



\$21.6 MILLION

NSF Funding at Vanderbilt in FY 2018

11

Active NSF CAREER Awards for FY 2018

3

New NSF CAREER Awards for FY 2018

Catalyzing cyber-physical research across the nation

Vanderbilt University researchers are leaders in cyber-physical systems (CPS) research, extending the use of the internet to create a deeply connected world where humans, their machines, and the physical environment interact seamlessly, continuously, and without mistakes and breakdowns that could lead to safety issues.

Vanderbilt's Institute for Software Integrated Systems is managing the Cyber-Physical Systems Virtual Organization for NSF, linking together all of the organizations working on the topic, archiving and disseminating documents produced by research, and offering collaboration and experimental platforms for thousands of CPS researchers. In 2015, Vanderbilt, with collaborators from other institutions, won a \$3.2 million grant from NSF to support the project, with a commitment of an additional \$2.4 million over the next two years. In 2017, the institute received a \$4 million, five-year grant from NSF to develop and test the concept of incorporating social norms, policies, and values into these new generations of systems.

NSF I-Corps Program at Vanderbilt

The I-Corps program prepares scientists and engineers to extend their focus beyond the university laboratory and accelerates the economic and societal benefits of NSF-funded, basic research projects that are ready to move toward commercialization. These grantees learn to identify valuable product opportunities that can emerge from academic research and gain skills in



This "smart" prosthetic ankle has a tiny motor, actuator, sensors, and chip that work together to either conform to the surface the foot is contacting or remain stationary, depending on what the user needs. (Photo: Vanderbilt University)

entrepreneurship through training in customer discovery and guidance from established entrepreneurs.

At Vanderbilt, I-Corps is helping researchers navigate the commercialization process for a new "smart" prosthetic ankle that moves with the user; conduct market research for a virtual environment to find a virtual reality-based addiction treatment solution for drugs or alcohol; and form a new company to develop a disposable CO₂ system for inflating the colon during colonoscopies, so doctors can view areas between folds. Vanderbilt is an I-Corps site.

Recent CAREER Awards at Vanderbilt

The Faculty Early Career Development (CAREER) Program is a foundation-wide activity that offers NSF's most prestigious awards in support of early-career faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of their organizations.

An assistant professor of psychology at Vanderbilt's Peabody College was awarded a Faculty Early CAREER grant to study Developmental Dyscalculia, which is a specific learning disability that affects otherwise typically developing children by impairing their arithmetic skills. It affects approximately 6 percent of Americans. He is part of a cadre of early-career scholars who are setting the agenda for a new discipline at the intersection of education and brain science.

An assistant professor of biomedical engineering received a CAREER grant to fund the development of a next-generation wearable ultrasound device to enable real-time ultrasonic visualization of blood flow and pressure in the brain, without the use of contrast agents, and translate these signatures into action. His team expects the portable ultrasound helmet prototypes will resolve ultrasound image quality problems, and the new integrated algorithms will lead to new techniques for both understanding brain activity and using it to interact with computers.

A paleontology researcher was awarded a CAREER grant to study the teeth of ancient and modern mammals to determine how their diets changed across the millennia and, by extension, their responses to climate change. Her research confirms the shape of tooth wear best indicates what they were eating, not how arid their environment was. For this study, she and a team of Vanderbilt graduate and undergraduate students analyzed casts and photographs of teeth from koalas and kangaroos that died over the past few decades to compare with modern climate and dietary data.

Education programs funded by NSF

Sixteen Vanderbilt graduate students won prestigious NSF graduate research fellowships in 2018, bringing our total number of fellows to 67. The program is aimed at aiding individuals who have demonstrated notable potential early in their research careers and increasing the diversity of the science and engineering workforce. The fellowships provide three years of support within a five-year fellowship period.

Tennessee State University and Vanderbilt are partnering to lead an expansion of the Tennessee Louis Stokes Alliance for Minority Participation (TLSAMP), a NSF-funded collaborative effort by 10 Tennessee colleges and universities to increase and improve the retention of underrepresented minority students in STEM fields statewide. Vanderbilt is the inaugural host of the expansion through a "bridge-to-doctorate program" that is funding 12 students this year.

The TLSAMP program builds upon the success and lessons learned from the Fisk-Vanderbilt Master's-to-Ph.D. Bridge Program. Launched in 2004 with NSF support, the Fisk-Vanderbilt two-year program

has built a detailed, research-based toolkit to support underrepresented minority students on their path to earning Ph.D.'s and has made Vanderbilt the leading producer of underrepresented minority Ph.D.'s in astronomy, materials science, and physics in the U.S. As of 2018, 137 students have participated in the Bridge Program; 30 have completed their Ph.D.'s; and all 30 have secured jobs in STEM fields.

Vanderbilt Institute for Nanoscale Science and Engineering (VINSE) has hosted a NSF-funded Research Experience for Undergraduates (REU) site program on campus since 2011. VINSE REU attracts undergraduates from across the country to Vanderbilt and also provides valuable supplementary enrichment and social activities to the participating students. In its eight years of operation, VINSE REU has provided opportunities to 89 students who have gone on to win numerous national awards, including thirteen NSF graduate research fellowships.

Vanderbilt also received one of NSF's inaugural INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science) awards. INCLUDES aims to improve access to STEM education and career pathways on a national scale, making them more widely inclusive to underserved populations.

"These could revolutionize the world" - Cheap, small carbon nanotubes

A Vanderbilt team of mechanical engineers and material scientists discovered the blueprint for turning the carbon dioxide in toxic air into the most valuable material ever sold - carbon nanotubes with small diameters. Carbon nanotubes are supermaterials that can be stronger than steel and more conductive than copper. The reason they're not in every application from batteries to tires is because they are extremely expensive, but the Vanderbilt team developed a way to produce carbon nanotubes that is much cheaper than any other method out there. These materials could steer the conversation on carbon emissions from their negative impact to their potential uses in future technology. The team has launched a company based on this patent-pending technology, and is incubating at Oak Ridge National Laboratory in the Innovation Crossroads Program.

