

World
Class
Research

TSU

*Boldness
Innovation
Creativity*

2017

Annual Report

RESEARCH HORIZONS



TENNESSEE
STATE UNIVERSITY

Division of Research and
Institutional Advancement

Excellence

FROM THE VICE PRESIDENT



LESIA CRUMPTON-YOUNG, PH.D.

Vice-President

Division of Research and Institutional Advancement
Tennessee State University

Recipient of 2017 HBCU Innovation Award

Greetings,

I am excited that our faculty, staff, and students continue to engage in cutting-edge research activities that advance discovery and fuel innovation! New research and sponsored program awards received at Tennessee State University (TSU) have grown tremendously during the last three years, with more than 500 new projects garnering an additional over \$149,000,000 in external support. This increase in the number of new awards and funding attests to the high quality research being conducted by faculty, staff, and students at TSU.

The President, members of the University administration, and staff within the Division of Research and Institutional Advancement have implemented initiatives that foster an environment where faculty can produce research solutions that address global challenges confronting society. These efforts have led to the development of a vast portfolio of innovative research programs spanning a variety of critical areas and disciplines including: animal science, plant genetics, biotechnology, food safety and security, robotics, autonomous vehicles, physics and astronomy, learning sciences, health disparities, nutrition, mechatronics, advanced materials, cyber security, advanced manufacturing, and renewable energy.

I am confident that research activities will continue to grow on our campus as we continue our commitment to producing research solutions that benefit local and global communities. We look forward to forging new partnerships and embarking upon new challenges. I commend our faculty, staff, and students for their hard work and continued efforts that reinforce our university mantra and clearly demonstrate that "Excellence is our Habit!"

Sincerely,

LESIA CRUMPTON-YOUNG, PH.D.

Chief Research Officer

Vice President for Research and Institutional Advancement

TSU AT A GLANCE

UNDERGRADUATE
STUDENT-FACULTY RATIO

17 to 1

77
DEGREE
OFFERINGS



COLLEGE OF
ENGINEERING
AWARDED
"BEST STEM
PROGRAM 2017"
BY HBCU
DIGEST

CAMPUS ACRES
520

405
FULL-TIME
ACADEMIC
FACULTY

FISCAL YEAR 2016
200 AWARDS
AT OVER

\$54.4M

FISCAL YEAR 2017
209 RESEARCH AWARDS
VALUED AT OVER
\$43.5M

FISCAL YEAR 2015
172 AWARDS
AT OVER
\$51.5M

FALL 2016
UNDERGRADUATE
ENROLLMENT

7,007

FRESHMAN
ENROLLMENT
INCREASE IN FY 2017

17%

FALL 2016
GRADUATE
ENROLLMENT

1,746



COLLEGES OF THE UNIVERSITY

College of Agriculture, Human, and Natural Sciences

Department of Agriculture and Environmental Sciences Department of Family and Consumer Sciences

The faculty of the College of Agriculture, Human, and Natural Sciences are engaged in conducting innovative research to solve problems facing our state, nation, and the world. The focus is on finding solutions to challenges faced by socially and economically disadvantaged groups and contribute to the prosperity of all. Research areas include childhood obesity prevention, food safety, climate change, and renewable biofuels.

College of Business

The College of Business is uniquely poised as a strong, robust, and expanding educational, entrepreneurship and research engine, positively impacting the entrepreneurial and economic tapestry of Nashville, the State of Tennessee, and the world. The faculty are engaged in conducting applied, discipline-based, and pedagogical research in accounting, business management, economics, finance, and information systems and technology.

College of Education

The College of Education faculty are engaged in research that examines disparities in education and student learning. They strive for the development of innovative models of instruction, such as; the integration of technology to influence student learning outcomes; strategies to increase representation of under-served populations engaged in science, technology, engineering, and mathematics (STEM) education; and more inclusive models of student academic success that are designed to impact student retention.

College of Engineering

The College of Engineering faculty are conducting research in signal and image processing, intelligent control systems, robotics, artificial intelligence tools, bioinformatics, health monitoring, systems engineering, wireless communication, and cybersecurity.

College of Health Sciences

The faculty of the College of Health Sciences are engaged in conducting research that includes speech pathology and audiology, behavioral science approaches to reduce health disparities, obesity, diabetes, and breast cancer prevention and treatment.

College of Liberal Arts

The faculty of the College of Public Service are engaged in conducting research on economic inequality, nonprofit management and community development, public administration and policy analysis, civic engagement, representative bureaucracy, organization theory, environmental justice, urban planning and policy, urban development, and the economics of education.

College of Life Sciences

Department of Chemistry

Research from the faculty of the Department of Chemistry is focused on environmental science, cancer, viruses, drug design, the synthesis of novel inorganic materials, and the interactions between different biological systems and membrane constituents.

Department of Biological Sciences

The faculty of the Department of Biological Sciences are engaged in research endeavors in the broad area of cellular and molecular biology. Research activities involve studies of plant extracts and the effect of cancer cell growth and function, studies of the role of D3 receptors in neuronal development, studies of collagen assembly and trafficking, and studies of global change ecology.

Department of Mathematical Sciences

Research interests from the faculty of the Department of Mathematical Sciences include applied mathematics, mathematical modeling, functional and numerical analysis, algebra, mathematics education, wavelets, physics, and astronomy.



TENNESSEE STATE UNIVERSITY RESEARCH CAPACITY

Founded in 1912, Tennessee State University (TSU) fosters scholarly inquiry and research, lifelong learning, and a commitment to service. Tennessee State University is an 1890 land-grant institution and Nashville's only comprehensive public university, as well as Middle Tennessee's first public Carnegie Doctoral/Research institution. TSU has demonstrated expertise as a robust educational and entrepreneurial research engine with a continuous positive impact on the economic tapestry of Nashville, the State of Tennessee, region and nation. The university offers unparalleled research, produces workforce-prepared talent, and provides educational and technical assistance services to industries, communities, and businesses worldwide.

RESEARCH CENTERS AND INSTITUTES AT TENNESSEE STATE UNIVERSITY

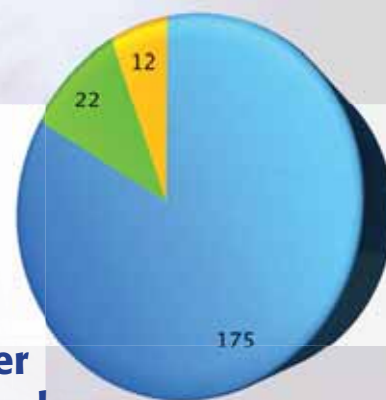
- Center for Advancing Faculty Excellence (CAFÉ)
- Center for Aging: Research and Education Services (CARES)
- Center for Entrepreneurship and Economic Development
- Center for Prevention Research
- Center of Excellence for Battlefield Sensor Fusion
- Center of Excellence for Learning Sciences
- Center of Excellence in Information Systems Engineering and Management
- Cooperative Extension Program (CEP)
- Institute of Food, Agricultural, and Environmental Research (IFAER)
- Institute of Government
- Nanoscience and Biotechnology Core Facility
- Otis L. Floyd Nursery Research Center at McMinnville
- TSU Interdisciplinary Graduate Engineering Research (TIGER) Institute
(Advanced Visualization and Computing, Bioinformatics, Cybersecurity, Mechatronics,
Nano-materials, Renewable Energy Systems)



**External
Funding**

AWARDS BY FUNDING SOURCE FY 2017

Private Agencies	\$2,441,668.87
State Agencies	\$1,614,796.70
Federal Agencies	\$39,549,059.59



**Number
of Awards**

Robotics Engineering Development at the TSU Interdisciplinary Graduate Engineering Research (TIGER) Institute

Researchers led by **Dr. Ali Sekmen** and directed by **Dr. Erdem Erdemir** are currently developing colon cancer detection robotics. These robots will perform colonoscopy procedures by using non-invasive cameras that are ingested and then operated remotely. Dr. Erdemir says that the final goal is to make these products low-cost and eventually for home use. In collaboration with the Agricultural College, the Engineering Department is also using this technology to develop intelligent robots that can detect anomalies diseases at the roots of plants in hydroponic farms. Additionally, the USDA awarded a grant to the Tiger Institute to develop meso-scale robots for a leak and lead detection in irrigation pipes. The continued support of **Dr. S. Keith Hargrove** is critical to the project's success by providing equipment for the researchers which allows them to develop and test their colonoscopy robots and intelligent prosthetic limbs.



Dr. Ali Sekmen

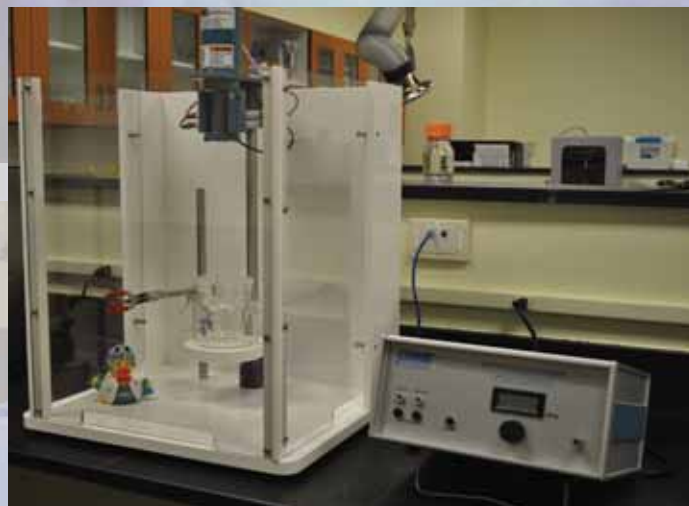


Dr. Erdem Erdemir



Dean S. Keith Hargrove





USDA Award to Synchronize the Bioavailability of Optimum Macro and Micronutrients for Plant Growth

Dr. Dharma Pitchay, Department of Agricultural and Environmental Sciences in the College of Agriculture, received a \$1.58M grant from the USDA to promote the Best Possible Management Strategies (BMPs) for planning and technical assistance in Nursery Production Systems throughout the Mid-South United States. The project researches container-growing processes that limit the amount of water, nutrients, and pesticides required to maximize benefits and minimize resource risks. The purpose is to conserve and protect the surrounding natural resources from adverse environmental impacts by training workers and technicians to plan and implement the strategies developed in the TSU nurseries. Dr. Pitchay has also received funding to establish Foliar analysis standards and sensitivity of macronutrient elements in several crops including strawberries, figs, and ginger. This research also investigates the visual symptoms of nutrient deficiencies in the chronological order in which they appear.



Dr. Dharma Pitchay



Micro and Nano Scale Devices

The Micro and Nano-systems Research Group (MNRG), under the direction of **Dr. Frances Williams**, develops novel nano- and micro-scale devices integrated with advanced materials for applications in the biomedical, environmental, and defense fields. Much research is being focused on the use of nanostructures (nanowires, nanotubes, nanoparticles, etc.) to provide for miniaturization and improved performance of sensors. The use of nanotechnology leads to small, low-power, and highly sensitive smart devices. MNRG's research includes developing nano-cantilever resonators functionalized with nanostructured-based biomaterials for sensing applications, specifically for prostate cancer screening. This research is potentially transformative in that its goal is to increase detection specificity and reduce false test positives, misdiagnosis of patients, and cost of testing. Further, it will provide for the development of an accurate, highly sensitive, fast, and low-cost method that is currently not possible. MNRG is also exploring methods to enhance the monitoring of corrosion on naval structures using fast, small, mountable sensing devices. This work integrates piezoelectric materials with microsensors to provide for an improved method for monitoring corrosion using surface acoustic wave (SAW) devices. The piezoelectric material polyvinylidene fluoride (PVDF) is being investigated to provide for optimal device performance. Further, this research group is also developing nanostructured-based electrochemical microsensors for detecting organophosphate pesticides (OPP) in environmental water samples. Presently, advanced analytical methods, such as gas chromatograph-mass spectrometry (GC-MS) and high-performance liquid chromatography (HPLC), etc., are employed to test for the presence of chemicals such as pesticides. These methods are costly, time consuming and limited to facilities with trained personnel. The microsensors being developed in this research will provide for low-cost measurements that can be performed on-site. In addition to Dr. Williams, members of the MNRG research team include staff researchers Dr. Yury Barnakov and Ms. April Falconer and a number of graduate and undergraduate students. MNRG research is supported by the National Science Foundation and the Office of Naval Research.



**Associate Dean
Frances Williams**



TSU's Dr. Deo Chimba Engages Research in his Transportation Engineering, Planning, and Safety Lab (TESP-Lab)

Dr. Deo Chimba, an Associate Professor and Interim Department Chair of the Department of Civil and Architectural Engineering recently received \$215,000 in grants from the Tennessee Department of Transportation (TDOT) to Evaluate Freight Intermodal Connectors (FICs) in Tennessee. This project evaluates these connectors to identify deficiencies related to congestion, capacity, safety, and environmental needs. Dr. Chimba is also collaborating to evaluate Tennessee's High Occupancy Vehicle (HOV) system performance to address high violation rates due to the high volume of traffic on freeways. This project conducts comprehensive literature and product review by evaluating instrumentation, operation, maintenance and field performances to determine lane utilization and the occupant numbers inside a vehicle. Furthermore, as part of the USDOT University Transportation Center Consortium led by Western Michigan University, Dr. Chimba received funding from USDOT to address the nation's critical transportation and improve affordable, environmentally sustainable transportation options for conventionally underserved communities.

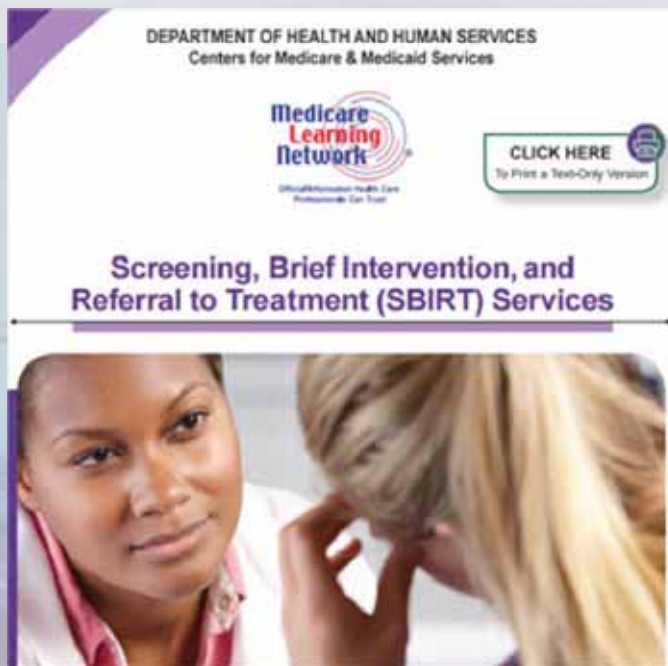


Dr. Deo Chimba



Success of Drug and Alcohol Abuse Screening and Intervention

Dr. Charles Brown of the College of Health Sciences successfully conducted an evaluation of Substance Use Screening, Brief Intervention, and Referral to Treatment (SBIRT) of services in Tennessee. Funding for Dr. Brown's research was made possible through a partnership with the Tennessee Department of Mental Health & Substance Abuse and the Centerstone Research Institute. The SBIRT program in Tennessee surpassed its screening goals by nearly 30% and many primary healthcare centers have continue its use as a standard of care. The SBIRT public health approach provides screening services to detect substance use problems and delivers early intervention and treatment services for persons at risk or currently suffering from substance abuse.



Dr. Charles Brown

Cancer Research

Dr. Venkataswarup Tiriveedhi studies the role of inflammation in tumor progression and metastasis. Specifically, to date, while several inflammatory cytokines play a role in carcinogenesis, there is minimal understanding of their exact effect in the tumor microenvironment. "We have previously defined the role of high salt on cancer cell division. Using advanced phosphor-proteomics based approaches we have identified a unique salt specific molecular target, salt-inducible kinase-3 (SIK3) which plays a critical role in cancer cell proliferation and metastasis. Our current efforts are directed at the continued understanding of the molecular mechanisms in the tumor microenvironment that skew the immune responses towards tumorigenesis," said Dr. Tiriveedhi. His team is also evaluating the effect of various drug therapies that could modulate immune cells and specifically target cancer cells. By determining the alterations in the specific gene expression profiles, their goal is to deliver personalized cancer treatment. This research will significantly lower the current treatment-failure and chemotherapy-related-toxicity.



Dr. Venkataswarup Tiriveedhi

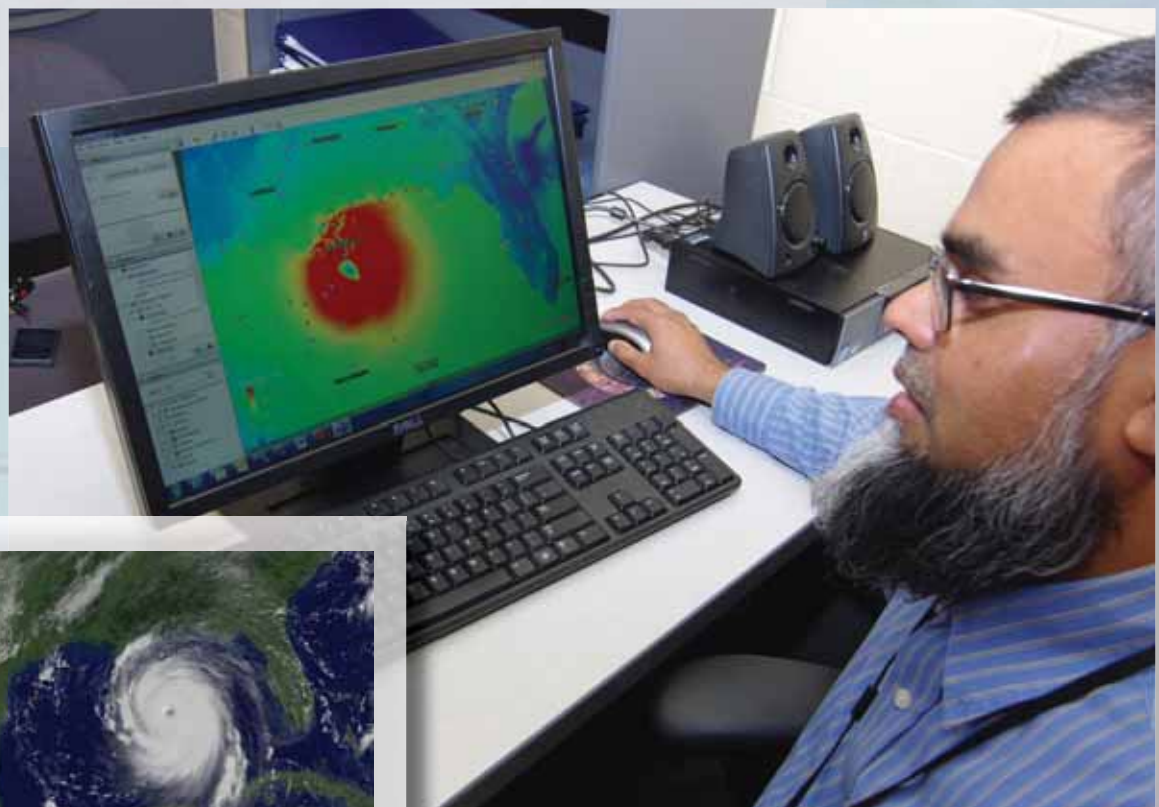


Models for Rapid Predictions of Hurricane Storm Surges

Dr. Muhammad Akbar, an Assistant Professor of Mechanical Engineering, has been researching ways to develop a robust model for the rapid and accurate prediction of hurricane storm surges. Such models use meteorological data from a hurricane to forecast or hindcast the extent and depth of the resulting flood. Recently, for a National Science Foundation (NSF) project, Dr. Akbar developed an implicit solver-based storm surge model that runs on a high-performance parallel computing platform. Dr. Akbar's model can use approximately 10 times larger time steps than ADCIRC, a widely used storm surge model. The research has led to new departmental courses and research opportunities. Currently, a PhD student is implementing this implicit solver as an option in ADCIRC. In addition to this research in storm surge models, he developed computational fluid dynamics (CFD) models and used commercial software to model incompressible flow, compressible flow, thermal management, fluid structure interaction, and other problems.



Dr. Muhammad Akbar



Distributed Engine Control for Turbine Engine Efficient Operation

Dr. Saleh Zein-Sabatto, Professor and Interim Department Head in the Department of Electrical and Computer Engineering, has developed an advanced distributed engine control algorithm and designed an integrated flight propulsion control, diagnostics and energy management system under network communication constraints. The Distributed Engine Control (DEC) allows for a reduction of engine control system weight, modularity, obsolescence reduction, scalability, and reduction in operational and maintenance cost. This energy saving and maintenance streamlining research were supported in partnership with Boeing and the Air Force Research Laboratory (AFRL). Dr. Zein-Sabatto's work has also inspired ongoing graduate research work in aircraft propulsion and airframe controls.



Dr. Saleh Zein-Sabatto



Improving Poultry Production Efficiency While ensuring Quality and Consumer Safety of Poultry Products



Dr. Samuel N. Nahashon

Dr. Samuel N. Nahashon, Professor and Interim Department Head, Department of Agricultural and Environmental Sciences, College of Agriculture, is engaged in research to improve the efficiency of poultry production while ensuring quality and consumer safety of poultry products. His research evaluates and seeks to understand the mechanisms of nutrient-utilization and how these nutrients, such as amino acids, minerals, and energy can be efficiently utilized for maximum gain. The goal is to minimize a number of nutrients in chicken feed and subsequently minimize the excessive run-off of these nutrients into the environment. Dr. Nahashon also works with the poultry industry to reveal the genetic potential of poultry by determining their nutrient requirements. Additionally, Dr. Nahashon researches ways to reduce the excessive use antibiotics in poultry production by reducing the threshold of the antibiotics through the reintroduction of probiotics.



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