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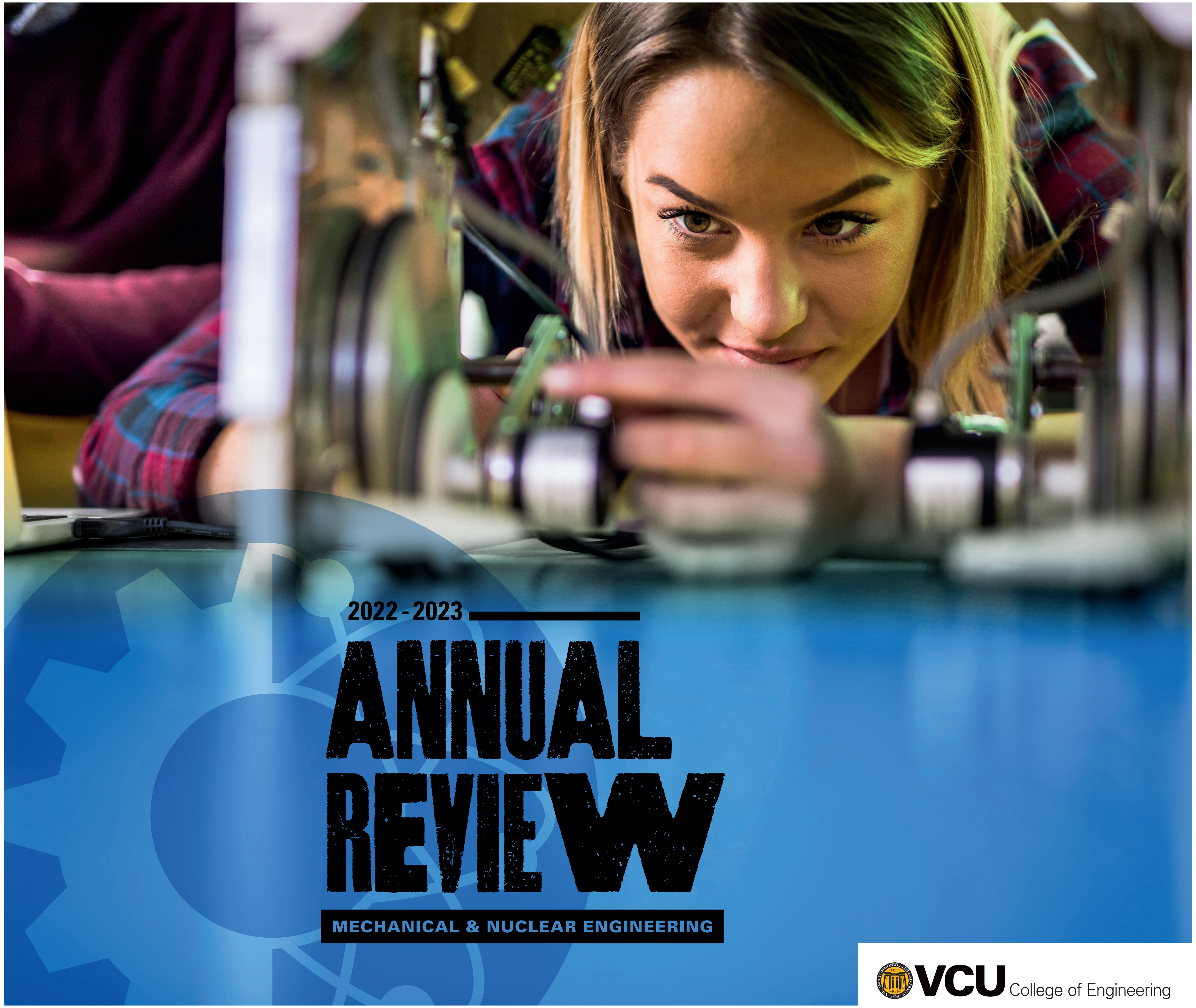


2022 - 2023

ANNUAL REVIEW

MECHANICAL & NUCLEAR ENGINEERING

VCU College of Engineering

CRUISING TO FIRST PLACE

ON A CUSHION OF AIR AT ASME'S INNOVATIVE ADDITIVE MANUFACTURING 3D CHALLENGE

Students from the VCU chapter of the American Society of Mechanical Engineers (ASME) recently won first place in ASME's Innovative Additive Manufacturing 3D (IAM3D) challenge.

Fifteen teams participated in the competition, which challenged students to use additive manufacturing to build a hovercraft capable of navigating a course, securing a package and delivering it.

"Our first hovercraft was a rudimentary one made of a fan, cardboard and trash bags," said **Ishaan Thakur**, vice president of the VCU ASME chapter and project manager for the IAM3D challenge. "We wanted to give our team the ability to test concepts and experiment with different parameters that can impact a hovercraft's ability to fly. Should we put a skirt on the bottom? Will having small perforations increase stability? What's the best way to let air flow out from underneath? Since the materials were cheap, we were able to make several of these prototypes and learn valuable lessons that informed our final design."

VCU Engineering's hovercraft was built from this iterative design process. Students collaboratively developed the vehicle's chassis, power systems, hover devices and payload delivery mechanism. Mechanical, electrical and computer engineering students comprised the majority of the team who worked together on this project.

VCU ASME students pilot their hovercraft through the IAM3D challenge obstacle course.

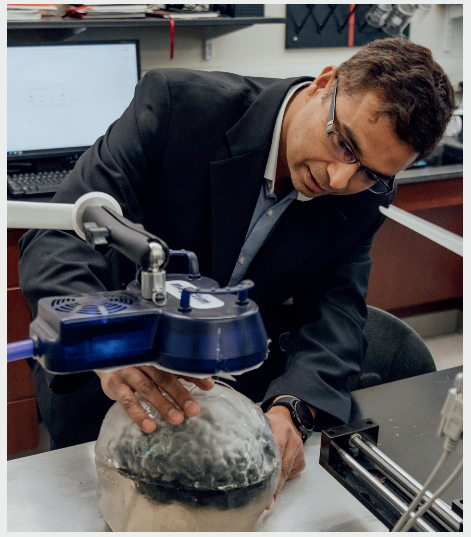
RESEARCHERS USE COMPUTER MODELS AND SIMULATIONS TO PREDICT SATELLITE RESILIENCE

Gennady Miloshevsky, Ph.D., is an associate professor of mechanical and nuclear engineering who specializes in computational physics with an emphasis on plasma, lasers and particle beams. He works to predict the behavior and state of materials when under extreme pressure, temperature and radiation.

With funding from the Defense Threat Reduction Agency (DTRA), an agency of the U.S. Department of Defense (DoD), Miloshevsky is studying the effect weapons of mass destruction have on satellites within Earth's orbit. Part of Miloshevsky's research involves developing methods to computationally simulate temperature, pressure and radiation in order to study the state known as "warm dense plasma," which occurs between the solid and classical plasma states and exhibits the characteristics of both.

Miloshevsky's research includes quantifying and reducing the uncertainty of computer model material properties, such as diamond, under the conditions of a nuclear blast using the REODP (Radiative Emissivity and Opacity of Dense Plasmas) computer code he developed. He works to understand and predict the interaction between X-rays and satellite surface materials (like silicon, germanium and other materials used to make solar panels) during a nuclear detonation in space.

Practical experiments in a lab use lasers to replicate the heat and pressure generated by X-ray radiation, shock and other physical effects of a nuclear detonation. Miloshevsky's colleagues at the John Hopkins Extreme Materials Institute heat carbide diamond and silica materials typically found in solar panels to temperatures between 11,600 and 1,160,000 Kelvin using lasers at the University of Rochester and Pacific Northwest National Laboratory to observe this momentary transformation into warm dense plasma. Researchers then use shadowgraphy, spectroscopy and other visual analytical methods to quantify the result. They can also investigate the depth, size and shape of the crater created by the laser within the material surface.



PHYSICAL MODELS OF A PATIENT'S BRAIN HELP RESEARCHERS TREAT NEUROLOGICAL DISORDERS AND DISEASES

Brain phantoms are a creative solution for a challenging question: How do you tune an electromagnetic field to a patient without testing on the actual patient? Transcranial magnetic stimulation (TMS) is an application of electromagnetic research with the potential to change the way we treat migraines, depression, obsessive compulsive-disorder and even conditions like schizophrenia and Parkinson's disease.

Ravi Hadimani, Ph.D., associate professor of mechanical and nuclear engineering, leads a team of researchers who seek to use TMS to excite or inhibit brain neurons to alter specific brain functions and treat these conditions.

Designed to specifications obtained from MRI scans, brain phantoms are a physical model of a patient's brain. Materials used in brain phantom construction are designed to replicate the electrical conductivity and electromagnetic permeability of different brain sectors. The result is a representation that, when connected to electrodes, provides instantaneous feedback to researchers calibrating TMS coils.

Scan to learn more about Mechanical & Nuclear Engineering at VCU.