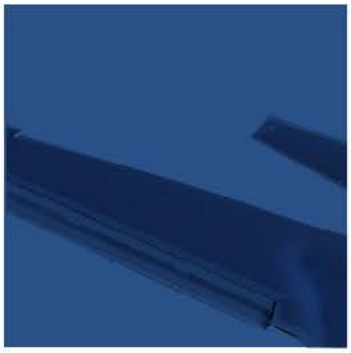
2017 SUCCESS STORIES

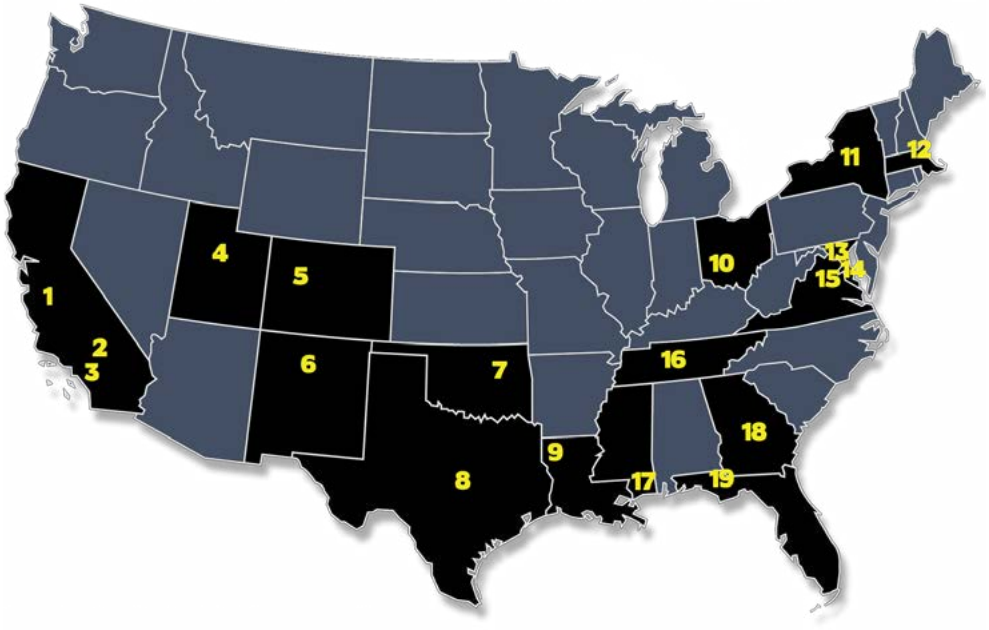


UNITED STATES AIR FORCE

TECHNOLOGY TRANSFER PROGRAM

LINKING TECHNOLOGY WITH THE MISSION AND MARKETPLACE

LOCATIONS WITH CURRENT
TECHNOLOGY TRANSFER AGREEMENTS



CALIFORNIA
1. TRAVIS AFB
   - 60th Medical Group
     David Grant Medical Center
2. EDWARDS AFB
   - Air Force Flight Test Center
3. LOS ANGELES AFB
   - Space & Missile Systems Center

UTAH
4. HILL AFB
   - Ogden - Air Logistics Center

COLORADO
5. U.S. AIR FORCE ACADEMY

NEW MEXICO
6. KIRTLAND AFB
   - Directed Energy
   - Space Vehicles

OKLAHOMA
7. TINKER AFB
   - Oklahoma City - Air Logistics Center

TEXAS
8. LACKLAND AFB
   - 688th Information Wing
   - 59th Medical Wing
     Wilford Hall Medical Center
   - Civil Engineering Center

LOUISIANA
9. BARKSDALE AFB
   - Air Force Global Strike Command

OHIO
10. WRIGHT-PATTERSON AFB
   - Aerospace Systems
   - Air Force Institute of Technology
   - ISR & Special Operations Forces
   - Materials & Manufacturing
   - Program Development & Integration
   - Research Collaboration & Computer Support
   - Sensors
   - Wright-Patterson Medical Center
   - 711th Human Performance Wing

NEW YORK
11. ROME LAB
   - Information

MASSACHUSETTS
12. HANSCOM AFB
   - Battlefield Management
   - Command, Control, Communications & Intelligence (C3I) & Networks

MARYLAND
13. ANDREWS AFB
   - Linthicum, MD - DoD Cyber Crime Center
   - Fort Detrick - Air Force Medical Evaluation Support Activity

VIRGINIA
14. ANDREWS AFB
   - Air Force Surgeon General
15. AFOSR - Arlington

TENNESSEE
16. ARNOLD AFB
   - Arnold Engineering & Development Center

MISSISSIPPI
17. KEESLER AFB
   - 81st Medical Group
     Keesler Medical Center

GEORGIA
18. ROBINS AFB
   - Warner Robins - Air Logistics Center

FLORIDA
19. EGLIN AFB
   - Munitions
   - Hurlbert Field - AFSOC (720th STG)

UNITED STATES AIR FORCE
TECHNOLOGY TRANSFER PROGRAM

Keith Quinn
U.S. Air Force Technology Transfer
Program Manager

What an exciting year for technology transfer. While cooperative research and development agreements and educational partnership agreements remain our primary method of collaboration, T2 delved into new ventures, exciting opportunities, and expanding markets.

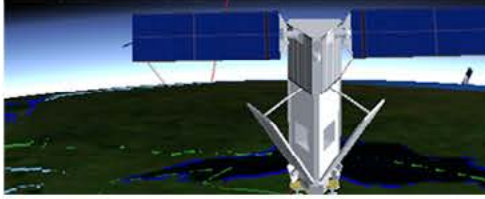
In FY17, seven new labs received T2 delegations and immediately began creating agreements. The Air Force now has 36 laboratories/technical activities with T2 delegated authority. Licensing and commercialization continue to be a major focus area for the Secretary of the Air Force. As a result, successful Invention Discovery Events led to a large increase in invention disclosures and patent applications across its Air Force enterprise.

New partnerships are also being created to expand outreach to non-traditional partners and small businesses. In Dayton, Ohio, the Wright Brothers Institute expanded into a new downtown facility to better support and encourage partnering. At MacDill Air Force Base, Florida, Doolittle Institute created a technology incubator called SofWerX. They are shattering preconceived notions by rapidly developing solutions for United States Special Operations Command warfighter problems. Also, the U.S. Air Force Academy partnered with the Center for Technology, Research and Commercialization to create CyberWorx which will focus on developing solutions to cyber problems.

The achievements and successes shown in this book reflect the leading edge of everything that was accomplished this year. For more information, stop by your Office of Research and Technology Application (see page 32).

AIR FORCE T2 PROGRAM OFFICE
1864 4TH STREET | BUILDING 15, ROOM 225 | WRIGHT-PATTERSON AFB, OH 45433
937-904-9830 | AF.TECHTRANSFER@US.AF.MIL

CONTENTS



CRADAs ...

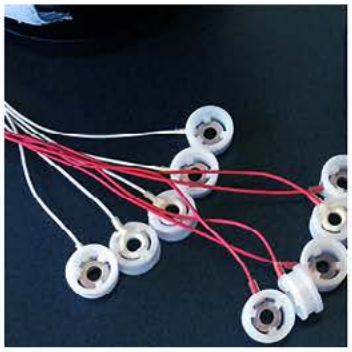
EPAs ...

EPAs (continued)...

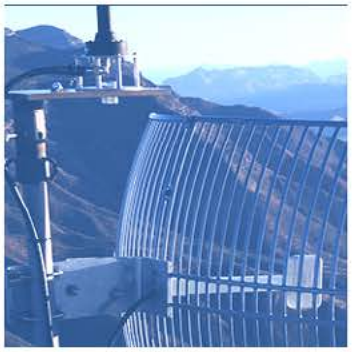
PLAs ...

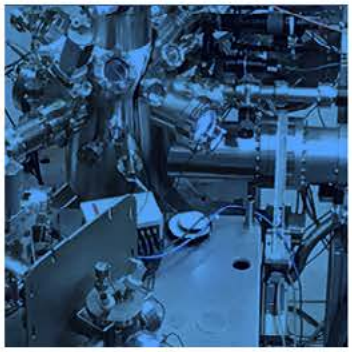
ITAs ...

CRADA SUCCESS STORIES



A Cooperative Research and Development Agreement (CRADA) provides quick, unique access to extensive government-funded research and development resources that can be leveraged to yield powerful research results, while providing intellectual property protection as companies move swiftly toward commercialization.





UNITED STATES AIR FORCE

TECHNOLOGY TRANSFER PROGRAM

AIR FORCE SUPPORTS IMPROVED METHOD FOR TRANSPORTING TRAUMATIC BRAIN INJURY PATIENTS

Cornerstone Research Group
Dayton, OH

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – Scientists with the U.S. Air Force School of Aerospace Medicine (USAFSAM) are playing an important part in the testing and evaluation of a novel aeromedical evacuation stretcher designed to safely transport traumatic brain and spinal injury patients in air and ground vehicles.

Ohio-based Cornerstone Research Group (CRG) developed the stretcher, which has applications across multiple services within the Department of Defense.

"Having adequate spinal immobilization is very critical when transporting patients with these types of injuries. Our wounded warfighters experience a much rougher ride back to definitive care than we experience stateside," explained Dr. David Burch, a biomedical engineer from the 711th Human Performance Wing, School of Aerospace Medicine, Aeromedical Research Department. "Military medical transport relies on vehicles of opportunity, which were never designed to provide a smooth ride. There is a lot of vibration and perturbation from turbulence or terrain gets transmitted to the patient, making adequate fixation necessary to prevent further neurologic damage."

Cornerstone Research Group and USAFSAM entered into a cooperative research and development agreement in Fiscal Year 2013 for the testing and evaluation of the new device. Under this agreement, USAFSAM provides experts who have an in-depth understanding of medivac needs and access to C-130 and C-17 High-Bays for ongoing device compatibility testing and evaluation.

"We would not be where we are now without this CRADA," said Kristin Cable, Team Leader with CRG. "Our goal is to exceed safety requirements for use and safety. Feedback from users and access to the military vehicles for testing has been hugely beneficial."

CRG began the design of the device under a Phase I Small Business Innovation Research agreement with the U.S. Army. Since military medical evacuation concerns are truly multi-service concerns, there is value in providing a stretcher design that not only meets Army requirements, but also meets the specifications for use on Air Force aeromedical evacuation platforms. Such a design could result in a common stretcher platform between the services, thus eliminating the need to transfer a patient from an Army stretcher (designed for ground transport) to an Air Force stretcher (designed for interface with airborne medical systems) in the field.

The new device, compatible with both ground and air vehicles, also improves several aspects of the stretcher currently being used. First, the new device is rigid, unlike the standard NATO litters currently used, which can bend more than six inches in certain conditions. Second, a specialized mattress pad was added to eliminate bed sores which can cause ongoing problems for the patient. The new device also includes a foot replacement that can absorb shock and vibration while in transit. One of the most important things about the new design is that it meets NATO design standards for loading, altitude and vibration.

Cornerstone Research Group's aeromedical evacuation stretcher is shown during a compatibility test on a KC-135. (Photo courtesy of Cornerstone Research Group)

As part of the Air Force Research Laboratory 711th Human Performance Wing, USAFSAM is able to provide unique evaluation and test facilities as well as personnel feedback to enhance the design and air vehicle compatibility. The research done under the CRADA is coordinated with the U.S. Army Aeromedical Research Laboratory (USAARL), as part of an overall program run by the U.S. Army.

In addition to the hi-bays, USAFSAM provided access to other military vehicles for compatibility testing, including military ambulances and an AMBUS (ambulance bus). CRG researchers were also able to work with Air Force Centers for the Sustainment of Trauma and Readiness Skills (CSTARS) under the agreement.

ADVANCED NAVIGATION SYSTEM DEVELOPED THROUGH AIR FORCE AGREEMENT

Locata Corporation
Canberra, Australia

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – Under a Cooperative Research and Development Agreement, the Air Force Institute of Technology and the Locata Corporation delivered a highly accurate navigation system that performs in wide-area GPS jamming environments caused by electronic warfare.

The 746th Test Squadron at Holloman AFB, New Mexico, required a highly accurate navigation system for testing methods developed for overcoming GPS jamming, or electronic warfare. This system is tested on equipment, such as aircraft or land-based vehicles that are used in locations where electronic warfare prevents the warfighter from using GPS in battle. The Locata Corporation, headquartered in Canberra, Australia, developed a commercially-available network system that provided highly accurate, terrestrial position, navigation and time, or PNT solutions in environments with or without GPS.

However, the Air Force requirement covered a larger geographic area than the Locata technology was originally designed to support and required additional updates. Since AFIT had experience with modeling errors and atmospheric delays on larger networks, they were chosen by the 746th Test Squadron to partner with the Locata Corporation through a CRADA. This collaboration allowed AFIT to provide research and government expertise for updating Locata's system to meet the requirements developed by the 746th Test Squadron.

The updates included new antennas for aviation use, amplifying the Locata transmitter signals for longer ranges and determining the additional dynamics associated with aircraft, such as speed, maneuverability and tropospheric variation adjustments. The updated Locata system was tested on military GPS equipment which can also utilize M-Code signals, or military signals that assist with encryption by providing a more secure signal than previous technology. Tests of the updated navigation system were conducted at White Sands Missile Range, New Mexico, by the 746th Test Squadron.

"The AFIT updates to the Locata system provide accuracy in a GPS-jammed environment that approaches the best we can get in a clear-air environment. We are currently using this system to test the DoD's next generation navigation systems," said Jim Brewer, 746th Test Squadron, Holloman, AFB.

Through the CRADA, AFIT had unique access to the challenges associated with building a real system versus building simulations. In addition, researchers had exposure to extremely relevant research that was only made possible through the agreement.

"This collaboration provided Locata with access to a large military base and aircraft so extremely long-range Locata systems could be tested and verified," said Paul Benshoof, business development manager, Locata Corporation.

"It's an honor to be working with the undisputed best in the business when it comes to precision reference systems. The Locata team is proud to provide a technology that can deliver such an important capability to the DoD," said Nunzio Gambale, chief executive officer, Locata Corporation.

A LocataLite transmitter transmits high-accuracy positioning signals across the White Sands Missile Range, New Mexico, for testing methods developed for overcoming GPS jamming, or electronic warfare. This highly accurate navigation system was created through a Cooperative Research and Development Agreement between the Air Force Institute of Technology and the Locata Corporation.
(Photo courtesy of Locata Corporation)

AFRL AGREEMENT WILL FURTHER NON-CONTACT INSPECTION METHOD DEVELOPMENTS

Creare LLC
Hanover, NH

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – The Air Force Research Laboratory Materials and Manufacturing Directorate (AFRL/RX) recently signed a Cooperative Research and Development Agreement with Creare LLC in order to transfer hardware and software to the Hanover, New Hampshire company so that they can continue important research to develop non-contact inspection methods for aircraft components.

For several years the Air Force has worked to develop non-contact inspection methods for military aircraft in order to decrease the amount of time inspections take and to increase inspection accuracy and repeatability.

The Hole-to-Edge Measurement Technology system performs a non-contact inspection. The HEMT was developed by Creare LLC under an Air Force Small Business Innovation Research agreement. The technology and other equipment was temporarily transferred to Creare LLC under a Cooperative Research and Development Agreement with the Air Force Research Laboratory Materials and Manufacturing Directorate. (Photo courtesy of Creare LLC.)

Current inspection methods involve physical contact with the surface of the aircraft parts such as placing transducers or measurement devices on the part. These methods require much more time to complete.

"The Air Force currently requires 100 percent component inspection as aircraft parts are manufactured. Non-contact methods will allow inspectors to make the necessary measurements in less than half the time of previous methods and with greater accuracy," said Mr. Craig Neslen, the AFRL/RX materials engineer managing the effort.

The equipment was originally developed by Creare as part of an Air Force Small Business Innovation Research effort to develop a non-contact inspection method that measures the distance between a drilled hole and the edge of a part. That agreement ended with significant elements of the project (hardware and software) being transitioned to a non-contact hole measurement requirement for Air Force aircraft. The new CRADA agreement allows the company to temporarily maintain physical ownership of the equipment and continue research.

"Creare's ability to continue to use the technology has been critical in fostering transition to end users and the development of new applications. We very much look forward to continuing to work with the Air Force to continue to leverage the work they have supported," said Mr. David Kynor, the Creare engineer leading development of the non-contact inspection systems.

A CRADA is one type of technology transfer agreement that provides quick access to extensive government-funded research and development resources that can be leveraged to create powerful results while also providing intellectual property protection. CRADAs are facilitated by the Air Force Technology Transfer Program and its affiliated Office of Research and Technology Applications. An ORTA is embedded at many Air Force research locations.

"CRADAs can be an extremely useful tool used in order to quickly establish a cooperative technical agreement with industry," Neslen said, "This agreement has worked out well. It allows Creare to maintain possession of equipment that will be used on research that benefits the Air Force."

AIR FORCE AND MICHIGAN STATE UNIVERSITY RESEARCH RESULTS IN PROGRAMMABLE MEMS DEVELOPMENTS

Michigan State University
College of Engineering
East Lansing, MI

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – Under a Collaborative Research and Development Agreement, a team of scientists from the Air Force and Michigan State University produced first generation smart-material based micro-electrical mechanical mirror devices (MEMS).

The Air Force Research Laboratory Sensors Directorate, Integrated Circuits and Microsystems branch (AFRL/RYDI) has explored MEMS mirrors for electro-optical military applications, specifically the use of vanadium dioxide as a microactuator for the MEMS technology. The microactuator supplies power to the device. Vanadium dioxide – also known as VO2 - is unique because it is considered a "smart" material, meaning it responds rapidly to stimulus, and it is also considered to be multifunctional because many of its properties change simultaneously to the stimulus. It requires little energy to power – at least much less than other technologies.

MEMS are miniaturized mechanical or electromechanical devices or structures that are created through microfabrication. The devices are usually a combination of microsensors, microactuators, microelectronics and microstructures on a substrate. They can measure anywhere between several millimeters to one micrometer. MEMS mirrors are used in multiple fields including optical phased-arrays, spectroscopy, optical switches, track positioning, microscopy, optical displays, and medical imaging.

Because Michigan State University scientists possess vast experience in the deposition and characterization of VO2, as well as the material's integration into micrometer-sized devices, the two parties entered into a five-year CRADA. The agreement allowed MSU scientists to have access to Air Force facilities, personnel, and materials in order to create thin VO2 films and integrate them onto MEMS devices for testing. Air Force personnel participated in the device testing, data analysis and new process design.

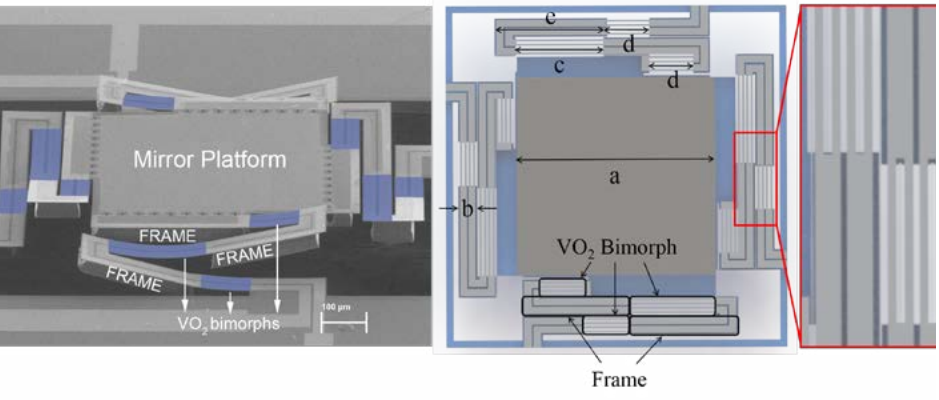
"Our collaboration with Michigan State University has been invaluable in advancing the science and technology of micro actuators and micro mirrors," said Dr. John Ebel from the Sensors Directorate. "Their expertise combined with AFRL's unique fabrication capabilities and talents has greatly accelerated the pace of research for MEMS actuators and mirrors."

In the first year of the agreement, the team developed first generation VO2-based MEMS mirror devices. The device showed a great deal of movement from minimal power during phase transition. During testing it showed vertical movements and tilt angles of 75 micrometers and 5.5 degrees. Through the course of the research the material displayed hysteretic behavior, meaning the response to force or stimuli was dependent on the previous response. Going forward the researchers can predict how the device will react to certain electrical signals and they can "program" the devices for specific responses.

"This CRADA has allowed for the use of unprecedented mechanisms in the operation of MEMS mirrors. The actuation of such devices using smart phase-change materials represents a new operating principle that enables their programming and reduces power consumption," said Nelson Sepulveda, a professor of electrical and computer engineering at Michigan State University.

"We have also made promising advances in implementing new techniques that can significantly advance military technologies, such as the use of smart windows that could potentially serve for cloaking applications," Professor Sepulveda explained.

A paper detailing the research results was published in the Journal of Microelectromechanical Systems. Moving forward, the research will focus on developing programmable MEMs mirrors and improving the device design to allow for better device control and larger movements. The team is also investigating VO2 for use in variable optical attenuators.



On the left, an image of the final VO2 based MEMs device with the bimorph in blue. On the right, a top view of the device. This device was created under a cooperative research and development agreement between the Air Force Research Laboratory Sensors Directorate and Michigan State University.
(Image courtesy of Michigan State University)

ENDPOINT CYBERSECURITY TECHNOLOGY DEPLOYED THROUGH AIR FORCE CRADA

Carbon Black
Waltham, MA

HANSCOM AIR FORCE BASE, MASSACHUSETTS – The Air Force Life Cycle Management Center Electronic Systems Development Division here and Carbon Black, a locally-based security company, signed a Cooperative Research and Development Agreement last month to improve cybersecurity for the Hanscom Collaboration and Innovation Center. This agreement will allow Carbon Black to deploy their advanced endpoint security technology on the HCIC's network to leverage identification, prevention, tracking and responses related to endpoint cybersecurity activity.

The HCIC serves as a collaborative testing and development arena for leading-edge advances in defense applications, cyber defenses and public safety. Carbon Black, based in Waltham, Massachusetts, is known for its work in endpoint next-generation security. Endpoint devices such as laptop and desktop computers are vulnerable to cyberattacks and technology is required to prevent and reduce cyber intrusions and threats for computer networks that connect to these devices.

"Together we will provide capabilities that will enhance the Air Force's visibility at the endpoint level to help them understand the techniques, tactics and procedures that are used in adversarial attacks," said Damon Cabanillas, vice president of federal sales and operations, Carbon Black.

CRADAs provide quick, unique access to extensive government research and development resources that can yield powerful research results. This technology transfer agreement will enable the HCIC to implement real-time, continuous cyber defense software not currently used by the Air Force. The CRADA will further enable the facility to provide crucial cybersecurity information, assistance and training to government, industry and academic activities that require secure research, development, test and evaluation environments.

"Cyberwarfare is a clear and present danger and can significantly degrade our country's ability to execute our mission on the frontline for both the government and commercial industry. This CRADA will allow our teams to collaborate on new ways of defending against cyber attacks that most technologies can't detect," said Cabanillas.

Advanced endpoint security allows users to create a profile to identify, contain and ban specific behaviors, activities and threats. In addition, users have access to 10,000 industry and proprietary experts via an online community.

"To dramatically improve cyber resiliency and data asset protection, I aim to collaborate with key contributors and leverage multiple, diverse capabilities to combat adversaries in the digital age. One recent example is the research and development agreement between Hanscom Air Force Base and Carbon Black, which uses advanced tools with United States Air Force data sets to enhance learning across the enterprise," said Lt. Gen. William Bender, chief, Information Dominance and chief information officer, Office of the Secretary of the Air Force.

Department of Defense computing networks, such as those used at the HCIC, are vulnerable to unknown threats. This cooperative effort will allow the center to be used as a model by Carbon Black to develop products that provide increased protection for DOD networks and current and future customers.

"We are really looking forward to experimenting with Carbon Black, learning from this opportunity and sharing these lessons across the Air Force. We have had success getting some of the technology deployed and will continue to share these lessons as we move forward working together through this CRADA " said Mike Canavan, chief, Electronic Systems Development Division, AFLCMC/XZC.

The Air Force Life Cycle Management Center Electronic Systems Development Division signed a Cooperative Research and Development Agreement with Carbon Black, a leader in endpoint next-generation security. (Air Force contributed photo)

AFRL AGREEMENT AIMED AT PROTECTING PUBLIC FROM UAS NOISE

Owens Corning
Toledo, OH

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – The Air Force Research Laboratory 711th Human Performance Wing, Airman Systems Directorate, Battlespace Acoustics Branch and Owens Corning have entered into a Cooperative Research and Development Agreement to develop and understand best practices for measuring and labeling the sound produced by small commercial unmanned air systems.

The Department of Defense uses a variety of UAS platforms to perform military functions. Similarly, commercial entities use UASs as a cost-effective solution for numerous activities, including agriculture and forestry management, cellular tower inspection, and landfill monitoring. Given the growing current and potential use of these devices in the future, UASs could become a source of sound pollution. As a result, researchers at the AFRL are working to develop sound regulations to avoid what could become a critical issue for the public.

Under the agreement, Owens Corning will measure the acoustic characteristics of UAS platforms in its world-class acoustic laboratory while the Air Force will provide open-air characterization at its White Sands Missile Range site in New Mexico. The research obtained from this agreement will be utilized to develop a national standard which could include measuring and labeling innovative acoustic materials and structures as well as defining manufacturing specifications for key technologies.

"The goal of this agreement is to recommend a national measurement and sound power labeling standard for small unmanned air systems. If adopted by the Federal Aviation Administration, all manufacturers of these products would be required to label their drones, similar to how appliance manufacturers attach a sound power label to a dishwasher," stated John Hall, program manager for AFRL/711HPW.

"Through this agreement, we are able to capture the sound power radiating from drones as measured in an anechoic (echo free) facility in a practical way rather than trying to measure drones in flight," continued Hall.

The Owens Corning Acoustic Research Laboratory in Granville, Ohio was designed by Hale Sabine, a pioneer of acoustic research, and is accredited through the National Voluntary Laboratory Accreditation Program (NVLAP). The lab houses three reverberant chambers and an anechoic chamber that enables precise sound measurements that acoustically simulate a drone in the sky at a high altitude.

A small unmanned aerial system undergoes tests in the Acoustics Laboratory at Owens Corning Science and Technology Center in Granville, Ohio. (Photo courtesy of Owens Corning)

AIR FORCE PARTNERS WITH RIO GRANDE NEUROSCIENCES ON TRANSCRANIAL STIMULATION RESEARCH

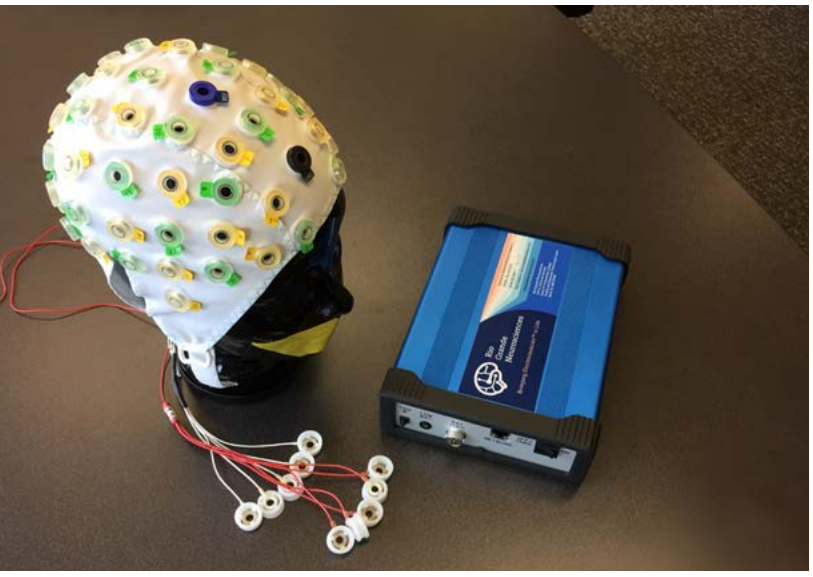
Rio Grande Neurosciences
Albuquerque, NM

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – Air Force researchers are investigating ways to enhance Airmen attention, vigilance, learning and memory without relying on prescription medications.

The 711th Human Performance Wing (711HPW) recently signed a Cooperative Research and Development Agreement with Rio Grande Neurosciences of Albuquerque, New Mexico, to expand its work in the field of transcranial direct current stimulation (tDCS) to include new stimulation methods. Specifically, the project will expand the 711HPW's work by focusing on the development and evaluation of pulsed electromagnetic field (PEMF) stimulation, new tDCS paradigms, and transcranial alternating current stimulation.

A CRADA is one type of technology transfer agreement that provides quick access to extensive government-funded research and development resources that can be leveraged to create powerful results while also providing intellectual property protection for both parties. These types of agreements are facilitated by the Air Force Technology Transfer Program and its affiliated Office of Research and Technology Applications (ORTA). An ORTA is embedded at many Air Force research locations.

Under the agreement, the 711HPW will use Rio Grande Neurosciences devices to conduct tests on 36 recruited participants. The results will be shared with the company. If shown to be effective in this project, these technologies/techniques may provide a new treatment for medical patients, as well as a simple and cost-effective method for sustaining Airmen performance in critical Air Force jobs such as image analysts, cyber operators, and remotely piloted aircraft operators.



A standard EEG cap with electrodes alongside the NeuroMod16. (Photo courtesy of Rio Grande Neurosciences.)

"This CRADA allows us to receive valuable product feedback from a research team who we have great respect for and whose input will be very beneficial to what we do," said Dr. Michael Weisend, senior scientist at Rio Grande Neurosciences.

The 711HPW has been studying tDCS for nine years in order to learn the method's effect on learning, memory, visual search, creativity, and decision making. The research has shown that the method can facilitate learning and improve attention span and reaction time. It is also pain-free and non-evasive. One issue with this method is that it requires the use of a gel for electrical conductance, which can be difficult to apply and remove completely from the hair. In addition, it requires a trained technician to set-up and conduct the treatments.

The new agreement will allow Air Force researchers the opportunity to examine similar methods developed by Rio Grande Neurosciences and cleared by the Federal Drug Administration. PEMF does not require conductive gels or solutions because it readily permeates tissue and changes brain activity by using magnetic stimulation. Historically, PEMF technology has been used to aid wound healing, but this CRADA will address its use as a neuromodulation technique.

The company has improved tDCS electrode designs and technology making application easier and more comfortable for the user. Similar to tDCS, PEMF appears to change brain activity by modulating the excitability of brain tissues.

The company has also developed advanced multiple coil transcranial magnetic stimulation (TMS) technologies to influence brain activity. The higher powered TMS technique directly activates brain tissue at the site of influence. TMS and PEMF application are as simple as placing insulated wires close to the scalp.

"Technology Transfer agreements like this CRADA are extremely important," said Mr. Andy McKinley, 711HPW Biomedical Engineer. "They allow the Air Force to leverage new technological advances in industry to advance scientific discovery here in the laboratory. Then we can transfer our discoveries back to industry to provide an acquisition pathway for the end-users here in the Air Force."

AFRL MATERIAL TRANSFER AGREEMENT LEADS TO INTERNATIONAL RESEARCH GRANT WITH AUSTRALIA

Griffith University
Australia

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – A recent Material Transfer Agreement between the Air Force Research Laboratory Materials and Manufacturing Directorate (AFRL/RX) and the Griffith University of Nathan, QLD 4111, Australia resulted in international cooperative research and development grant. The new agreement is between AFRL/RX, the Naval Research Laboratory and the Australian Defense Science and Technology Group.

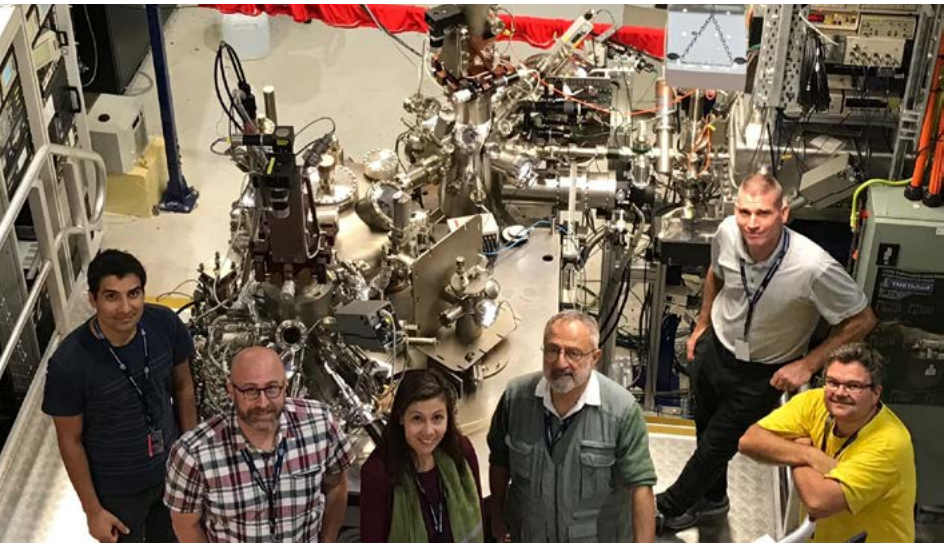
An MTA is one type of limited-purpose Cooperative Research and Development Agreement that allows for quick collaboration with the Air Force. A CRADA is a legal agreement between a federal laboratory and one or more nonfederal parties such as private industry and academia. CRADAs offer both parties the opportunity to leverage each other's resources when conducting research and development that is mutually beneficial.

Under the MTA and with partial funding under a grant from the Asian Office of Aerospace Research and Development, the Air Force Office of Scientific Research's international office in Tokyo, the university delivered samples of epitaxial cubic silicon carbide (3C-SiC) on silicon (Si) substrates. The purpose of the agreement was for the Air Force to investigate the graphene fabrication that results from the 3C-SiC material. Graphene is a material of interest for several applications, including electronic device development, because of its high conductivity, flexibility and strength.

The directorate has had a working relationship with the university for several years. Griffith University also houses an Australian NanoFabrication Facility Node for growing SiC epitaxially on a silicon substrate. The university is one of only a handful of groups in the world that can fabricate this material and one of only two that grow and then convert it into graphene.

"The CRADA was a helpful tool to formalize this research collaboration, spell out the IP that would be owned by each organization, and effectively outline the scope of the research being conducted," said Dr. John Boeckl, the AFRL/RX materials scientist leading the effort.

AFRL scientists conduct cross-sectional transmission electron microscopy to evaluate the material quality, helping to guide the graphene synthesis development, and scientists at the Naval Research Laboratory measure the plasmonic response of nano-scaled device structures fabricated from the material. The team also submitted a proposal to the Australian Synchrotron Facility in Melbourne and was granted use of the facility's Soft-X-ray Spectroscopy testing equipment. This allowed the team to conclusively identify the existence of the buffer layer of graphene on the 3C-SiC, which was known for graphene grown on bulk hexagonal poly-types of SiC, but was unconfirmed on the cubic poly-type. These results will be a key in refining future device structures.



A team of researchers from the Air Force Research Laboratory Materials and Manufacturing Directorate, Griffith University, and Australian Synchrotron Facility are pictured in the Soft X-Ray Spectroscopy laboratory. (Photo courtesy of Dr. John Boeckl)

Pictured from left to right: Mojtaba Amjadi Pour (QUT student), Tyson Back (AFRL contractor, Surface Scientist), Francesca Iacopi (former professor at Griffith University, currently at University of Technology Sydney) Patrick Soukiassian (long-time collaborator from CEA-Saclay, Synchrotron Expert), John Boeckl (AFRL/RX), and Anton Tadich (Australian Synchrotron, Beamline Scientist).

As a result of the MTA CRADA and the favorable plasmonic response measured, the research was awarded a grant from the Secretary of the Air Force, International Affairs Office. In addition, an official Project Agreement will be established between AFRL/RX, the Naval Research Laboratory and the Australian Defense Science and Technology Group (DSTG). This research will focus on complex low-loss plasmonic structures based on Griffith University graphene material.

"Working with the US Air Force, and other US military laboratories has been a boon to my research interests, and shows how a strong international collaboration can enhance and benefit each country's interests," asserted Francesca Iacopi, the Griffith University professor whose pioneering graphene synthesis from SiC has earned her numerous awards. She recently accepted a new position at the University of Technology in Sydney where she will continue to pursue this research.

AIR FORCE PARTNERSHIP WITH INDUSTRY SPARKS A MORE ROBUST STEM INTERSHIP PROGRAM

Cummings Aerospace
Hunstville, AL

EGLIN AIR FORCE BASE, FLORIDA – The Air Force Research Laboratory Munitions Directorate and Cummings Aerospace have partnered to provide a unique internship experience for college engineering students.

Under a Cooperative Research and Development Agreement, the two parties developed an internship program that will allow four college students in the AFRL Scholars Program to be mentored by scientists from both Cummings Aerospace and the Munitions Directorate (AFRL/RW). The students will work at the Directorate's Dynamic Materials Characterization Laboratory at Eglin Air Force Base.

This summer will be the first time there has been an Industry Scholars segment within the AFRL Scholars program.

"The program provides a new and innovative way to provide interns with the perspective of working with both AFRL and an industry partner," explained Brian Mitchell, who leads the Munition Directorate's Education Outreach Program. "In this way the scholars can gain a better understanding of what working as a scientist or engineer is like from both the government and private industry perspective."

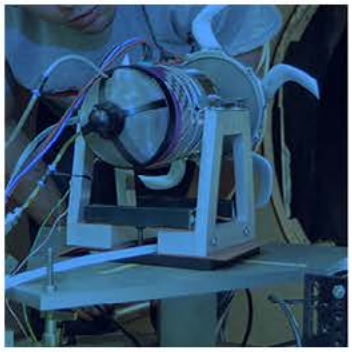
The AFRL Scholars Program is facilitated by the Universities Space Research Association and offers stipend-paid summer internship opportunities to high school, undergraduate and graduate students pursuing STEM degrees. The selected interns gain valuable hands-on experiences working with full-time AFRL scientists and engineers on cutting-edge research and technology and are able to contribute to unique, research-based projects. Graduate interns are able to collaborate with AFRL on current research and incorporate the research into their graduate work.

This year Industry Scholar students will be focusing on materials and mechanical characterization of high performance structural casing materials. The project involves characterization of microstructure using optical/electron microscopy as well as quasi-static and dynamic mechanical testing using mechanical test frames. Students will also be responsible for designing and conducting thermal process experiments to develop an improved understanding of phase stability and transformations. They will be trained on equipment, and be expected to work as a team with technicians and scientists to develop data and gain an understanding for new prototype material systems.

"The collaboration between AFRL and Cummings Aerospace, enabled by the CRADA, will provide both interns and their mentors with valuable insight into industry and Air Force technologies and capabilities to develop the next generation of weapons," said Cummings Aerospace President and Chief Executive Officer, Sheila Cummings. "Additionally, this opportunity demonstrates the committed relationship and shared strategic vision between industry and AFRL to find new and innovative ways to address the challenges of future weapons science and technology needs."

EPA SUCCESS STORIES

An Educational Partnership Agreement (EPA) is a formal agreement between a defense laboratory and an educational institution to transfer and/or enhance technology applications and to provide technology assistance for all levels of education (pre-kindergarten and up).



UNITED STATES AIR FORCE
TECHNOLOGY TRANSFER PROGRAM

AIR FORCE PARTNERSHIP WITH UNIVERSITY ENABLES 3D TECHNOLOGY RESEARCH

Bowling Green State University
School of Human Movement, Sport and Leisure Studies
Bowling Green, OH

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – The Air Force Research Laboratory 711th Human Performance Wing signed an Educational Partnership Agreement with Bowling Green State University's School of Human Movement, Sport and Leisure Studies due to a mutual interest in the areas of human biomechanics and three-dimensional (3D) motion analysis.

An EPA is a type of technology transfer agreement between a federal laboratory and an educational institution that enables the transfer or development of technological resources and applications, such as equipment, facilities and professional expertise.

Under this agreement, AFRL/711 HPW and BGSU, a public university in Ohio, collaboratively developed research projects to be conducted at BGSU. The 711 HPW loaned motion analysis equipment to BGSU, which enabled BGSU students and faculty to conduct research of benefit to both parties. Several research papers have been published regarding the multiple projects that were conducted through the equipment loan.

"The purpose of the EPA is to encourage and enhance study in scientific disciplines. AFRL/711 HPW found that working with BGSU was mutually beneficial and validated the importance of partnering with academia," said Jennifer Whitestone, biomedical engineer, AFRL 711 HPW.

"Sharing technologies and assets with our BGSU colleagues offers a unique collaborative opportunity that can lead to new ideas, innovations, and solutions to help solve our current Air Force challenges as we help to develop the bright young minds that will become part of tomorrow's workforce."

Access to collaborative resources allowed researchers to analyze concealed objects of various sizes in the torso and the changes that occurred to the size, shape and motion of an individual. The datasets collected are expected to result in improvements of defense and security processes for the military.

Research efforts were also made in the area of simulated entry control point development for evaluating human deception and its influence on human dynamics when individuals were near a simulated air base, town or other restricted security checkpoint. When illegal objects made it through the checkpoint undetected, individuals received a monetary incentive of $100.

Projects of interest to the School of Human Movement, Sport and Leisure Studies have been conducted to analyze soccer kicking and hockey slap shot techniques. Results from this research included a discovery in the differences between how skilled and unskilled soccer players use the torso when kicking and developing novel gait assessment models for a specialized non-motorized treadmill.

"The partnership with AFRL has helped every facet of our research to grow and has added significantly to our opportunities for student instruction," said Dr. Matt Laurent, an associate professor of exercise physiology at BGSU.

This agreement supports the Air Force goal of promoting science, technology, engineering and mathematics, or STEM education. In addition, undergraduate and graduate students of BGSU were also provided with invaluable opportunities to participate in innovative research. The research is scheduled to continue until 2019.

"I believe my experience with the Air Force set me apart from other students and played a vital role in my admission into a doctoral program," said Dano Tolusso, BGSU graduate and current doctoral student at the University of Alabama.

A test participant receives a 3-D full body scan at Bowling Green State University in Ohio. The participant is attempting to conceal an illegal object under their clothing through a simulated security checkpoint. (Image courtesy of Bowling Green State University.)

AIR FORCE AGREEMENT PROVIDES EDUCATIONAL OPPORTUNITIES TO LOCAL COMMUNITY

Emerald Coast Science Center
Fort Walton Beach, FL

EGLIN AIR FORCE BASE, FLORIDA – The Air Force Research Laboratory Munitions Directorate recently established an Educational Partnership Agreement with the Emerald Coast Science Center. ECSC is a facility that seeks to inspire and grow a scientifically engaged community to promote the study of science, technology, engineering and mathematics in the future workforce at all levels of education.

This partnership will enable the application of professional expertise and knowledge from AFRL scientists and engineers through mentorships, educational outreach programs and volunteer opportunities. AFRL will also assist with creating a program for students to receive academic credit for their assistance with defense laboratory research projects.

Additionally, ECSC will be able to utilize unused or excess laboratory equipment for student enrichment and educational purposes.

"Our partnership with AFRL allows us to bring real-world STEM-related issues to the general public," said Diane Fraser, ECSC's executive director. "This will help us shape our educational programs to focus on the needs of the workforce. The Science Center is looking forward to working with AFRL and the rich educational opportunities this partnership will provide to students of all ages."

This collaboration directly supports the Air Force goal of promoting STEM education by connecting AFRL experts with the local community, teachers and students by offering enriched programs with the expertise provided through this partnership.

"For STEM education to flourish, AFRL needs to rely on every partner we can," said Brian Mitchell, the AFRL Munitions Directorate's STEM outreach coordinator, "ECSC is rapidly becoming the focal point for STEM in Northwest Florida and I can't think of a better organization to partner with."

The AFRL Munitions Directorate is located at Eglin Air Force Base, Florida, and ECSC is located in nearby Fort Walton Beach.

Peggy Milz of BAE Systems speaks to STEM professionals and students at the "Women in Science Conference," the first partnership event for AFRL Munitions and ECSC on October 13, 2016.
(Photo courtesy of Beth Hanning, Doolittle Institute)

30TH SPACE WING PARTNERS WITH DISCOVERY MUSEUM TO CREATE SPACE LAUNCH EXHIBIT

The Santa Maria Valley Discovery Museum
Santa Maria, CA

VANDENBERG AIR FORCE BASE, CALIFORNIA – The local community doesn't always get to peek inside Vandenberg Air Force Base and see its role in launching and landing space vehicles. But, for some of its younger residents, that's about to change. A new Educational Partnership Agreement between the 30th Space Wing and the Santa Maria Valley Discovery Museum is going to provide area students with hands-on experience of the aerospace industry.

An EPA is a technology transfer agreement between a defense laboratory and an educational institution for the purpose of encouraging and enhancing study in scientific disciplines at all levels of education.

Under the new agreement, the 30th Space Wing will be able to further its Science, Technology, Engineering and Mathematics outreach efforts by modifying and donating a subscale Discovery Space Shuttle that will be added to the museum's existing Mission to Mars climbing wall exhibit. Students and visitors will be able to climb onboard the shuttle and imagine what it's like to be a pilot. The shuttle is expected to be delivered in early 2017.

"Partnering with the museum is an excellent way to achieve our STEM outreach goals and show the 31,000 students that visit the museum each year what a career with the Air Force at Vandenberg has to offer," said Thomas Stevens, Technical Director of the 30th Launch Group and Base STEM coordinator.

In addition to the shuttle, the 30th Space Wing is collaborating with the museum on a new simulated space launch exhibit called the Vandenberg Launch Experience. The exhibit will allow the students to act as a launch operator and will include a set of consoles with a large screen video display to simulate a launch into space. The exhibit will be delivered in phases beginning in 2017 and will include scheduled events with Air Force representatives who will interact with the students during missions.

"We are thrilled to be working in partnership with the 30th Space Wing to bring much-needed STEM educational opportunities and an exciting interactive space launch exhibit to the Santa Maria Valley Discovery Museum," said Chris Slaughter, executive director of the museum. "As the only children's museum in Santa Barbara County for 20 years, we will be exposing over 31,000 children and their families every year to the vast world of launch activities through engaging, fun hands-on exhibits and programs."

A rendering of the future Vandenberg Launch Exhibit that will be installed at the Santa Maria Valley Discovery Museum in 2017. The exhibit is part of an Educational Partnership Agreement between the museum and the 30th Space Wing at Vandenberg Air Force Base, CA. (Photo Courtesy of the 30th Space Wing.)

AEROSPACE SYSTEMS DIRECTORATE USES EDUCATIONAL PARTNERSHIP TO FURTHER STEM PROGRAM

Multiple Agreement Partners

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – The Air Force Research Laboratory Aerospace Systems Directorate's (AFRL/RQ) is using Educational Partnership Agreements as important tools in the Aerospace Propulsion Outreach Program (APOP).

The program, referred to as APOP, is a directorate science, technology, engineering, and math (STEM) initiative that funds year-long undergraduate engineer capstone programs across the country that focus on gas turbine engine projects. APOP has been in place for seven years.

This year the program has signed EPAs with eight universities in order to loan each school a Jetcat P90 turbojet engine. The Jetcat P90 is a turbojet designed and marketed to the model aircraft market. While Jetcats are not optimized for military use, at ~$100 per lb of thrust, they are a cost-effective development testbed or low-cost turbojet alternative.

"APOP is intended to get undergraduate engineering students excited about gas turbine engines. The EPAs are a flexible tool by which we can quickly loan equipment to the universities and make the process easier," said Paul Litke, Lead Engineer in the RQ Small Engine Research Lab (SERL). "These engines are the perfect, cost-effective platform for this type of program."

One of the features of APOP is that at the end of the year-long project, student teams are expected to come to Wright-Patterson AFB, install their design on the thrust stand in the RQ SERL, and SERL personnel evaluate their design against a set of design criteria and key performance parameters that were established at the beginning of the year. Without the EPAs, most of the schools wouldn't have access to the Jetcat P90 engines and other equipment used in the past years.

This year, the six universities are designing a new engine nozzle for a Jetcat P90 turbojet, which they will demo in SERL. Additionally, they participate in a poster session in mid-May 2017.

"One additional benefit of funding six university teams is a recruiting aspect; student resumes are collected and circulated through the turbine engine division through the year. A handful of students have been hired out of APOP by a number of USAF organizations on base," said Litke

Captain Joseph Ausserer assists Aerospace Propulsion Outreach Program students installing their design for testing and evaluation in the Aerospace Systems Directorate's Small Engine Research Laboratory. The program, referred to as APOP, is a directorate science, technology, engineering, and math (STEM) initiative that funds year-long undergraduate engineer capstone programs across the country that focus on gas turbine engine projects. (U.S. Air Force photo)

AFCEC USES TECHNOLOGY TRANSFER AGREEMENTS TO PROVIDE STEM MATERIALS TO LOCAL SCHOOLS

Multiple Agreement Partners

TYNDALL AIR FORCE BASE, FLA – The Air Force Civil Engineer Center has been working with Gulf County and Bay County school districts to advance science, technology, engineering and math programs and equipment for their students.

Through educational partnership agreements with each district, AFCEC identified areas of need within each district and provided the necessary assistance. An EPA is a technology transfer agreement between a defense laboratory and an educational institution for the purpose of encouraging and enhancing study in scientific disciplines at all levels of education.

"The Air Force STEM program is an investment in our kids and their development into productive citizens and possible future Air Force assets," said Dr. Joseph Wander, who leads the AFCEC STEM program. "It's a good bet to place."

The staff of AFCEC comprises engineers working in a variety of areas including emergency management, training, pavement analysis, fire protection, explosive ordnance disposal, aircraft arresting systems, computer automation, and energy management. AFCEC has a history of interacting with the local communities by holding demonstrations led by the explosive ordnance disposal team. These demonstrations feature the robots used by the team to assess and disarm or detonate unexploded ordnance and improvised explosive devices.

Work under the EPAs has been very broad, ranging from internships for local high school students to helping design elementary school laboratories and selecting the appropriate equipment.

"The educational partnership that we have with AFCEC has allowed us to provide STEM opportunities for our students and teachers that would not have been possible without a partnership," said Katie McCurdy, the Bay District School District STEM Administrator. "AFCEC has been instrumental in providing necessary resources that provide our teachers with quality STEM professional development, STEM materials, and a STEM lab just to name a few."

More recently, AFCEC was able to use STEM-designated funds from the Office of the Secretary of Defense to sponsor FIRST LEGO League teams from the schools. With the help of adult coaches, these teams select and research a real-world problem to which they are challenged to develop a solution. They also must design, build, program a robot using LEGO MINDSTORMS® technology, then compete on a table-top playing field.

Under the agreements, AFCEC personnel have supported other STEM events such as science fairs and MathCounts by serving as judges, proctors, and graders. The agreements have also provided a formal vehicle for AFCEC to provide the schools with several computers, a 3-D printer, and five research microscopes.

Currently, AFCEC is working with Wildcat Creek Educational Center through an EPA to develop a two-weekend solar-and-nature camp for eight students in grades 4-5 at the center. Held during the summer, the first weekend the students will experience nature and the selection of a solar energy project. The project will be conducted at home for the following two weeks. The second weekend will be a show-and-tell of the projects and open discussion.

Fifth graders from Port St. Joe Middle School in Florida participate in a First LEFO League program in Biloxi, Mississippi. The students were sponsored by the Air Force Civil Engineering Center at Tyndall Air Force Base, with funds provided by the Office of the Secretary of Defense and delivered through an educational partnership agreement with Bay County School District. (Photo courtesy of Gulf County School District)

NEW AGREEMENT PAVES WAY FOR UC STUDENTS TO WORK IN AIR FORCE LABS

University of Cincinnati
College of Engineering and Applied Science
Cincinnati, OH

WRIGHT-PATTERSON AIR FORCE BASE, Ohio – Materials science and engineering students from the University of Cincinnati now have the opportunity to gain research experience at the Air Force Research Laboratory's Materials and Manufacturing Directorate (AFRL/RX).

The directorate recently signed an Educational Partnership Agreement with the College of Engineering at the University of Cincinnati. An EPA is one type of technology transfer agreement between a defense laboratory and an educational institute to transfer and/or enhance technology applications and to provide technology assistance for all levels of education.

Students will be performing materials research in areas of interest to the Air Force. The effort is being led by Dr. Benji Maruyama, a senior materials research engineer from AFRL/RX, and Dr. Vesselin Shanov, a professor of chemical and materials engineering at the University of Cincinnati.

"Under the agreement, students will have access to the unique equipment at Wright-Patterson, such as a high-resolution transmission electron microscope," said Dr. Shanov. "Because of this students will be able to conduct advanced research in collaboration with Air Force materials experts."

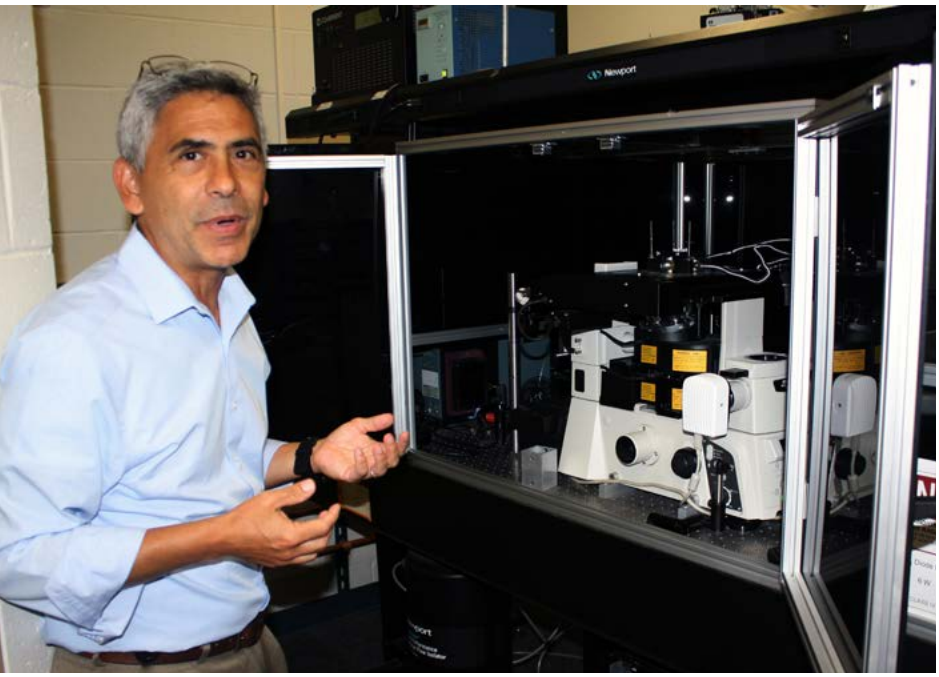
Mark Haase, a Ph.D. student from UC, is currently working with Dr. Maruyama under the agreement. Haase is researching the structure and spin-ability of carbon nanotube forests using transmission electron microscopy.

"Yarns made from carbon nanotubes exhibit exceptional strength-to-weight, as well as electrical and thermal conductivity, making them useful for applications from structures to electronics," explained Dr. Maruyama.

"I wouldn't be able to do the work I'm doing without this partnership," said Haase. "Beyond that, I've enjoyed my experience working with the Air Force. It's given me the chance to learn from some brilliant people."

The EPA will involve numerous students over the five-year agreement. In addition to UC students working in RX labs, there is a possibility of Air Force experts assisting with curriculum and course development at the university, as well as co-authoring journal articles with students and UC staff.

"It is our hope that more faculty and students from UC, and researchers from AFRL, take advantage of this unique opportunity for collaboration in the next few years," said Dr. Shanov.



Dr. Benji Maruyama with AFRL's Autonomous Research System. Dr. Maruyama is the senior materials research engineer from the AFRL Materials and Manufacturing Directorate coordinating the educational partnership agreement with the University of Cincinnati. (U.S. Air Force photo/Marisa Novobilski).

WORLD'S LARGEST LAUNCHED AMATUER ROCKET BUILT THROUGH AIR FORCE PARTNERSHIP AGREEMENT

University of New Mexico
Albuquerque, NM

KIRLTAND AIR FORCE BASE, New Mexico – Students from the University of New Mexico's Rocket Engineering Team built the world's largest launched amateur rocket through an Educational Partnership Agreement with the Air Force Research Laboratory, Directed Energy and Space Vehicles Directorate.

Under the agreement, students utilized Air Force facilities for building a similar version of the PGM-11 Redstone rocket for real world and predicted performance comparisons. The PGM-11 Redstone rocket was the first United States Army short-range ballistic missile used to carry a live nuclear warhead in West Germany during the Cold War.

UNM supplied the materials for constructing the rocket and the AFRL provided UNM temporary access to an Air Force facility with enough space to assemble the 48-foot tall rocket and launch tower. The rocket took more than six months to construct and weighed 260 pounds.

The project provided program management experience for students and the opportunity to work with professionals and acquisition processes across Kirtland AFB. Students used a computer program to calculate the design of the rocket, such as center of pressure, mass and weight to ensure the rocket could fly and predict its real world performance launch of 200 mph for velocity, or speed and an altitude of 3,000-feet high.

On the morning of the launch, UNM students and faculty met before sunrise in a remote area in Rio Rancho, New Mexico, to assemble the rocket and tower for takeoff. Due to a mechanical failure shortly after takeoff, the rocket reached an altitude of only 300-feet and additional metrics, such as velocity were unable to be tracked for calculating predicted to real world performance comparisons.

"Solving complex, real world engineering problems 'on the fly' taught me invaluable lessons about adapting and being flexible when working in a group," said Ben Urioste, UNM mechanical engineering student, structural design lead.

"The most exciting aspect about this collaboration was the opportunity to work on Kirtland Air Force Base. The AFRL staff was very accommodating and supportive of our efforts and their facility provided plenty of space for creating the world's largest amateur rocket," said Urisote.

Students from the University of New Mexico's Rocket Engineering Team built the world's largest launched amateur rocket through an Educational Partnership Agreement with the Air Force Research Laboratory, Directed Energy and Space Vehicles Directorate. Under the agreement, students utilized Air Force facilities for building a similar version of the PGM-11 Redstone rocket for real world and predicted performance comparisons. (U.S. Air Force photo)

EPAs are a form of technology transfer between an Air Force laboratory and an educational agency, college, university, or nonprofit institution for encouraging and enhancing the study of science, technology, mathematics, and engineering education.

"This unique opportunity was a tremendous success and an excellent use of an EPA. The students did a great job and I was very impressed with the quality and detail of their work," said Dr. Imelda Atencio, section chief, Laser Division, AFRL Directed Energy Directorate.

"The agreement also enabled the AFRL to continue forming relationships with UNM professors and students. I believe our willingness to work with the students made a lasting impression," said Atencio.

PLA SUCCESS STORIES

A Patent License Agreement (PLA) is a form of technology transfer that allows individuals, companies, and universities to incorporate, manufacture, sell, or leverage intellectual property developed by the Air Force in their own products.

UNITED STATES AIR FORCE
TECHNOLOGY TRANSFER PROGRAM

AIR FORCE AGREEMENT HELPS SMALL BUSINESS COMPETE IN THE GENERAL AVIATION INDUSTRY

PS Engineering
Lenoir City, TN

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – A patent licensing agreement and Cooperative Research and Development Agreement with the Air Force have been major factors in helping one small business directly compete with the largest aviation companies in the industry.

PS Engineering of Lenoir City, Tennessee, signed an exclusive PLA in 2012 with the Air Force Research Laboratory, 711th Human Performance Wing's Human Effectiveness Directorate (711HPW/RH), now known as the Airman Systems Directorate, for a patented speech technology that processes radio signals such that each signal appears to come from a unique location in space when presented over a pilot's headset.

This 'multi-talker' separation greatly enhances communication effectiveness and serves to improve safety during flight operations, according to Dr. Brian Simpson, technical advisor for the 711 HPW/RH Battlespace Acoustics Branch, which developed the technology.

The CRADA allows experts from the Battlespace Acoustics Branch to carry out additional testing and answer questions about the technology while the PS Engineering develops and refines products based on technology in the patent.

An installed PS Engineering PMA450A audio panel is shown. (Photo courtesy of PS Engineering.)

A CRADA is one type of technology transfer agreement that provides quick access to extensive government-funded research and development resources that can be leveraged to create powerful results while also providing intellectual property protection. Both PLAs and CRADAs are facilitated by the Air Force Technology Transfer Program and its affiliated Office of Research and Technology Applications (ORTA). An ORTA is embedded at many AF research locations.

"On our own, we didn't have the expertise to develop multi-talker technology," said Mark Scheuer, founder and CEO of PS Engineering. "Being able to interact with Air Force scientists under this CRADA was crucial to our product development. Without these agreements, we would not be leaders in our field."

Since the agreements have been in place, the company has developed a line of products using the technology. As a result, they are able to compete against industry giants. The product line, the PMA450, received FAA certification in 2014. The PMA450A model is the first audio panel of its kind to have graphics displays that uses soft keys.

The multi-talker technology spatially separates overlapping radio transmissions received during flight. Instead of the messages coming out at the same time and playing over top of each other, the pilot and flight crew hear distinct messages that seem to come from different locations, making it easier to decipher messages and react.

PS Engineering competes in the commercial aviation aftermarket industry, serving companies like Honeywell and Avidyne Avionics. Many of its products are compatible with an aircraft's original equipment manufactured by Garmin Ltd.

"Using a PLA with a follow-on CRADA allows a company to leverage both Air Force resources and the inventor's knowledge. It helps to further develop the licensed technology for the company's specific commercial application. In return, the Air Force obtains additional data and a commercial product is more likely to result from the agreements," said Dr. James Kearns, 711HPW Technology Transfer and Domestic Alliances manager.

COMMANDER'S CHALLENGE ACTIVE SHOOTER TECHNOLOGY LICENSED BY NEW SMALL BUSINESS

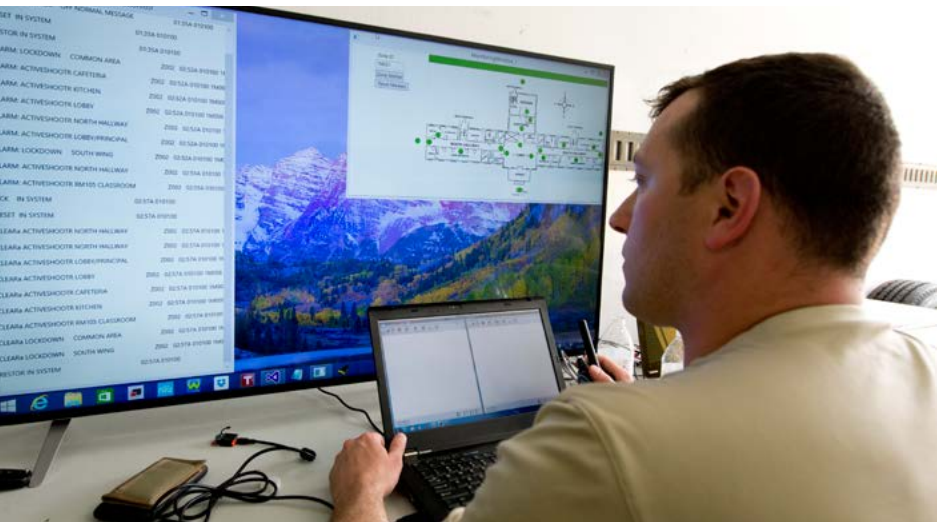
Protective Innovations
Montgomery, AL

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – A recently signed Air Force Research Laboratory Patent Licensing Agreement is set to commercialize an active shooter alert system developed by the Air Force.

TheAFRL Sensors Directorate signed a PLA with the newly incorporated Protective Innovations. The company, soon to be headquartered in Washington D.C., was founded by Chris Perrine, a former Air Force captain. Perrine was part of the team that developed the Active Shooter Protection System during the 2015 Air Force Research Laboratory Commander's Challenge.

TThe ASPS was developed with simplicity in mind and is described as a fire alarm for active shooters. It detects the sound of a gunshot using advanced digital signal processing and artificial intelligence to differentiate from other loud noises. When a gunshot is detected, the system sounds an alarm and transmits the exact location of the emergency to police and fire dispatch.

"As soon as our team began analyzing this problem, it was apparent that we can very easily improve our response to active shooter situations, saving the lives of both victims and first responders in the process," explained Perrine.



Former U.S. Air Force Capt. Chris Perrine, Air Force Life Cycle Management Center, chief of acquisitions for net centric services-2, from Robbins Air Force Base, Ga., monitors his team's active shooter detection system during the 2015 Air Force Research Laboratory Commander's Challenge. The system, which was patented by the Air Force, enables dispatchers to see exactly where in the building an alarm was activated and inform emergency responders, allowing them to better respond to the threat. Protective Innovations LLC, a company started by Perrine after his separation, licensed the technology for commercialization in 2017. (U.S. Air Force photo by Wesley Farnsworth)

Additionally, the ASPS integrates into existing fire alarm systems and associated wiring, eliminating the need for stand-alone networks, servers or software. This greatly reduces cost, putting gunshot detection systems within the realm of widespread affordability for the first time ever.

"The fact that we can provide a solution so affordably makes this opportunity even more urgent," said Perrine. "I left my career as an Air Force officer to make sure this technology is available to protect our service members, as well as the public at large."

The PLA between the Air Force and Protective Innovations is exclusive, meaning no other company can receive a license to develop and market the technology to the same industries. The agreement was developed with the assistance of TechLink, a Department of Defense partnership intermediary.

Partnership intermediaries facilitates joint projects and accelerate technology transfer between DoD laboratories and their partners.

"Working with TechLink to secure the PLA was incredibly easy and painless, although there is always some waiting involved in this kind of activity," explained Perrine. "The biggest challenge was just figuring out the right person to call to get the process started."

Protective Innovations is still looking for investors and has seen significant interest from the education and military markets. With at least one major university interested in fielding the system, the company expects to make initial deliveries next year.

"There's no reason why every school, airport and military base in the United States cannot be protected from gunshots the way they currently are from fires within the next five years," said Perrine.

The system was developed jointly by Perrine, Captain Carlos Horner, and First Lieutenants Dan Gunderson, Evan Glowiak, Andrew Hyde and Bruce Von Niederhausern from Robins Air Force Base. Every member of the team has maintained an interest in the technology. Perrine hopes that in the future some of them may join the company full-time.

The Commander's Challenge is an annual Air Force-wide competition focused on finding solutions for real-world threats the military faces each year. Participants work in teams to develop a problem solution and deliver a presentation at the end of each challenge. This process stimulates innovation, and allows AFRL a chance to see more than one potential solution, ultimately choosing the best or even a combination of the solutions presented.

AIR FORCE PATENT LICENSE COULD LEAD TO NATURAL FIBER AUTOMOTIVE COMPONENTS

Natural Fiber Welding
Peoria, IL

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH, VIRGINIA
The Air Force Office of Scientific Research signed a Patent License Agreement with Natural Fiber Welding, Inc. that allows the company to use an Air Force developed fiber welding process in the creation of automotive components.

Air Force research showed that with proper solvents and control, polymers from neighboring natural fibers interact and individual fibers are 'welded' as new molecular associations are generated. Removal of the solvent results in molded materials with robust mechanical properties. This is referred to as fiber welding.

This process maintains the chemical makeup of natural materials even while fibers are redesigned into desired shapes and structures without the use of glue. In comparison to many conventional natural and synthetic materials, fiber welded composites are stronger, lighter, more affordable, sustainable, environmentally-friendly, and more easily recycled and reused. When used for automotive interior materials, these composites can also contribute to improvements in the fuel economy of vehicles since they are lighter in weight. Fibrous materials demonstrated include hemp, cotton, jute, sisal, and flax.

"Fiber welding is changing the way we use naturally occurring fibrous materials to improve peoples' lives," said Dr. Luke Haverhals, founder and chief executive officer of NFW. "We are very excited to continue expanding our relationship with the United States Air Force and our understanding and commercial application of this paradigm-shifting technology."

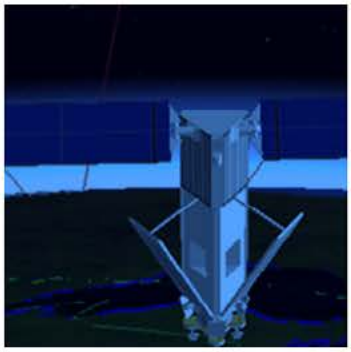
NFW has seen success with the creation and efficient manufacturing of diverse natural, bio-based automotive products. The 3-dimensional products were molded with high-value materials from agriculture and "upcycled" waste fibers such as cotton, flax, silk, rayon, saw dust, and other waste wood products.

The PLA was signed in 2015 with the help of TechLink, a DoD Partnership Intermediary. PLAs are a form of technology transfer that allows individuals, companies, and universities to incorporate, manufacture, sell, or leverage intellectual property developed by the Air Force in their own products. Each year, the Air Force signs approximately 30 to 40 licenses which contribute to maximizing the use of Air Force technology in the economy, creating new businesses and job opportunities and stimulating research.

"Technologies developed, tested and evaluated within the Air Force have tremendous potential for commercial applications. Furthermore, Air Force innovations can dramatically enhance the competitiveness of small businesses who otherwise may not have the resources to conduct the research and development that is necessary to develop these technologies," said Abby Boggs, Air Force technology transfer specialist.

ITA SUCCESS STORIES

An Information Transfer Agreement (ITA) allows the government to share government developed software that is related to design or manufacturing activities with other entities. Software executable files, source code, or both may be shared under the agreement with industry or academic partners.



UNITED STATES AIR FORCE
TECHNOLOGY TRANSFER PROGRAM

AFRL SHARES UAV SOFTWARE TO FURTHER RESEARCH

Bihrle Applied Research Inc.
Hampton, VA

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – The 711th Human Performance Wing's Airman Systems Directorate is using an Information Transfer Agreement construct to provide commercial companies with access to its Vigilant Spirit Control Station software package, which allows operators to control multiple unmanned air vehicles (UAVs) at once.

The Department of Defense relies on a variety of UAVs to perform military functions. Similarly, commercial entities use UAVs as a cost-effective solution for numerous activities, including agriculture and forestry management, cellular tower inspection, and landfill monitoring. Because UAVs are piloted remotely, each one comes with operator software from the manufacturer.

Typically, software from the manufacturer is proprietary, meaning the customers can't modify the software source code in order to customize its capabilities. This is one of the reasons the Air Force had an interest in developing a new non-proprietary software capability that can work with multiple groups and brands of UAVs and be easily modified based on operator need. Most importantly, the software is needed to allow operators to maintain multi-vehicle and sensor control.

Captain Anthony Castello views the Vigilant Spirit Control Station at Wright-Patterson Air Force Base, Ohio. Engineers in the 711HPW's Supervisory Control & Cognition Branch developed the software which allows operators to control multiple UAVs at once. (Courtesy photo)

Engineers in the 711HPW's Supervisory Control & Cognition Branch developed the software with a focus on improved human/machine interface and adaptability. The software package offers multi-role, human-machine teaming and an advanced simulation and training component. It has been used in a variety of Air Force training and research & development activities.

"The Vigilant Spirit Control Station, also known as VSCS, was designed with the user experience in mind. We wanted it to be user-friendly, adaptable, and cost effective. It's providing a unique advanced capability for future DoD UAV systems," said Greg Feitshans, the chief engineer and program director for the software.

Because the source code is able to be modified depending on operator need, the software is an important research and development tool for both the Air Force and commercial UAV companies. As a result the 711HPW has entered into five information transfer agreements, also known as ITAs, with different commercial companies, with several more ITAs in the pipeline. The agreements allow researchers from the companies to use the software while protecting the Air Force's intellectual property rights.

An ITA with Bihrle Applied Research Inc. has become essential for continued testing of the integration of VSCS and the Jointly Optimal Conflict Avoidance sense and avoid algorithm. A team from Bihrle Applied Research is working with AFRL Aerospace Systems Directorate on the project.

"Having access to the software allows our algorithm development team to operate and observe the algorithm's dynamic interaction with the software controls and display functions in real time and under different encounter scenarios," said Jacob Kay, the director of sense and avoid technologies at Bihrle Applied Research. "This first-hand experience with VSCS greatly expedites our development, testing, and refinement process."

"By allowing government and commercial users to enter into such ITAs, VSCS is more likely to be adopted as a preferred software for controlling multiple UAVs," said Dr. James Kearns, the 711HPW Technology Transfer Program Manager. "The 711HPW also benefits by retaining control of its software while having access to any software enhancements developed by users under the agreements."

INFORMATION TRANSFER AGREEMENT ENABLES AFRL SOFTWARE SHARING WITH INDUSTRY

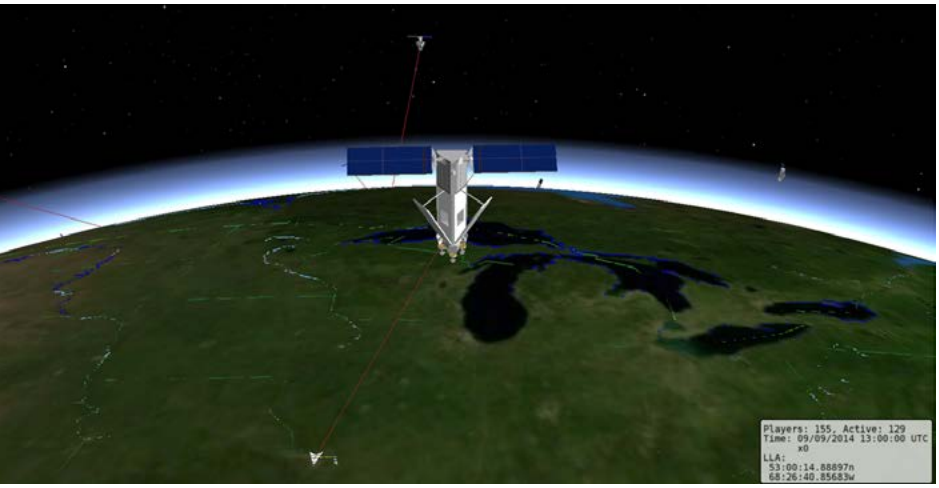
Multiple Agreement Partners

WRIGHT-PATTERSON AIR FORCE BASE, OHIO – The Air Force Research Laboratory Aerospace Systems Directorate used Information Transfer Agreements to transfer its Advanced Framework for Simulation, Integration and Modeling software, a robust simulation and modeling tool, to 80 industry partners for development and evaluation.

An ITA is a relatively new type of technology transfer agreement used by the Air Force to share government developed software, such as executable files or source codes that are related to design or manufacturing activities with external, non-DoD partners. These partners can include state and local governments, academia and industry, depending on the distribution statement applied to the technology being transferred. For AFSIM, the software can only be shared with industry partners due to its distribution limitations.

AFSIM was created to rapidly represent advanced technologies and technology concepts for both government and industry developments that were often difficult or impossible to accurately represent with existing legacy tools. It is a powerful, flexible software simulation tool for use in research and development (R&D), operations analysis, and experimentation communities.

The software covers domains from sub-surface to space and can be used to assess how military systems function throughout the course of a mission. Users can manipulate the abilities and interactions of the participants as they travel through space and time through constructive, virtual and mixed constructive/virtual engineering to mission-level analytic simulations.



The Air Force Research Aerospace Systems Directorate used Information Transfer Agreements to transfer its Advanced Framework for Simulation, Integration and Modeling software. AFSIM is a powerful, flexible software simulation tool for use in research and development (R&D), operations analysis, and experimentation communities. As simulated above, the software covers domains from sub-surface to space and can be used to assess how military systems function throughout the course of a mission. (Courtesy photo)

"The ability for industry to utilize a government tool, such as AFSIM for its internal R&D efforts is a game-changer," said Dave Panson, modeling and simulation lead for the Air Force Strategic Developmental Planning and Experimentation office.

Without an ITA, a contract would need to be established in order for an industry partner to utilize government owned software tools. At the end of the contract, the software would either be returned to the government or transitioned to another contract. For industry users, this option makes it challenging to both maintain and remain proficient in tools that are non-accessible.

More importantly, transitioning advanced concept models to a contract may result in the use of legacy tools built on older programming languages. In addition, it is becoming increasingly difficult to find individuals that possess experience with using older programming languages.

However, these agreements allow industry to have complete access to the software, thus saving time, money and resources. For example, the AFSIM ITA helped create a common framework where all collaborators who are performing engineering to mission-level modeling and simulation for R&D could engage.

This common framework assists both Air Force and collaborators with reductions in duplications during model development, minimizes technology integration on cooperative efforts, and provides the ability to perform comparisons and software improvements.

"Before AFSIM, we lacked a common simulation framework which could be widely distributed with minimal barriers for adoption, leading to duplication of effort on many projects," said Brian Birkmire, AFSIM model manager.

The Air Force is committed to AFSIM and plans to fully fund its continued development and sustainment. As AFSIM is adopted over time, the return on investment for this technology will be realized in time and money savings across the entire Department of Defense.

MID-CONTINENT REGION NOTABLE TECHNOLOGY DEVELOPMENT 2017 FLC AWARD

The Structure for Storing and Unfurling a Flexible Material (U.S. Patent 8,356,774), an Air Force owned invention, demonstrated in this solar technology.
(Photo credit: AFRL/RVSV)

AFRL Space Vehicles Directorate

AFRL/RV received the 2017 Federal Laboratory Consortium Mid-Continent Region Technology Development award for entering into two exclusive patent licensing agreements with Roccor LLC. The agreements will enable the company to build a large number of Solar Array Development Systems to support mega-constellations. Under the two PLAs, Roccor will undertake development and marketing of the following six (6) AFRL/RV patents: U.S. Patent 7,895,795, titled "Triangular Rollable and Collapsible Boom"; U.S. Patent 8,356,774, titled "Structure for Storing and Unfurling a Flexible Material"; U.S. Patent 7,354,033, titled "Tape-Spring Deployable Hinge"; U.S. Patent 7,435,032, titled "Resilient Joint for Deployable Structures"; U.S. Patent 8,462,078, titled "Deployable Shell with Wrapped Gores"; and U.S. Patent 8,434,196, titled "Multi-Axis Compliant Hinge."

AFRL TECHNOLOGY TRANSFER MANAGER RECEIVES REGIONAL 2017 FLC AWARD

Tina Culpepper, Technology Transfer Manager
Air Force Research Laboratory Sensors Directorate

Ms. Culpepper received the 2017 Federal Laboratory Consortium Midwest Regional Excellence in Technology Transfer award for her work securing the directorate's first patent licensing agreement.

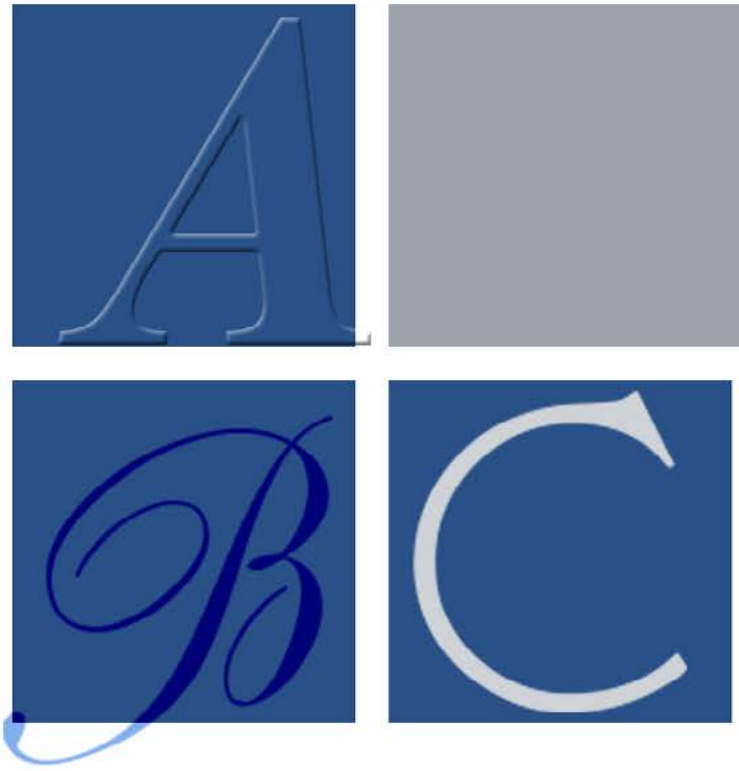
The award recognizes Culpepper's effort in the transfer of the Active Shooter Protection System (ASPS), a technology developed by the Air Force during the 2015 Air Force Research Laboratory Commander's Challenge. (Read the full story on page 23.)

At the outset, Culpepper helped facilitate the invention disclosure process and set expectations for the parties involved. She engaged the Air Force attorneys and the inventor team in order to complete a patent application with the USPTO. Ultimately, when Protective Innovations expressed interest, Culpepper worked with them to apply for the license, reviewed their business plan and license application – and began negotiating the exclusive license on behalf of the Air Force. Creatively, she used a new patent analytics tool to help assess patentability and determine the value of the IP.

Culpepper consulted with TechLink, a Department of Defense Partnership Intermediary and conducted formal market research to assess the commercial potential and market viability. She also consulted with the Air Force law office on legal aspect of the agreement. Her work enabled this effort to be a success.

Tina Culpepper

ACRONYMS



UNITED STATES AIR FORCE
TECHNOLOGY TRANSFER PROGRAM

	ACRONYM	UNABBREVIATED
A		
	AFB	Air Force Base
	AFIT	Air Force Institute of Technology
	AFLCMC	Air Force Life Cycle Management Center
	AFRL	Air Force Research Laboratory
	AFRL/RQ	Air Force Research Laboratory Aerospace Systems Directorate's
	AFRL/RX	Air Force Research Laboratory Materials and Manufacturing Directorate
	AFLR/RYDI	Air Force Research Laboratory Sensors Directorate, Integrated Circuits and Microsystems Branch
	AFSIM	Advanced Framework for Simulation, Integration and Modeling
	AMBUS	ambulance bus
	APOP	Aerospace Propulsion Outreach Program
B		
	BGSU	Bowling Green State University
C		
	CRG	Cornerstone Research Group
	CRADA	Cooperative Research and Development Agreement
	CSTARS	Centers for the Sustainment of Trauma and Readiness Skills
D		
	DoD	Department of Defense
	DSTG	Defense Science and Technology Group
E		
	ECSC	Emerald Coast Science Center
	EPA	Educational Partnership Agreement
F		
	FLC	Federal Laboratory Consortium for Technology Transfer
H		
	HCIC	Hanscom Collaboration and Innovation Center
	HEMT	Hole-to-Edge Measurement Technology
	HPW	Human Performance Wing
I		
	IP	Intellectual Property
	ITA	Information Transfer Agreement
M		
	MEMs	micro-electrical mechanical mirror devices
	MSU	Michigan State University
	MTA	Material Transfer Agent
N		
	NFW	Natural Fiber Welding
	NVLAP	National Voluntary Laboratory Accreditation Program
O		
	OMEP	Oregon Manufacturing Extension Partnership
	ORTA	Office of Research and Technology Applications
P		
	PEMF	pulsed electromagnetic field
	PIA	Partnership Intermediary Agreement
	PLA	patent licensing agreement
	PNT	position, navigation and time
Q		
	QLD	Queensland
	QUT	Quensland University of Technology

	ACRONYM	UNABBREVIATED
S		
	SBIR	Small Business Innovative Research
	SERL	Small Engine Research Lab
	SiC	silicon carbide
T		
	tDCS	transcranial direct current stimulation
	TMS	transcranial magnetic stimulation
U		
	USAARL	U.S. Army Aeromedical Research Laboratory
	UAS	Unmanned Aircraft Systems
	USAFSAM	United States Air Force School of Aerospace Medicine
	USAF	United States Air Force

CONTACT INFORMATION

Air Force Technology Transfer agreements are facilitated by the Air Force Technology Transfer Program Office and its affiliated Office of Research and Technology Applications (ORTA). An ORTA is embedded at many Air Force research locations.

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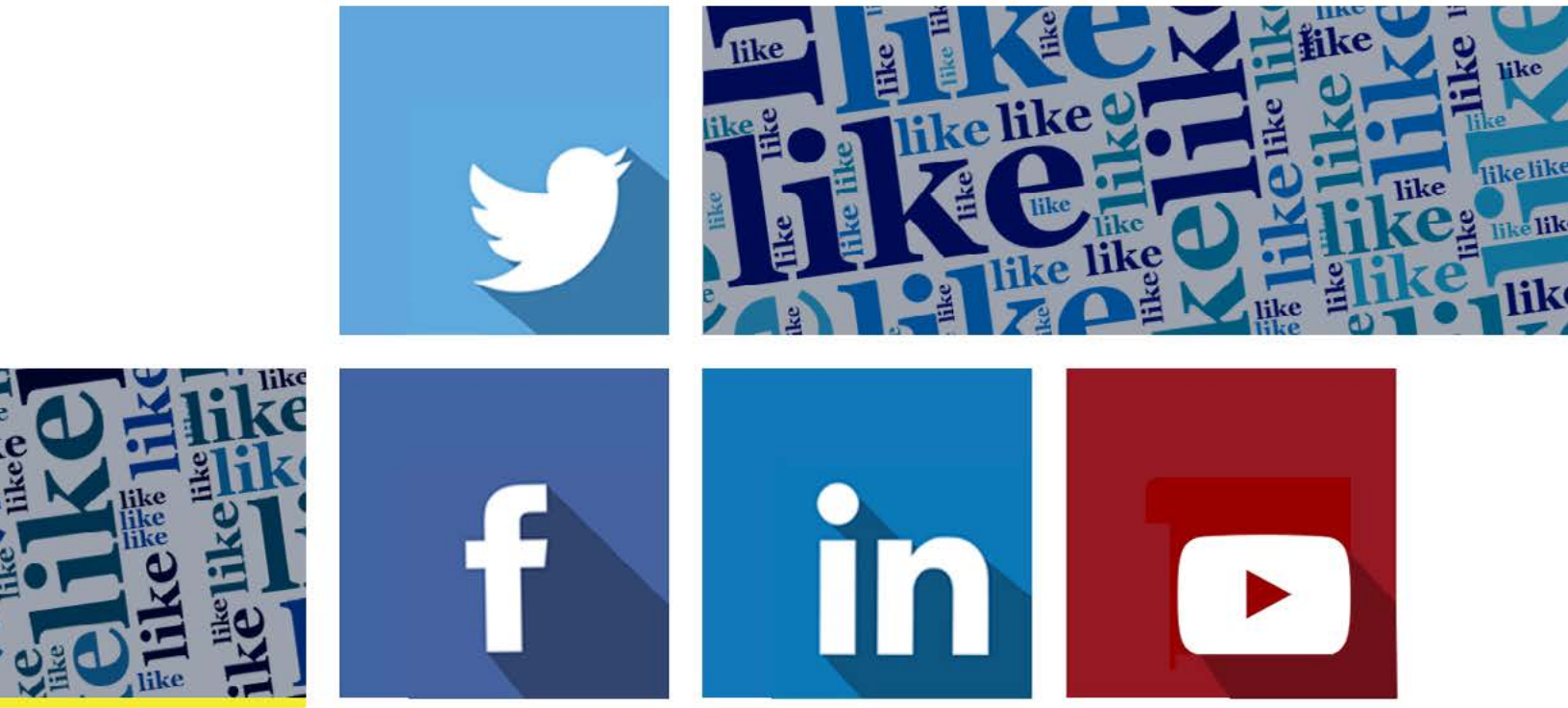
The Air Force Technology Transfer Program Office is presently supporting several organizations such as the Air Force Nuclear Weapons Center, Air Force Weather Service, and the Space and Missile Center.

UNITED STATES AIR FORCE
TECHNOLOGY TRANSFER PROGRAM

SOCIAL MEDIA



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