commanders in Afghanistan.

For airborne operations, Soldiers now have the ability to use a special navigation system during descent with the Parachutists Navigation System. The PARANAVSYS is a Soldier-wearable (chest, wrist or otherwise mounted to the parachutist) multipurpose navigation system designed for military free fall operations. It will allow for enhanced mission planning and improved parachutist infiltration capabilities and use for follow-on ground missions. The system provides jumpers with real-time situational awareness on their current location, ground speed, wind speed and direction, and other essential information for successfully navigating to pre-planned impact points.

The NSRDEC and PM FSS partnership also includes academia. In conjunction with the University of Massachusetts-Lowell, NSRDEC scientists and PM FSS, along with university students and professors, are conducting research related to fabric porosity under dynamic pressure changes. This research focuses on existing and future parachute canopy materials and how they react in flight.

Other critical partnerships with PM FSS exist in contingency basing by providing improved living conditions and increased force protection.

NSRDEC and PM FSS, including 20 matrixed personnel, are teaming for testing and testing support at the Base Camp Integration Lab. The BCIL consists of two 150-man Force Provider expeditionary camps located side by side in the same perimeter. Using advanced wireless monitoring devices, data from the baseline camp and experimental camp is collected, compared and analyzed. The BCIL focuses on reducing power, water, electricity and fuel consumption through innovations in flexible photovoltaic panels,

other alternative energy systems, water reclamation systems, microgrid electric power distribution and advanced insulation systems.

To provide increased force protection for expeditionary basing, NSRDEC and PM FSS partnered to develop the Modular Ballistic Protection System. Working with the University of Maine, the partnership created the MBPS, a quickly erectable, redeployable and lightweight ballistic protection system. MBPS provides ballistic protection for Soldiers and equipment in expeditionary basecamps where mobility and rapid deployment requirements prevent the immediate use of heavyweight systems like sandbags and concrete barriers. MBPS provides force protection in the shelters where they work, sleep, eat and live, as well as MBPS stand-alone systems for use with any shelter or equipment needing protection. All MBPS designs provide ballistic protection capability and can survive blast overpressure associated with these threats.

The partnership also involves feeding, food safety and preservation efforts. Applying technology developed by industry, the collaboration applied ultraviolet lighting systems to provide a fully automated, low-cost shelf life extension to maximizes freshness and quality of fresh fruits and vegetables. The technology is also being evaluated for application to Navy refrigerated storerooms and the Army's Multi-Temperature Refrigerated Container System.

Other collaborative efforts in field feeding, also taking place at the BCIL, involve NSRDEC and PM FSS testing a 150-troop configurable kitchen installed alongside an equivalent all-electric kitchen. The kitchen serves as the initial platform to demonstrate new capabilities made possible by modular appliance technologies projects to determine energy savings of fuel-fired appliances relative to the all-electric kitchen.

NSRDEC has important partnerships with Massachusetts' state university system. NSRDEC's recent agreement with the University of Massachusetts-Lowell is a collaborative research partnership and exemplifies the promotion of innovation. Together both organizations recently announced the program, known as Harnessing Emerging Research Opportunities to Empower Soldiers, at UM-Lowell campus, which enables NSRDEC researchers to work closely with professors and students. This partnership combines the capabilities of both UM-Lowell and NSRDEC's unique facilities, intellectual capacity and knowledge base to expedite research and development efforts and allows for innovation and emerging technologies for transition.

HEROES is a collaborative research and development opportunity with NSRDEC scientists and engineers sharing more than 5,000 square feet of laboratory, office and conference space on site at UM-Lowell along with students and faculty.

"We will bring together some of the best minds from both organizations to brainstorm new solutions to challenges our men and women in face," said Marty Meehan, UM-Lowell chancellor. "We are going to be able to, in this collaboration, help our troops and clearly save lives."

Not yet a year old, HEROES has over a dozen broad-based areas of collaboration between NSRDEC researchers and UM-Lowell faculty and students. These areas include efforts in flame and thermal protection, chemical/biological warfare protection and detection, ballistic protection, and antimicrobial protective materials. Other research is being conducted in the areas of airdrop, nutrition, power generating nanocomposites, wearable thermoelectrics and combat ration safety and novel polymer packaging technology.

New Life for Old Shells

The saying goes, "no guts, no glory," but the Army has found glory of sorts in a gutted ammunition stockpile that would have been sold as scrap metal.

Instead of scrapping the gutted shells of 77,000 155 mm M483A1 Dual-Purpose Improved Conventional Munitions shells, the Army will pack them with payloads consisting of parachutes and candle assemblies that will illuminate nighttime operations for troops in training and combat.

Until recently, the payloads were being manufactured and shipped from Crane Army Ammunition Activity, Ind., to Pine Bluff Arsenal, Ark., where they were being packed into new shell bodies to make M485A2 Visible Light and M1066 Infrared Illumination rounds.

More on NEW LIFE here: http://go.usa.gov/BBfGw

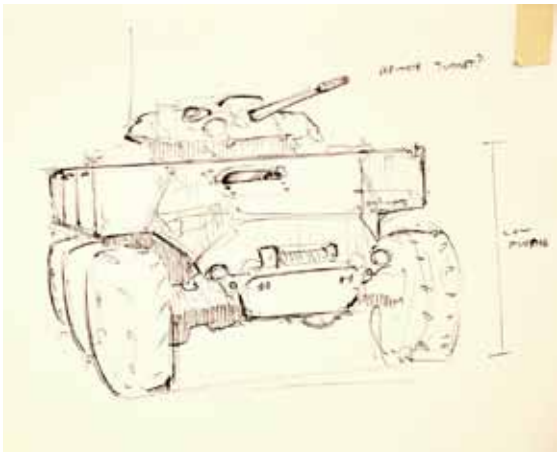
Soldier Innovation Workshops

A Soldier's perspective and a designer's creative touch are proving to be vital tools when developing ground vehicle concepts.

TARDEC has hosted three Soldier Innovation Workshops over the past year to bring together Soldiers, students and engineers to create concepts for new military technologies.

The most recent workshop pulled together Soldiers primarily from the Army's 82nd Airborne Division, along with transportation design students from the College for Creative Studies in Detroit, and engineers from TARDEC and other labs and research centers. Working together, the CCS industrial design students drew more than 180 ideations that will inform the concept and requirements of an Early Entry Combat Vehicle capability for the Army.

More on WORKSHOPS here: http://go.usa.gov/BB6W



Unified Lab for Tactical Radios

The Army formed the new Unified Lab for Tactical Radios-Army, known as ULTRA, to combine research, development, sustainment and acquisition efforts for the Army's radio portfolio in a single location.

The new facility combines CECOM, PEO C3T and CERDEC personnel and resources to provide economies of scale and better coordination of radio technologies throughout their lifecycle, officials said.

A Jan. 7 ribbon-cutting ceremony for the ULTRA facility, which is located on the C4ISR campus at APG, Md., inaugurated an effort to support the full lifecycle of Army radios.

More on ULTRA here: http://go.usa.gov/BBJw

Partnerships for Synergy

Over the past 10 years, RDECOM has been striving to strengthen partnerships and collaborations to develop cutting edge technology for Soldiers.

One example is the technology enabled capability demonstration effort, known as TECDs. Through the synergy of partnerships and cooperation, TECDs deliver many key technologies to fill official capability gaps identified by TRADOC.

TECDs partner several independent efforts across and beyond RDECOM with larger Army goals and capability gaps. TECDs demonstrate several next-generation capability improvements.

More on TECDs here: http://go.usa.gov/BBJQ

MAPS Research

TARDEC officially kicked off a joint mission Dec. 3-4, 2013 to develop a Modular Active Protection System, known as MAPS, by welcoming technology leaders from across the Army.

Officials from AMC, RDECOM, the Maneuver Center of Excellence at Fort Benning, Ga., and ground vehicle PEOs formed a joint team to deliver a common framework to enable affordable, reduced-weight, protective systems for ground vehicles.

More on MAPS here: http://go.usa.gov/BBMw

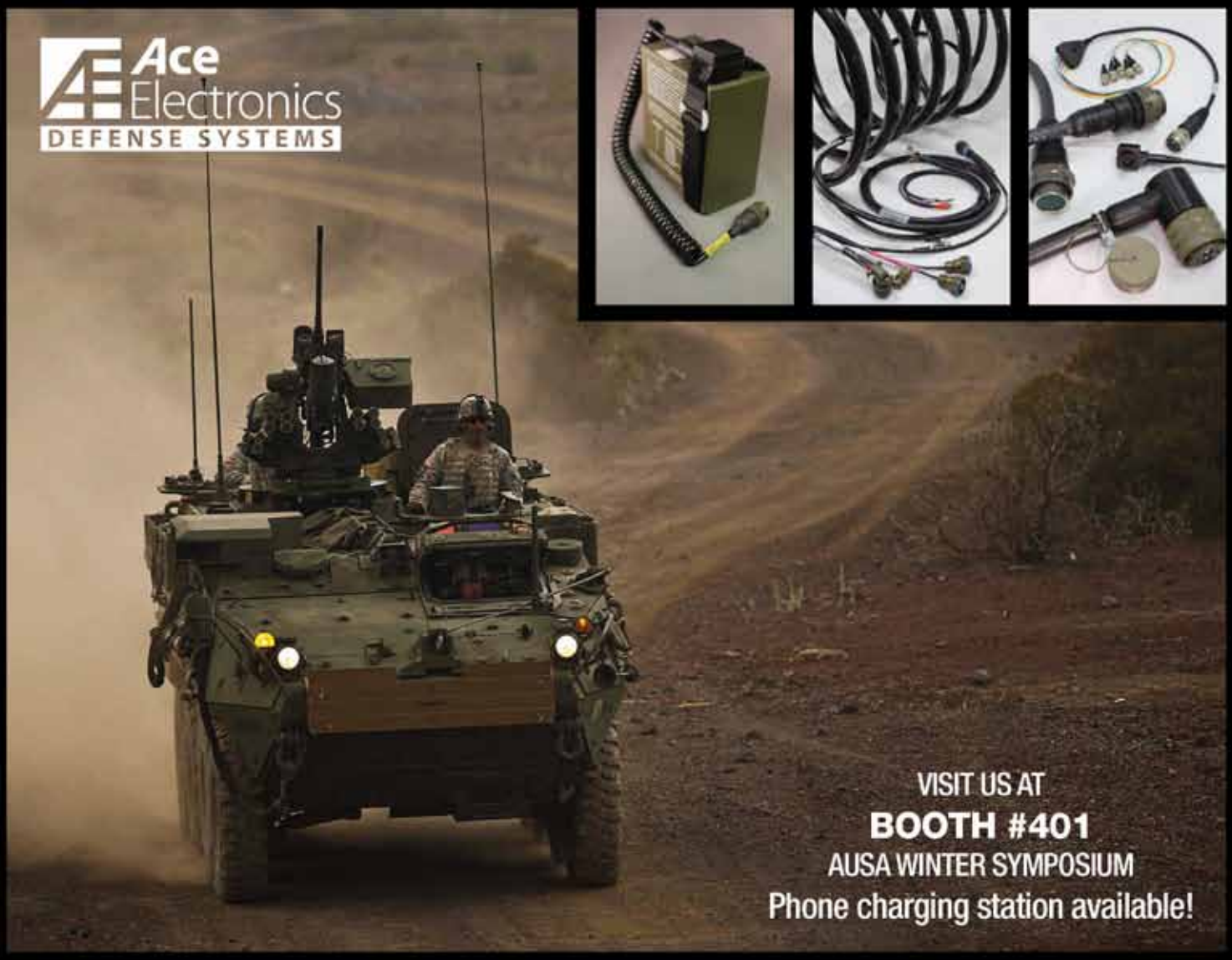
STEM Superstars

During its second full academic year, the STEM Superstar program continues to bring science, technology, engineering and mathematics to elementary students around Aberdeen Proving Ground, Md.

CERDEC created the STEM Superstar program to engage Harford and Cecil County students from first through fifth grade in stimulating activities challenging students to think creatively and solve problems like an engineer.

"Building, imagining, discovering – these are all things kids do naturally when they play," said Erica Bertoli, CERDEC Educational Outreach team lead. "No one ever puts the word engineering next to it, but that's what they're doing. We hope that STEM Superstar shows students that engineering is truly a creative science."

More on STEM here: http://go.usa.gov/BBJB



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STRENGTH OF THE NATION

RONALD MEYERS

ARMY RESEARCH LABORATORY

The U.S. Patent Office granted Army Research Laboratory scientists Ronald Meyers and Keith Deacon a patent November 26, 2013, for their invention "System and Method for Image Enhancement and Improvement."

The new quantum imaging system and method demonstrates clear long-distance imaging through strong turbulent and low light conditions. The invention uses the quantum properties of light to help cancel turbulence and imaging noise. It is expected to be the basis for new types of Army systems for improved imaging in adverse battlefield conditions. This patent is the 19th for Meyers in the areas of quantum technology and physics.

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