

RESEARCH SUMMARY

tickle.utk.edu/research



COLLEGE OVERVIEW

Over the past several years, research in the Tickle College of Engineering (TCE) has grown by leaps and bounds with increases in funding, leadership positions, and new facilities as well as significant growth in PhD student involvement.

Productivity

- \$85.6M annual research expenditures from NSF, DoE and UT-Battelle, DoD, industry, the State of Tennessee, and other federal and private agencies.
- TCE has 15% of UT's tenure-line faculty producing 50% of UT's externally awarded research expenditures.

Faculty

- 181 TT and 67 non-TT faculty members.
- 3 NAE members; 11 UT-ORNL Governor's Chairs; 2 Distinguished Professors; 1 Distinguished Scientist; 39 endowed chairs/professorships and faculty fellows.
- 24 Early Career Awards (NSF, DoE, DARPA, AFOSR, and ARO) since 2016.

Intellectual Property

TCE is firmly committed to translating basic research outcomes to technology solutions for society through intellectual property (IP) development. TCE faculty members are among the most active participants in the technology commercialization efforts of the UT Research Foundation.

In the past 2 years, TCE has yielded 141 IP disclosures, 24 patents, 11 licenses/options, and 2 startups.

Undergraduate Research

In AY2018, about 300, or 10%, of undergraduates pursued research projects with supervision from over 100 faculty members on campus and at JIAM, ORNL, and off-site locations such as the Thomas Jefferson National Accelerator Facility.

Engineering Research Support

The Engineering Research Office is a difference maker for accelerating and diversifying faculty funding success through providing research development and proposal support for a great variety of agencies and foundations.

Zeanah Engineering Complex

This high-tech, 228K-sq-ft building will open in the fall of 2021 and house the Stoneking *engage* Engineering Fundamentals and Cook Grand Challenge Honors programs, the Min H. and Yu-Fan Kao Innovation and Collaboration Studio, the top-ranked Department of Nuclear Engineering, and flexible research laboratories.

RESEARCH STRENGTHS

An increase in the quality of faculty and a broadening of facility capabilities has diversified the college's research portfolio. Particular areas of strength include:

Energy

- Pioneering technologies for **resilient and sustainable power grids** to improve power grid performance.
- Developing **novel catalytic processes** for biomatter to create clean, sustainable biofuels and biodegradable plastics.
- Creating novel, smart devices for **microgrids** and **new-generation power electronics**.
- Advancing technologies and materials for **energy conversion and storage**.



Advanced Manufacturing

- Improving **hybrid and soft materials** and fabrication for novel functionality and sustainable processing, including large-area additive manufacturing, novel coatings, and light-weight composites.
- Enabling real-world **additive manufacturing** through nanoscale welding, 3D printing strategies, and precision engineering for metals.

Next-Generation Materials

- Creating customizable **2D functional materials** for superior superconductors, magnets, and quantum computers.
- Developing **new scintillators** to improve medical imaging, homeland security, and nuclear non-proliferation.
- Engineering **materials for extreme environments** like nuclear reactors, hypersonic flight, and outer space.

Future Computing

- Leading research in software and hardware development for future **exascale computing**.
- Designing adaptive, self-learning **neuromorphic computers** for real-time data analysis.

Revolutionary Aviation

- **Reimagining wing design** for faster, more fuel efficient, and safer next-generation commercial aircraft.
- Developing and testing designs, materials, and manufacturing solutions for sustained **hypersonic flight**.

Healthcare, Robotics, and Smart Technologies

- Designing and testing **computer-assisted technologies** for rehabilitation, prosthetics, and surgical procedures.
- Advancing **smart health-management technologies** to collect, integrate, and interpret real-time health data.
- Linking the **brain-computer interface** via non-invasive technologies to enhance human performance.



Environmental Engineering

- Harnessing sensor technologies, data analytics, and high-performance computing for **dynamic urban systems** and **sustainable environmental technologies**.
- Remediating contamination and wastewater and protecting environmental resources through **microbial engineering**.

RESEARCH INSTITUTES AND CENTERS

UT Space Institute

Located in Tullahoma, Tennessee, UTSI provides a unique blend of facilities for large-scale aviation research, including a high-speed wind tunnel, propulsion laboratory, large vacuum chamber, and high-temperature combustion facility.



Institute for Advanced Composites Manufacturing Innovation

IACMI is a UT-led \$259M private-public partnership focusing on advanced fiber-reinforced polymer composites combining strong fibers with tough plastics to yield materials lighter and stronger than steel.

Center for Ultra-Wide-Area Resilient Electric Energy Transmission Networks

A collaborative Engineering Research Center funded mostly by the National Science Foundation and DoE, CURENT works closely with industry to improve the power grid through breakthrough monitoring, response techniques, and devices.

Innovative Computing Laboratory

A world leader in enabling technologies and software for high performance computing, ICL provides state-of-the-art tools to tackle challenging problems and develop scientific computing standards.

Center for Materials Processing

Designated by the State of Tennessee as a Center of Excellence, CMP supports teaching and conducting basic and applied research that emphasizes relationships among processing, structure on various scales, and properties of all classes of materials. CMP fosters faculty and student relationships with industrial partners through a variety of memberships.



Scintillation Materials Research Center

SMRC is supported by Siemens Medical Solutions and federal agencies for the discovery and development of new scintillation materials with applications in medical imaging and national security.

Joint Institute for Advanced Materials

JIAM is an interdisciplinary faculty community focused on creating novel quantum materials, advanced functional materials, and next-generation soft polymers.

Center for Transportation Research

CTR addresses technical and policy issues about highway safety, railway and inland waterway systems, transportation economics and planning, and traffic demand modeling with support from the Tennessee Department of Transportation and the federal government.

Institute for a Secure and Sustainable Environment

As a THEC Center of Excellence, ISSE's mission to build a sustainable environment includes deploying alternative fuel technologies, conducting water resources-related research, determining the impact of climate on societal food supply, and improving methane-related environmental impact while engaging constituencies to improve water management and utilization.



PARTNERSHIP WITH OAK RIDGE NATIONAL LABORATORY

The decades-long UT-ORNL partnership links complementary expertise and resources to provide unparalleled research and education opportunities through shared faculty and facilities and direct research funding. The relationship was strengthened in 2000 when UT-Battelle LLC assumed management of ORNL.

Collaborative efforts include Governor's Chair, Distinguished Scientist, and Joint Faculty programs as well as the Bredesen Center for Interdisciplinary Research and Graduate Education. Facilities available to TCE include the Spallation Neutron Source, High Flux Isotope Reactor, and Manufacturing Demonstration Facility. This relationship was further strengthened by the implementation of the Oak Ridge Institute in 2020 that initiated with \$20M in federal funding.

For both TCE and ORNL personnel working at UT, research is supported by more than \$12M in annual ORNL funding.

UT-ORNL Governor's Chair Program

This program has brought world-renowned researchers from several fields to the college. The funding brought in by these professors is measured in the tens of millions, while the research done under their watch has elevated the intellectual capacity of UT and benefited doctoral, graduate, and undergraduate students through research opportunities.

