$12.2M

DOD Funding at Vanderbilt, FY 2022

Soldiers partner with Vanderbilt researchers to create a new model for innovation

Soldiers from the 101st Airborne Division, the 160th Special Operations Aviation Regiment, and 5th Group at Fort Campbell have teamed up with researchers at Vanderbilt University to solve tactical problems to support soldier missions and enable strategic new Army capabilities that benefit national security. The five-year education partnership agreement between Vanderbilt and Army Futures Command is a potential model for military-academic collaboration across the region and the nation.

A team of Vanderbilt engineers has completed a collaborative project with the 101st Airborne Division to design and test a first-of-its-kind exoskeleton that supports U.S. Army soldiers participating in sustainment and logistics operations. The exoskeleton—the Soldier Assistive Bionic Exosuit for Resupply, or SABER—is being prepared for manufacturing and commercialization by HeroWear and for field use by the Army. This work is part of the Department of Defense-funded Pathfinder Project, one avenue for advancing the Army Futures Command's modernization goals.

Also funded by Pathfinder, a professor of ophthalmology and visual sciences is addressing concerns from the U.S. Army and 160th Special Operations Aviation Regiment on the impact of aircraft’s percussive forces on the performance and health of soldiers. The project could benefit soldiers by optimizing their neuromotor developmental performance through suggested behavior protocol and by improving aircraft design and equipment to reduce the effects of in-flight vibration and percussion.

These two projects are the tip of the Pathfinder iceberg at Vanderbilt. Several teams of transdisciplinary researchers, soldiers and industry partners are collaborating on additional projects to pioneer technologies that could benefit both soldiers and civilians, advancing the complementary missions of Army Futures Command and Vanderbilt to further modernize the U.S. Army and improve the human condition. To support these and future collaborations, Vanderbilt has invested in equipment for rapid prototyping and mobile measurements to advance soldier-centered innovation at Fort Campbell. By partnering with the University of Tennessee on future applied research solutions, the effort will accelerate learning for both soldier and civilian students in STEM management, entrepreneurship and design, as well as provide the Department of Defense additional laboratory space and expertise to address modern challenges facing soldiers.

Vanderbilt computer science professor leads DARPA project to improve machine learning

An assistant professor of computer science in the School of Engineering received a DARPA award to seek ways to improve statistical modeling of machine-learning systems’ outputs. The $875,000 grant, part of DARPA’s Artificial Intelligence Exploration Opportunity on Enabling Confidence, focuses on scalable methods to generate accurate statistical models for the outputs of machine-learning systems and allows for computationally efficient and rapid propagation of input uncertainties into the output of ML systems. The goal is to advance fundamental research and apply the team’s cutting-edge tools to critical applications, such as surgical operations.

That same professor was awarded another grant from DARPA for $1 million to create advanced artificial intelligence programs that will enable machines to learn progressively over a lifetime and share those experiences with each other. The prototype project received the award as part of the agency’s Shared-Experience Lifelong Learning initiative. DARPA wants to develop AI agents that share their experiences with each other and is seeking innovative basic or applied research concepts in lifelong learning. The real-world uses of this new technology could include cooperating self-learning autonomous vehicles such as self-driving cars, robotic rescue and exploration systems, distributed monitoring systems to detect emergencies, or cybersecurity systems of agents that monitor large networks.

Vanderbilt to lead $5 million Air Force center of excellence in radiation effects research on electronics

The Institute for Space and Defense Electronics at Vanderbilt University has been selected as the Center of Excellence in Radiation Effects by the U.S. Air Force Office of Scientific Research and the Air Force Research Lab. The $5 million, five-year program will develop tools, experimental techniques, theoretical understanding, and models that can be applied to multiple emerging technologies that will be integral to advanced satellite systems, GPS navigation, remote sensing, communications, and other electronics applications. The capabilities developed through the center will contribute to a wide range of Department of Defense programs and systems. The DOD currently funds work on many electronic and photonic systems that have the potential to provide dramatic improvements in space microelectronics, but little is known about how these new systems will perform or survive in extreme environments, particularly those with significant radiation requirements.

With approximately $5 million in annual funding from the Navy, the Air Force, the Defense Threat Reduction Agency, NASA and more than 20 commercial enterprises, ISDE is one of the only academic programs directly supporting the DOD in radiation effects for strategic applications and is one of very few programs involved in microelectronics research for space applications. Over the past decade, ISDE has trained more than 150 engineers with master’s degrees and Ph.D.’s. These highly trained individuals go on to support our nation’s efforts in radiation hardening and microelectronics research. In addition to government and industry positions, many of them have gone on to work in academia, training future generations to create a sustainable workforce.
**Institute for Software Integrated Systems**

Founded in 1998, Vanderbilt's Institute for Software Integrated Systems is a key national player in an effort to design the software-integrated systems that have become an essential part of human lives today—in consumer appliances, vehicles, planes, hospitals, schools, design shops, factories, space systems and the energy sector. Major sponsors of the institute include the Defense Advanced Research Projects Agency, the Air Force, the Army, the Navy, the National Science Foundation, the National Security Agency, the Department of Energy, the Department of Education and NASA. The institute has received more than $243 million in federal funding since 1998—approximately 60 percent of which is from DOD.

From its inception, the Institute was intentionally designed to address defense needs and enable protection against cyberattacks in real-world systems (e.g., power grids, transportation, robotics) and translation of high-impact solutions into the hands of national security and armed forces end-users. Since 2012 they have served as a Science of solutions into the hands of national security and armed forces and have one of six national Science of Security Tablets.

**DOD SBIR/STTR funding at Vanderbilt**

Four companies with ties to Vanderbilt are recipients of highly competitive Small Business Innovation Research/Small Business Technology Transfer grants from DOD:

- **ARMS Cyber Defense Inc.**—develops adaptive cyber technologies for creating a strategic defender advantage.
- **HeroWear LLC**—designs back-assist exosuits to reduce strain on the back while fitting like a comfortable piece of clothing.
- **SkyNano LLC**—a science-based technology company that focuses on commercializing a free-market solution to carbon pollution.
- **International FemtoScience Inc.**—develops and utilizes functionalized diamond nanoparticle technologies to produce products as additives for enhanced thermal and mechanical performance of liquids and solids.

The SBIR/STTR program encourages domestic small businesses to engage in federal research and development with the potential for commercialization and enables small businesses to explore their technological potential and provides the incentive to profit from its commercialization. This program is crucial to the innovation ecosystem at Vanderbilt, especially as it relates to getting research and development off the ground in the early stages of these companies. In 2021, nine startups with roots at Vanderbilt were awarded more than $4.5 million in SBIR/STTR grants and matching funds from Launch Tennessee.

The Wond’ry, Vanderbilt's Innovation Center, and the Center for Technology Transfer and Commercialization at Vanderbilt University contributed to the startups’ growth in various capacities, from assisting with ideation and R&D to facilitating invention disclosures and commercialization services. Founders of these startups span Vanderbilt faculty, alumni, staff and students.

According to Launch Tennessee, companies awarded their SBIR/STTR matching funds have created more than 505 direct jobs and had an economic impact of $146,125,214 in Tennessee—a return of $11.24 for every public dollar invested into the program.

**DOD supports Vanderbilt students**

A first-year student in the Vanderbilt School of Engineering was selected as a DOD SMART scholar. The Science, Mathematics and Research for Transformation award is designed to enhance the DOD workforce with "talented, innovative and brilliant scientists, engineers and researchers" by supporting students. The award provides students with mentorship, summer internships, a stipend, and full-time employment with the DOD after graduation.

Seniors in the College of Arts and Science and the School of Engineering were named 2022 Barry M. Goldwater Scholars, one of the nation's most competitive scholarships, in collaboration with DOD’s National Defense Education Program. The program is for undergraduate STEM students who show exceptional promise for becoming the nation's next generation of research leaders.

Two engineering doctoral students received 2021 National Defense Science and Engineering Graduate Fellowships. Sponsored and funded by DOD, the NDSEG Fellowship is a highly competitive fellowship awarded to U.S. citizens and internationals who intend to pursue a doctoral degree in one of 15 supported disciplines.

Peabody College of education and human development doctoral students were awarded 2022 David L. Boren Fellowships which support graduate students pursuing the study of languages, cultures and world regions that are critical to U.S. interests. Boren Scholarships fund undergraduate students who wish to work in the federal national security area as they study less commonly taught languages. These awards are an initiative of the Defense Language and National Security Education Office.

**Novel advanced light design and fabrication process could revolutionize sensing technologies**

Engineering researchers at Vanderbilt, with support from DOD, have developed a new way to make thin-film infrared light sources along with a machine-learning program that helps them quickly design these light sources in a matter of minutes, instead of weeks or months that it would take on a multi-core computer. Developing infrared light sources this way is inexpensive and more efficient and can be used for free-space communications, infrared beacons for search and rescue, and molecular sensors for monitoring industrial gases, environmental pollutants, and toxins.

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