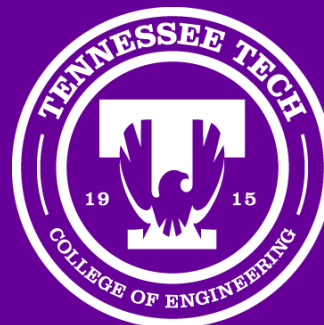


Center For Energy Systems Research Tennessee Tech University Annual Report for Fiscal Year 2020-2021



Annual Report for Fiscal Year

July 1, 2020—June 30, 2021

Satish M. Mahajan, Director

www.tntech.edu/cesr



Center for
Energy
Systems
Research

“Where research is put into practice.”



Tennessee
TECH

Center for Energy Systems Research

1020 Stadium Drive, PRSC 233

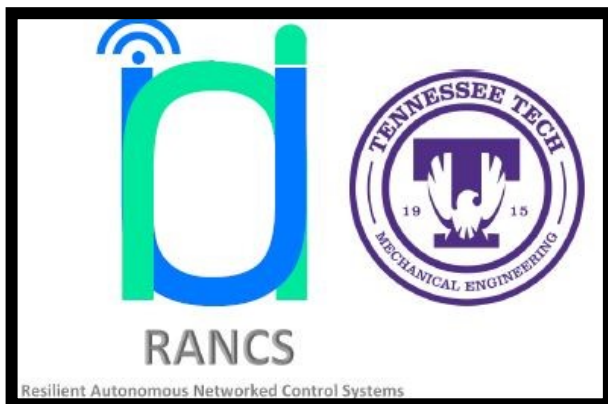
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Ford Fusion Hybrid for NSF research in
Connected and Autonomous Vehicles. (See p. 8)

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PROGRAMMATIC REPORT

MISSION

The Center for Energy Systems Research (CESR) was established to advance and apply scientific and engineering knowledge associated with energy systems and in particular with electric power while supporting the instructional program of Tennessee Technological University (TTU) in academic areas associated with energy systems. During the College of Engineering Strategic Planning of 2012-13, two strategic research areas, Smart Grid and Resilient Infrastructure, were assigned to the Center for Energy Systems Research as focus areas of research. Present research efforts, both theoretical and experimental, are focused on solving current and anticipated problems associated with energy and infrastructure systems. Special emphasis is given to the needs of the electric power industry by way of conducting research on Smart Grid.

VISION

The Center will be known and be recognized nationally for its research contributions in Energy Systems and Infrastructure areas.

The Center's vision is to enhance research and education in support of its mission. The Center will conduct advanced and applied research to enhance knowledge in currently needed and emerging technical areas of Energy and Infrastructure Systems. The Center also has major interests in the dissemination of knowledge and enhancing education in energy systems.

The Center draws upon the expertise from the faculty in the College of Engineering as well as from other faculty on campus. Participating faculty and faculty associates represent Basic Engineering, Chemical Engineering, Civil and Environmental Engineering, Computer Science, Electrical and Computer Engineering, Mathematics, Mechanical Engineering, Manufacturing and Engineering Technology, and Physics.

HISTORY

The State of Tennessee established the Center for Electric Power in 1985 in the College of Engineering at Tennessee Technological University. Reflecting the broadening of the activities of the Center, its name was changed to Center for Energy Systems Research. Over the years, research projects have been sponsored by more than 20 major electric utilities, EPRI, NAVY, Air Force, DOD, federal agencies such as DOE, NASA, NSF, and ONR, State agencies such as TDOT and Tennessee Department of Education, and industries such as Buswell Energy.

In the 2012-2013 academic year, the College of Engineering identified six strategic research areas in which to focus the research efforts of its faculty and students. Of the six areas, CESR chose two areas, namely, 1) Smart Grid and 2) Resilient Infrastructure to focus its research. In addition, CESR has started research in the area of 'wireless power transfer' from the year 2019. Development of large collaborative research proposals will be encouraged in these areas.

To promote the research and innovation, CESR provides services of an R&D Engineer, Financial Analyst, Financial Associate, and Administrative Associate in support of the various research activities performed by faculty and students. The Center has set up laboratories and computational resources for the benefit of researchers.

The Center promotes international collaboration by hosting visiting scholars, scientists and engineers and establishing Memoranda of Understanding with international academic institutions and research organizations.

YEAR IN REVIEW



Dr. Satish M. Mahajan continued as the Director of the Center for Energy Systems Research (CESR) for fiscal year 2020-2021. The CESR continues to focus on three strategic research areas: Smart Grid, Resilient Infrastructure, and Wireless Power Transfer.

2020-2021 was a good year for the CESR, considering COVID-19 all around us. This year, the external funding has remained about the same (compared to last year's record funding) for a total of \$2,323,390. It certainly represents the extra energy put in by the Center faculty associates, and the extra support given to them by the Center staff. It is only the fifth time since 1985 that the CESR activations have crossed \$2 million, and this is three years in a row! This year's 56 proposals submitted by the CESR faculty associates amount to about \$13.8 million, representing a small increase over last year's numbers. Hopefully, this increased number of proposals will help CESR sustain activations over \$2 million per year and possibly go beyond. The CESR's momentum lines up very well with the TTU President's vision of doubling the external funding/activations by 2025. While benefits to the students' education are of primary interest, benefits to the State of Tennessee are bound to increase as a result of long-term investments made by the State.

In the 2020-2021 fiscal year, the CESR funded: 27 M.S. assistantships (11 on grants only; 9 on CESR only; and 7 on grants plus CESR plus other University sources); and 21 Ph.D. assistantships (3 on grants only; 12 on CESR only; and 6 on grants plus CESR plus other University sources), representing a significant commitment to improve the research efforts at TTU. The CESR supported a total of 51 graduate students on an hourly basis. The combined headcount of the CESR-supported graduate students is 65. The CESR also supported 41 undergraduate students, a significant number of them on the grants.

The CESR faculty associates received grants from NSF, NAVY, NASA, ORNL, DOE, Air Force, STRIDE, TVA, Qatar National Research Foundation (QNRF), Appalachian Regional Commission (ARC), and some industrial sponsors. The variety of funding agencies represents commitment from our senior faculty associates as well as the mid-career ones. It is also wonderful to see the success of the junior faculty, and the investment made by the CESR via start-up commitments paying off.

Dr. Ali Arzani is joining the CESR in August 2021 as our second Research (Assistant) Professor. He comes from Clemson University and will certainly strengthen our Smart Grid group. The CESR will continue to invest in new faculty via start-up packages. This year the CESR is committing to two more faculty (Drs. Rizvi and Chen—both in ECE). We welcome them, and look forward to their contributions.

Ms. Etter Staggs, Financial Analyst, retired after 35 years of service. She was with the CESR from the start in 1985. She will be missed by each and every one who worked with her. The difficult transition was made relatively smooth by the tireless efforts of Ms. Anya Milum and Ms. Barbara Fenlon. Many thanks to them!

PROGRAMMATIC REPORT

Research contract and grant awards included in Matching from July 1, 2020 thru June 30, 2021 total \$1,729,452. Gifts and Other Awards included in Matching total \$138,136. Therefore, the 2020-2021 Match is \$1,867,588. Indirect costs of approximately \$455,802 were also received during the 2020-2021 Fiscal Year. The result is that the 2020-2021 External Funding (including matching and indirect costs) totals **\$2,323,390**. The State Appropriation was \$989,500.00 for 2020-2021.

CESR continues to enjoy a broad base of support. The funding categories for 1985 thru 2021 as illustrated in Figure 1 are: in-state utilities, 9.20 percent; out-of-state utilities, 4.99 percent; state and local agencies, 8.65 percent; federal government, 63.24 percent; other, 13.91 percent. The “other” category includes a variety of national and international industries, universities and professional societies. Through June 2021, the cumulative research funding of the Center is \$37,226,378.85. State appropriations are compared to matching, on an annual basis, in Figure 2. Matching is divided into contracts and grants (without indirect costs); equipment; and all other items such as software, books and reports, and funding for faculty and student exchange programs. The 36-year match of about \$35.3 million represents 109.23% percent of the state appropriations of \$32.3 million. Indirect costs of approximately \$6.63 million were also received. A list of the projects conducted under the major research areas is given in SM-3 in this report.

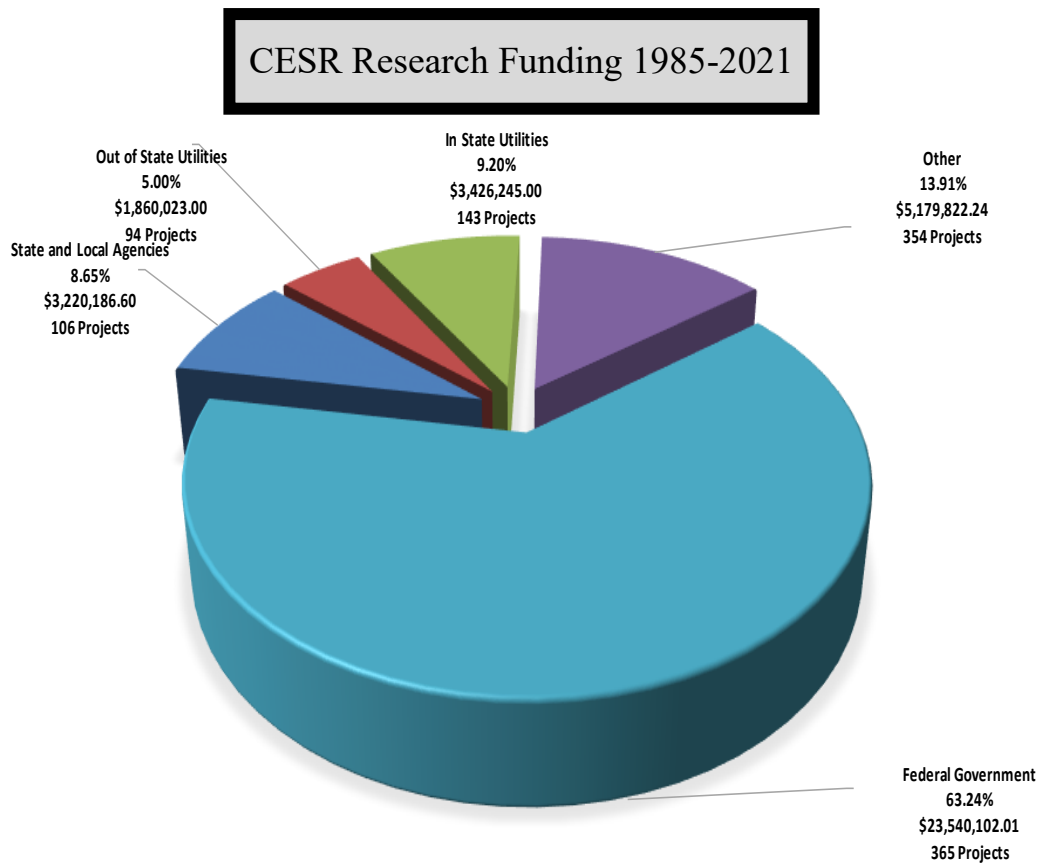


Figure 1: Types of Research Funding (Total External Contracts \$37,226,378.85)

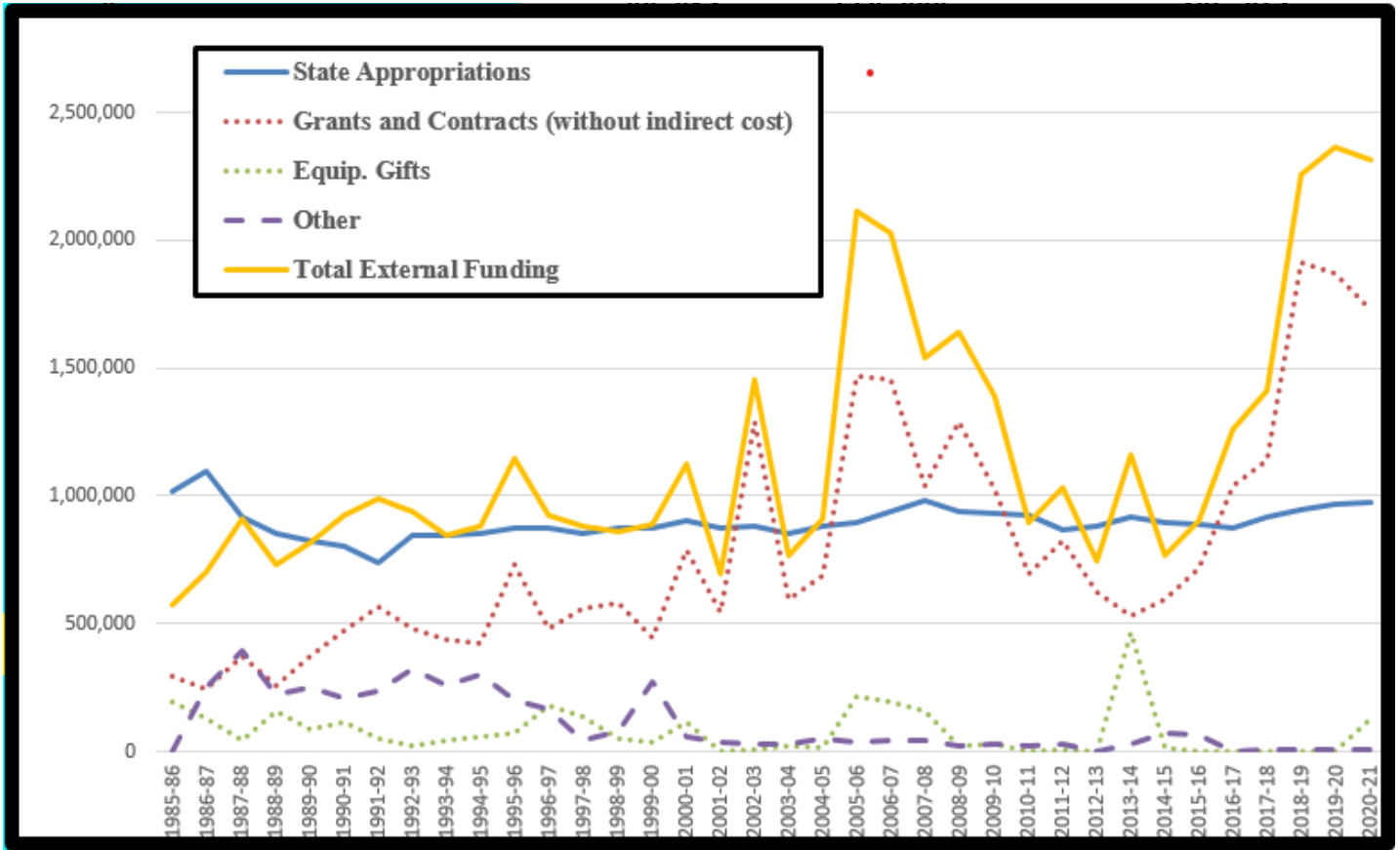


Figure 2: Historical State Appropriations, Matching, & Total External Funding 1985-2021

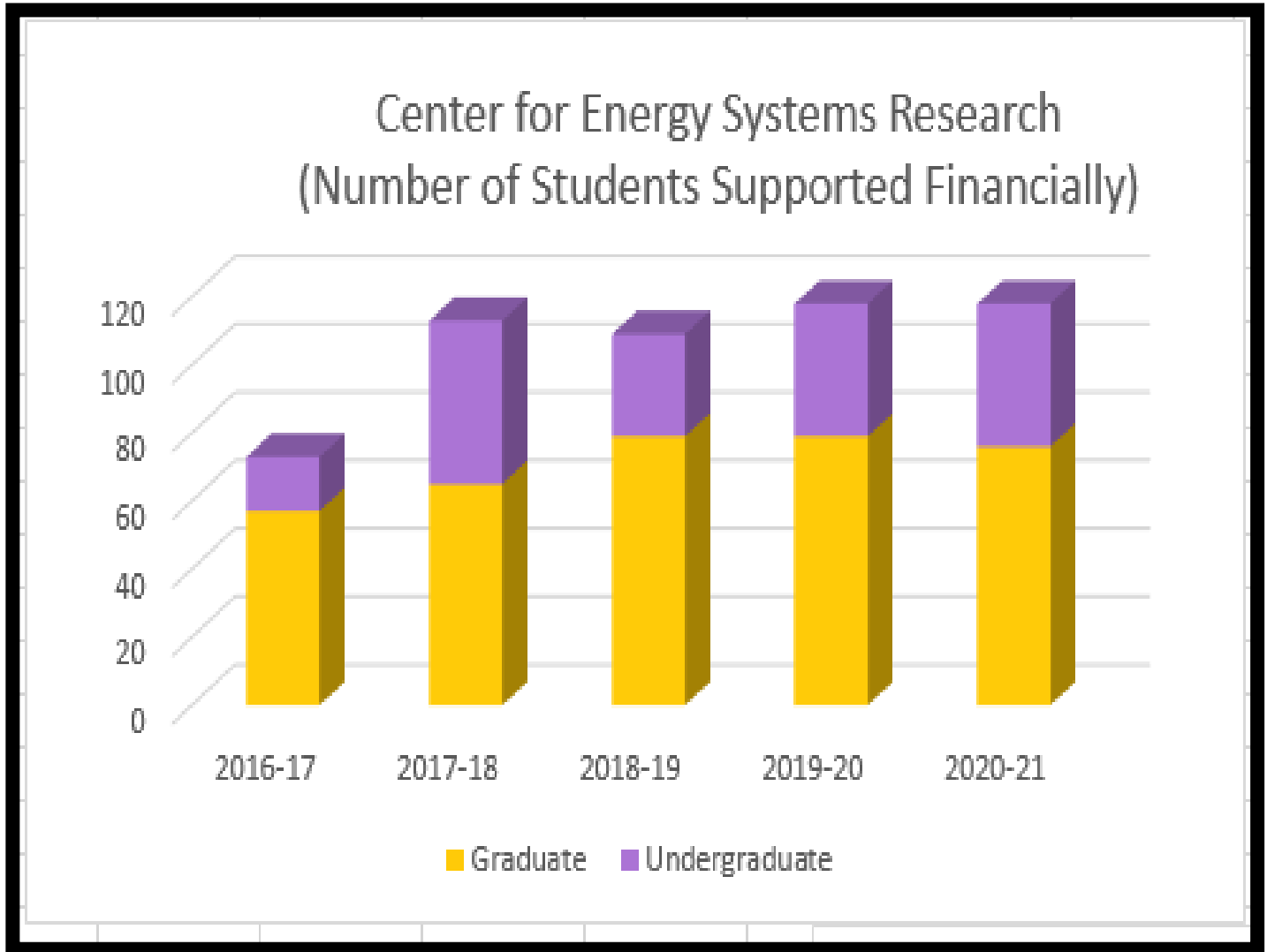


Figure 3: Number of Students Supported.



Dr. Sheikh Ghafoor, Computer Science Professor:

- Recipient of the **Brown Henderson Award**, Tennessee Tech 2021. This award is given annually to honor outstanding performance in teaching and research or service and carries the names of Engineering Dean Emeritus James Seay Brown and James Henderson, the first dean of the College of Engineering.
- **Invited** to lead the pervasive and emerging topics aspect area of NSF/IEEE-TCPP Curriculum Initiative on Parallel and Distributed Computing - Core Topics for Undergraduates. This is a multi-year effort funded by the National Science Foundation.
- **Invited** as managing guest editor for the *Journal of Parallel and Distributed Computing*, 2020-2021, special issue on parallel and distributed computing education



Dr. Indranil Bhattacharya, Associate Professor in Electrical & Computer Engineering, received the **Scholar-Mentor Award** at Tennessee Tech University, 2020-2021.



Dr. Ambareen Siraj, Computer Science Professor and Director of CEROC:

- **ABET Claire L. Felbinger Award for Diversity and Inclusion, 2020.**
- **Cybersecurity Person of The Year 2020, Cybersecurity Ventures.**
- **Invited Panelist**, “Is There a Security Mindset and Can it be Taught?” - 11th ACM Conference on Data and Application Security and Privacy (CODASPY '21), Virtual, April 26 - 28, 2021.
- **Invited Panelist**, “Broadening the Participation of Women in Cyber: A French-American Discussion” - Embassy of France – Office of Science and Technology, March 8th, 2021.
- **Invited Panelist**, “Non-Profit Organizations Role in Diversifying the Future Tech Workforce?” - 1st NSF Re-Enter STEM through Emerging Technology Conference (RESET '21), Virtual, March 4 - 6, 2021.
- **Keynote**, “Data Inspired Doing” - FloCon 2021 organized by Carnegie Mellon University, Software Engineering Institute, January 12-15, 2021
- **Invited Panelist**, “Fearless Computing” - IGNITE, February 17, 2021
- **Invited Panelist**, “To Empower - Empower Women to Lead and Shine” - WiCSME, November 14, 2020



MAHAJAN HONORED WITH CAPLENOR AWARD

COOKEVILLE, Tennessee (May 15, 2021) — Satish Mahajan, Director of the Center for Energy Systems, has been awarded Tennessee Tech University's highest faculty honor, the 2021 Caplenor Faculty Research Award.

The director of Tech's Center for Energy Systems Research (CESR) and a professor of electrical and computer engineering, Mahajan's current research is focused on electrical power systems, renewable energy, Photovoltaics/nanoparticle doped devices, and sensors.

"Satish is an exceptionally talented researcher. He has many original ideas," said Thomas Thundat, SUNY Empire Innovation professor, department of chemical & biological engineering at the University of Buffalo. "A hallmark of his approach is his generosity in sharing his ideas with others, which not only inspires many young researchers but also spreads his scientific influence at TTU and around the world."

In his 33 years at Tech, Mahajan has advised 29 master's students and 12 Ph.D. students since he began his career at Tech an assistant professor in 1987. His students are well-published, and have built successful careers.

"Dr. Mahajan has built a consistent record of high-quality, peer-reviewed publications and competitive external funds," said Vahid Motevalli, associate dean for research & innovation and a professor of mechanical engineering. "During his career, he has published 160 journal papers, conference proceedings and presentations. His efforts in research while at Tech has resulted in more than \$6M in external funding when he has served as PI, or co-PI. He has received nearly \$3.5M of the funding since 2015. His external funding has been from NSF, NASA, DoD, TVA, EPRI and other government and industry agencies."

Mahajan has enjoyed his time at Tech whether it is working with students or other departments on campus.

"I work with a lot of young minds and what I have seen is they are not only intelligent, they are respectful and curious and serious about their profession or career," said Mahajan. "I've been here 33 years, and I have worked with not just departments in engineering, but I have worked with agriculture, business, physics, chemistry, biology, geology and sociology. Interdisciplinary research is the name of the game."

The Caplenor award was established in 1984 in memory of Charles Donald Caplenor, former associate vice president for research and dean of instructional development. This is the first time Mahajan has garnered the prestigious award.

"It's always good being recognized by my peers. It makes me more motivated. I am a humble person and I came from a modest background," said Mahajan. "The first thought that came to my mind when I found out about the award was my parents. They made a lot of sacrifices. They are the reason why I am where I am today."

Published Thursday, May 13, 2021, at <https://www.tntech.edu/news/releases/20-21/mahajan-earns-caplenor-award.php>



RANCS Research Group tests new Ford Fusion Hybrid for NSF research in Connected and Autonomous Vehicles

Students and faculty in the Resilient, Autonomous, Networked Control Systems (RANCS) Research Group recently conducted the first test of its new Ford Fusion Hybrid research vehicle as part of a National Science Foundation grant for testing and verifying the safety and security of Connected and Autonomous Vehicles (CAVs). The \$350K grant has provided for research and development of a large-scale Hardware-in-the-loop (HiL) simulation facility for CAVs, which also offers the opportunity for students to gain hands-on experience and attract industrial partners to test their systems.

Software-driven products such as CAVs can be targets of digital disruption. RANCS Director Arman Sargolzaei, Ph.D., assistant professor of mechanical engineering, is developing the Vehicle-in-the-Loop (ViL) facility at Tennessee Tech for testing connected and autonomous vehicles in a virtual world. This concept, known as “digital twins,” uses a virtual representation of an object or system combined with real-time data and simulation to see information happening in the physical world.

Technology partners AutonomouStuff, IPG Carmaker, and Genesys equipped the Fusion with state-of-the-art sensors that, when combined with this virtual technology, enable Sargolzaei and other researchers to simulate real-world crashes and driving scenarios to conduct tests on faults and failures in these systems, learn the potential for cyberattacks and develop a technical language for industry and regulators to communicate safety issues.

“Vehicle-in-the-Loop implementation is a significant step toward achieving safe, realistic and cost-efficient test procedures before moving the experiments onto roadways, said Sargolzaei. “The ability of this research vehicle to detect and react to simulated actors makes it an excellent platform for testing against cyberattacks in a safe and realistic environment.”

The RANCS research laboratory focuses on advancing the science in the field of Networked Control Systems (NCSs) and focuses on safety-critical cyber-physical systems such as power systems, transportation systems (unmanned aerial and ground vehicles), and biomedical systems. RANCS provides the infrastructure and support services necessary to engage faculty and students interested in multidisciplinary research, educational activities or community services.

Published Friday, May 14, 2021, at <https://www.tntech.edu/engineering/news/articles/research/2021-05-14-resilient-autonomous-networked-control-systems-rancs-research.php> (See demonstrations at <https://youtu.be/yG0UnTQkT08> and <https://youtu.be/s8EZTtxhRaE>)



Academic Review and Rewrite of NAVFAC DM 7.02

In the spring of 2021, **Dr. Daniel VandenBerge (Assistant Professor, Civil and Environmental Engineering)** was awarded a grant from the US Naval Facilities Command (NAVFAC) via the National Institute of Building Sciences to rewrite NAVFAC's *Design Manual 7.2 – Foundations and Earth Structures*. The two-year project has a total budget of **nearly \$500,000** and including coauthors and advisors from Virginia Tech, Lafayette College, Keller Foundation Company, US Army Corps of Engineers, and private consulting. The project follows a successful revision of NAVFAC's *Design Manual 7.1 – Soil Mechanics*, completed March 2021.

The DM 7.1 and DM 7.2 manuals are two of the most broadly used reference documents by geotechnical engineers across the globe. They provide quick, accurate, and concise information and design guidance on a broad range of topics. The key topics that will be addressed in the revised DM 7.2 manual are:

Excavations – Provides methods for both open cut and supported excavations in soil and rock, as well as trenching techniques. Methods of groundwater control, excavation stabilization, monitoring, and excavation safety are also discussed.

Compaction, Earthwork, and Hydraulic Fill - Reviews purposes and applications of earth fill along with the theory of compaction. Compaction methods, equipment, and control methods are outlined. Design and construction of earth embankments and hydraulic fills are discussed.

Analysis of Walls and Retaining Structures – Covers the fundamental mechanics of earth pressure, wall movement, and the effects of groundwater, surcharge, construction loads, earthquake loading, frost action, and swelling. Methods for designing both rigid and flexible retaining walls are presented.

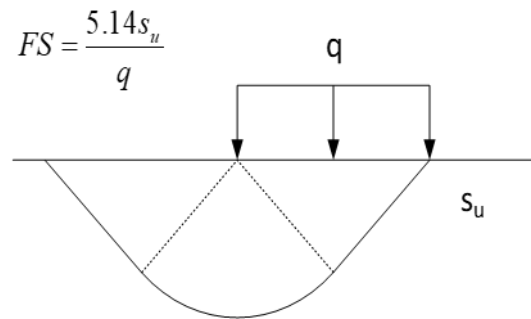
Shallow Foundations – Discusses bearing capacity analysis, design of spread footings and mats, and design for challenging soil and groundwater conditions. Practical guidance is provided for construction, waterproofing, pressure relief, and uplift resistance.

Deep Foundations - Reviews the design and installation of various types of deep foundation. Design topics include static capacity analysis, group effects, settlement, and lateral load capacity. Installation of both driven and drilled foundations is reviewed.

Problem Soils (New chapter) – Summarizes design guidance for walls and foundations in problematic natural materials, such as expansive soils, collapsible soils, organic soils and peat, and corrosive materials, as well as manmade materials such as dredged soils and municipal solid waste. Specialized geotechnical construction techniques are discussed.

Applications of Probability and Reliability in Geotechnical Engineering - Introduces the basic principles of probability required to understand and implement geotechnical reliability analysis. The use of probability to understand uncertainty in soil and rock properties is described. The basics of load and resistance factor design (LRFD) are elaborated.

Academic Review and Rewrite of NAVFAC DM 7.02, continued



June 1, 2021: **Dr. Daniel Vandenberg**, Assistant Professor in Civil & Environmental Engineering, was awarded a **patent** (#11,022,717) based on research with Luna Innovations Incorporated (of Roanoke) from 2016 to 2018, along with Osgar Ohanian of Blacksburg, Virginia, and Matthew Davis of Christiansburg, Virginia.

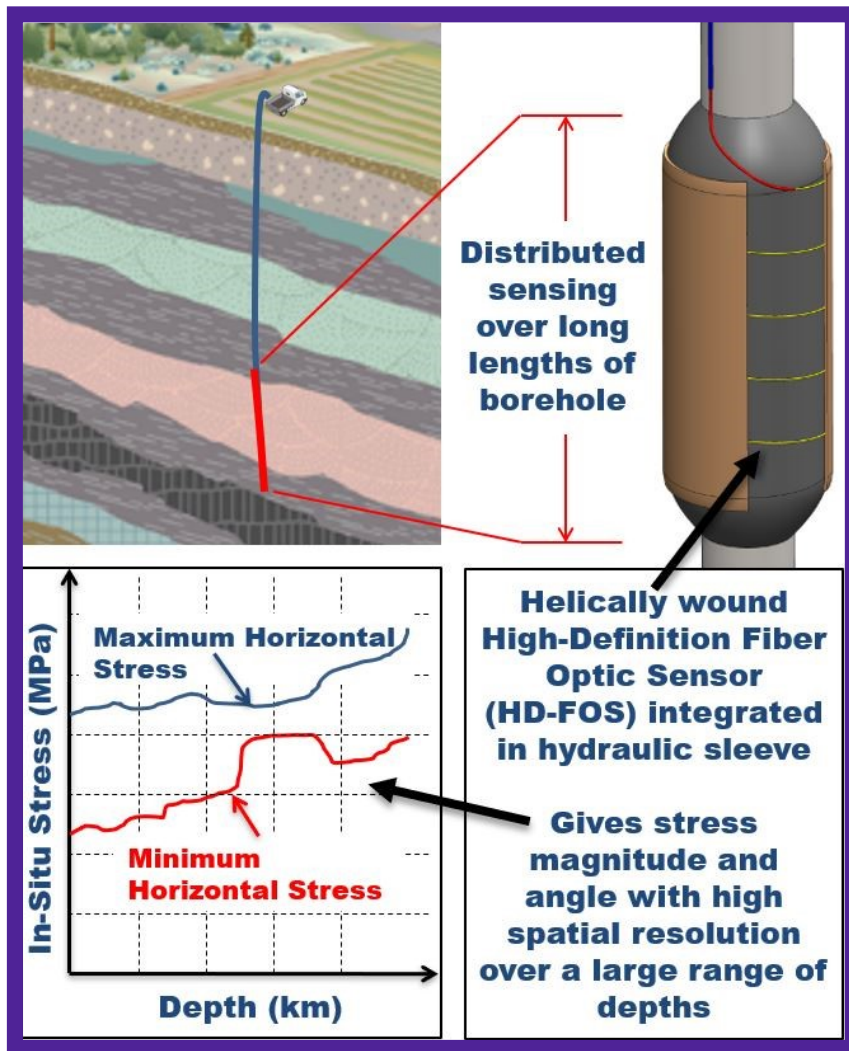


Image to left from press release dated 10/15/2020.

To read full press release, visit:
<https://lunainc.com/news/luna-develops-unique-high-resolution-rock-stress-measurement-concept>

- Undergraduate student of Dr. Liqun Zhang, **Chase Yancey**, won a poster award in the TTU Student Research and Creativity Poster Day, April, 2021.
- Graduate student of Dr. Liqun Zhang, **George Rucker**, won an Eminence Award of TTU, April, 2021.

Deborah Afolayan, M.S. student of Dr. Satish M. Mahajan, was awarded the Certificate of Achievement below at the annual Research and Creative Inquiry Day 2021.



Eungkyun Kim, student of Dr. Indranil Bhattacharya wins the National Science Foundation Graduate Research Fellowship Program award, 2021.

Webster Adepoju, Ph.D. student of Dr. Indranil Bhattacharya, wins Best Research Poster Award in Electrical Engineering, Annual Student Research and Creative Inquiry Day for 2021, Tennessee Tech University.

Thomas M. Hines, student of Sheikh K. Ghafoor, was one of the authors for Best Paper Award: Md Bulbul Sharif, **Sheikh K. Ghafoor**, Thomas M. Hines, Mario Morales-Hernández, Katherine J. Evans, Shih-Chieh Kao, Alfred J. Kalyanapu, Tigstu T. Dullo, and Sudershan Gangrade, 2020. Performance Evaluation of a Two-Dimensional Flood Model on Heterogeneous High-Performance Computing Architectures. In Proceedings of the Platform for Advanced Scientific Computing Conference (*PASC '20*), July, 2020, Geneva, Switzerland.



At left: ECE Assistant Professor, Dr. Charles Van Neste, and Ph.D. student Tyler Marcrum setting up a wire-free robotic arm at the NASA EMI Testing facility in spring 2021.



At right: Ph.D. student Tyler Marcrum and UG student Erika Rogers building a second wire-free robotic arm in the Wireless Power Transfer Laboratory.



Above: M.S. student Brandon Neiman testing data transfer from a sensor module wirelessly powered from a special transmitter that injects and propagates electrical energy through soil.

PLANS FOR 2021-2022

Increase Research Activity in the Areas of the Center

Generate external funding that will contribute to the long-term growth and sustainability of the Center. As a minimum, the external funding generated per year by the center should match the state funding. Efforts will be made to sustain \$2 million level.

Center faculty and the R&D Engineer will produce at least five publications in total. This year we had a total of six publications. With the second Research Assistant Professor joining the CESR, it is anticipated that there will be more publications.

The Center Focus Areas also intersect the University Flight Plan focus areas to Create Distinctive Programs and Invigorate Faculty. This year the CESR started a new activity called 'Faculty Research Associate' to release department faculty from a course so that they can write significant proposals. Two faculty members (CEE and CSC) were supported in the spring 2021 semester. This activity will continue.

Increase Student Research Activity

Continue pursuing support to the MS and Ph.D. graduate students in the strategic research areas of the Center consistent with the level of external funding.

Support at least two undergraduate research projects per year in the areas related to energy systems.

This goal intersects the University Flight Plan's New Graduate Programs sub goal.

Increase Collaborative Research

Continue pursuing the development and submission of two collaborative proposals with interdisciplinary focus. The number of collaborative proposals submitted should be at least two per year.

This goal intersects the University Flight Plan's Multidisciplinary Research Innovation sub goal.

Add Laboratory Facilities

Continue to support the development of the wireless power laboratory. The newly initiated 'optical diagnostics laboratory' will be expanded further.

This goal intersects the University Flight Plan's Physical Infrastructure Priorities sub goal and the Technology Service to Students sub goal, and the Technology in Teaching sub goal. Better facilities in areas of national importance like the Smart Grid benefit research, education, and hire-ability of our graduates.

Increase Outreach Activities

Assuming COVID-19 pandemic ends soon, organize a minimum of two seminars by external speakers per year. Attempts will be made to arrange virtual seminars.

This goal intersects the University Flight Plan's Co-Curricular Undergraduate Program sub goal and the Multidisciplinary Research Innovation sub goal. By having research area experts from outside the university come teach seminars, workshops or short courses, the students will be exposed to a broader base of information and hopefully promote collaborative efforts from TTU researchers with those at other institutions.

SUPPORTING MATERIALS

Panoramic view of the SOLBAT-TTU Energy Research Battery Laboratory



Inductive wireless charging test bench



Evan Kixmiller (on left) and Michael Gerard, students of Dr. Indrinal Bhattacharya, Associate Professor of ECE, discussing research projects in SOLBAT-TTU Energy Research Laboratory

CESR FACULTY & STAFF—2020-2021

Center Director:	Dr. Satish M. Mahajan, Professor	Director, CESR
Center Faculty:	Dr. Shirin Noei	Assistant Research Professor
Center Staff:	Mr. Robert Craven	R & D Engineer
	Ms. Barbara Fenlon	Administrative Associate 4
	Ms. Tammy Martin (Part Time)	Administrative Associate 3
	Ms. Anyssa Milum (also with CMR)	Financial Associate 6
	Ms. Etter Staggs	Financial Analyst
CESR Staff (Part Time, Temporary):		
	Mr. Samuel Hollifield	Research Assistant
	Dr. Mohamed Baza	Research Engineer
	Mr. Isaac Reff	Research Assistant
	Mr. George Rucker	Research Assistant
	Mr. Nicholas Skjellum	Research Assistant

Faculty participating in the Strategic Research of the Center are:

Smart Grid

Ali Alouani – ECE
Indranil Bhattacharya – ECE
Nan Chen—ECE
Robert Craven – CESR
Tarek Elfouly—ECE
Sheikh Ghafoor – CSC
Maanak Gupta—CSC
Syed Rafay Hasan – ECE
Muhammad Ismail—CSC
Brian Leckie—Agriculture
Satish Mahajan – ECE
Mohamed Mahmoud – ECE
Joseph Ojo – ECE
Ghadir Radman – ECE
Rory Roberts—ME
Michael Rogers—CSC
Arman Sargolzaei—ME
Susmit Shannigrahi—CSC
Ambareen Siraj – CSC
Denis Ulybyshev—CSC
Charles Van Neste – ECE
Ahmad Vasselbehagh—ME

Resilient Infrastructure

Steven Anton—ME
Daniel Badoe – CEE
Joseph Biernacki – CHE
J.W. Bruce—ECE
Laura Arias Chavez – CHE
Steven Click – CEE
L. K. Crouch – CEE
Jie Cui—ME
Jerry Gannod – CSC
Craig Henderson – CEE
Timothy Huff – CEE
Sharon Huo – CEE
Stephen Idem – ME
Alfred Kalyanapu—CEE
Ethan Languri – ME
Jane Liu – CEE
Allen MacKenzie—ECE
Benjamin Mohr – CEE
Shirin Noei—CESR
Mustafa Rajabali - PHY
Daniel VandenBerge – CEE
Liqun Zhang – CHE

CONTRACT AND GRANT AWARDS
Activated Between July 1, 2020 and June 30, 2021

Contract Number	Title	Source	Project Dates	Total Amount
532607	Quasi-Wireless Capacitive (QWiC) Surface Power for Adaptive and Reconfigurable Sensor Elements on Space Infrastructure (Principal Investigator Charles Van Neste; Co-Principal Investigators Satish M. Mahajan, Denis Ulybyshev, and Maanak Gupta)	National Aeronautics and Space Administration (NASA)	7/1/20-8/20/21	60,405.00
531317	CC*CRIA: Planning a Regional Cyber-Infrastructure-Research Consortium for Middle Tennessee (Year 1 of 2) (Principal Investigator Sheikh Ghafoor)	National Science Foundation via UTC	7/1/20-6/30/21	71,728.00
531311	Collaborative: CyberTraining: Pilot: Semi-Automatic Assessment of Parallel Programs in Training of Students and Faculty (Year 2 of 2) (Principal Investigator Sheikh Ghafoor; Co-Principal Investigator Ada Haynes)	National Science Foundation (NSF) via UNC Chapel Hill	9/1/20-8/31/21	42,119.00
532388	Tracking Water Storage in Lakes: Citizens and Satellites Implementation Phase - Year 3 (Principal Investigator Sheikh Ghafoor)	The University of North Carolina at Chapel Hill (Funding from NASA)	6/25/20-6/24/21	84,053.00
SUB - TOTAL, GRANTS AND CONTRACTS				258,305.00

CONTRACT AND GRANT AWARDS
Activated Between July 1, 2020 and June 30, 2021

Contract Number	Title	Source	Project Dates	Total Amount
531323	Collaborative Research: CyberTraining: Implementation: Medium: Broadening Adoption of Parallel and Distributed Computing in Undergraduate Computer Science and Engineering Curricula (Year 1 of 3) (Principal Investigator Sheikh Ghafoor)	National Science Foundation	10/15/20-9/30/21	23,789.00
539377	From Can't to Can: Attack Prevention & In-situ Detection of Advanced Attacks of Controller Area Networks (Principal Investigator Sheikh Ghafoor)	Oak Ridge National Laboratory	7/1/20-9/30/20	10,888.43
539377	From Can't to Can: Attack Prevention & In-situ Detection of Advanced Attacks of Controller Area Networks (Principal Investigator Sheikh Ghafoor)	Oak Ridge National Laboratory	10/1/20-12/31/20	11,977.57
535276	Resiliency Tester "Bouncer" for Superior Graphite (Principal Investigator Jie Cui; Co-Principal Investigator Stephen Idem)	Industrial Sponsor	8/1/20-10/9/20	29,276.00
532318	UFC 3-220-ION Soil Mechanics (DM7-01) Supplement 3 (Principal Investigator Daniel VandenBerge)	Virginia Tech via US Navy	8/1/20-1/1/21	30,000.00
SUB - TOTAL, GRANTS AND CONTRACTS				105,931.00

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2020 and June 30, 2021**

Contract Number	Title	Source	Project Dates	Total Amount
539507	MRI: Development of a High Resolution Neutron Detector for Decay and Reaction Studies with Exotic Nuclei (Year 2 of 3) (Principal Investigator Mustafa Rajabali)	National Science Foundation	8/1/20-7/31/21	47,974.00
532392	Regional Transportation Center on Reducing Congestion (STRIDE) K12 STEM in Motion (2021) Year 4 (Principal Investigator Steven Click; Co-Principal Investigator Darek Potter)	University of Florida Transportation Institute (UFTI), Department of Transportation	1/1/21-12/31/21	26,008.00
532392	Regional Transportation Center on Reducing Congestion (STRIDE) ADMIN Year 4 (Principal Investigator Steven Click; Co-Principal Investigator Darek Potter)	University of Florida Transportation Institute (UFTI), Department of Transportation	1/1/20-12/31/20	21,294.00
539306	MRI: Hardware/Vehicle-in- the-Loop Environment for Verification of Connected and Autonomous Vehicles (Principal Investigator Arman Sargolzaei)	Florida Polytechnic University (Funded by the National Science Foundation)	10/1/20-9/30/21	148,935.00
532613	Development of Laser- Based System for Maintenance of Ice Condensers (Principal Investigator Ahmad Vasselbehagh and Co- Principal Investigator Satish M. Mahajan)	Tennessee Valley Authority	11/14/20-11/13/21	185,000.00
SUB - TOTAL, GRANTS AND CONTRACTS				429,211.00

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2020 and June 30, 2021**

Contract Number	Title	Source	Project Dates	Total Amount
539229	Hypersonic Onboard Power and Thermal Management System (Phase 2) (Principal Investigator Rory Roberts)	Air Force STTR via Special Power Sources	10/26/20-10/14/21	75,000.00
532602	Simulation of HF Inverter Circuits for High-Power Wireless Charging (Modification No. 4) (Principal Investigator Satish M. Mahajan)	Oak Ridge National Laboratory	1/1/21-8/31/21	24,210.00
535271	Enabling Efficient Integration of Electric Vehicles in Qatar's Smart Grid: Planning, Operation, and Cybersecurity, Year 2 of 3 (Principal Investigator Muhammad Ismail)	Texas A&M Engineering Experiment Station (TEES); Funding from QNRF	1/1/21-1/1/22	34,872.00
535272	Enabling Efficient Integration of Electric Vehicles in Qatar's Smart Grid: Planning, Operation, and Cybersecurity, Year 2 of 3 (Principal Investigator Mohamed Mahmoud)	Texas A&M Engineering Experiment Station (TEES); Funding from QNRF	1/1/21-1/1/22	30,264.00
531309	Tennessee Louis Stokes Alliance for Minority Participation (TLSAMP) - Year 3 (Principal Investigator Jessica Oswalt)	Tennessee State University (TSU) Funding from NSF	9/1/20-8/31/21	26,100
SUBTOTAL, GRANTS AND CONTRACTS				190,446.00

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2020 and June 30, 2021**

Contract Number	Title	Source	Project Dates	Total Amount
532803	Academic Review and Rewrite of ANVFAC DM 7.02 (Principal Investigator Daniel VandenBerge)	National Institute of Building Sciences via U.S. Navy	3/31/21-8/31/23	460,367.00
539204	Typhoon Technology Transfer to TTU (Principal Investigator Satish M. Mahajan, Co-Principal Investigator Michael Rogers)	Upper Cumberland Development District (UCDD), Funding from the Appalachian Regional	1/15/21-5/31/21	50,000.00
539025	Standardized Test Method and Calculation Protocol for Determining and Reporting Annual Heat Rate for Coal-Fueled EGUs (Principal Investigator Stephen Idem)	Industrial Sponsor	3/11/21-12/31/22	114,552.00
535283	Going Beyond ACI 332: Commercial/ Residential Enhanced Durability Concrete: Phase III The Effect of Limited Curing (Principal Investigator L. K. Crouch)	Tennessee Concrete Association (TCA)	3/15/21-11/30/21	6,332.00
539385	Investigating Early Transition Metal Dopant Effects in Cobalt Free Lithium ion Batteries (Principal Investigator Indranil Bhattacharya)	Oak Ridge National Laboratory	1/1/21-8/31/21	29,430.00
SUB - TOTAL, GRANTS AND CONTRACTS				660,681.00

CONTRACT AND GRANT AWARDS
Activated Between July 1, 2020 and June 30, 2021

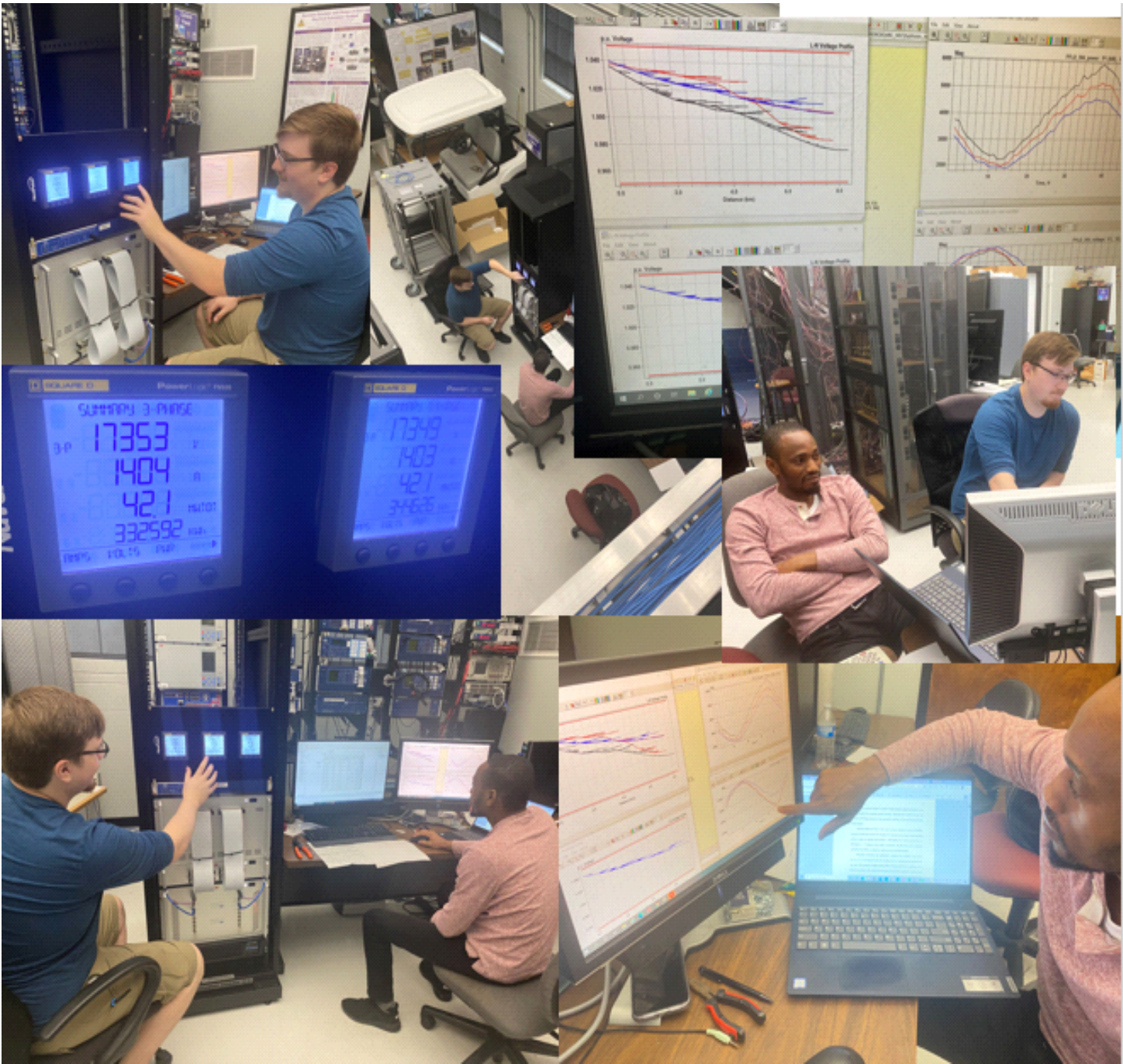
Contract Number	Title	Source	Project Dates	Total Amount
531325	Improving Undergraduate Success through Effective Critical Thinking (Principal Investigator Joseph Biernacki, Co-Principal Investigators Indranil Bhattacharya, George Chitiyo, Barry Stein, Elizabeth Lisic)	National Science Foundation	3/15/21-2/28/22	107,605.00
535390	Building Critical Thinking Skills through Geotechnical Assignments (Principal Investigator Daniel VandenBerge)	USUCGER	5/1/21-12/31/21	5,000.00
539507	MRI: Development of a High Resolution Neutron Detector for Decay and Reaction Studies with Exotic Nuclei (Principal Investigator Mustafa Rajabali)	National Science Foundation	4/1/21-7/31/22	48,368.00
532392	Regional Transportation Center on Reducing Congestion (STRIDE) ADMIN Year 5 (Principal Investigator Steven Click; Co-Principal Investigator Darek Potter)	University of Florida Transportation Institute (UFTI), Department of Transportation	1/1/21-9/30/22	4,185.00
532279	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay (Principal Investigator Mustafa Rajabali)	Department of Energy	5/1/21-4/30/22	91,000.00
SUBTOTAL, GRANTS AND CONTRACTS				256,158.00

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2020 and June 30, 2021**

Contract Number	Title	Source	Project Dates	Total Amount
531326	Advanced Metal Anode with Artificial Solid Electrolyte Interphase (SEI) for Rechargeable Lithium Metal Batteries (Principal Investigator Liqun Zhang)	National Science Foundation via LiBAMA	5/17/21-8/31/21	5,000.00
531280	Supplement Tennessee Cybercorps: A Hybrid Program in Cybersecurity (Principal Investigator Ambareen Siraj)	National Science Foundation	8/1/2020-12/31/2020	14,266.00
531279	Tennessee Cybercorps: A Hybrid Program in Cybersecurity (Principal Investigator Ambareen Siraj)	National Science Foundation	1/1/2020-12/31/2020	202,944.00
535238	Atmosphere Independent Bipropellant Consuming Additively Manufactured Solid Oxide Fuel Cells (SOFCs) for Assured On-Orbit Space Power (Principal Investigator Rory Roberts)	Air Force Research Laboratory via Southwestern Ohio Council for Higher Education (SOCHE)	8/1/2020-11/30/2021	34,040.00
SUBTOTAL, GRANTS AND CONTRACTS				256,250.00

CONTRACT AND GRANT AWARDS
 Activated Between July 1, 2020 and June 30, 2021

Contract Number	Title	Source	Project Dates	Total Amount
532619	Cryo Thermal Management of High Power Density Motors and Drives (Principal Investigator Rory Roberts)	Department of Energy via Hyper Tech Research Inc.	4/6/2021-10/30/2021	22,710.00
POWER-TEST-SERVICE ACCOUNT				
538597	Power-Test-Service Account (Principal Investigators: Professor and Director Satish M. Mahajan; Professor L. K. Crouch)	Various		5,562.00
SUB-TOTAL				22,710.00
POWER-TEST-SERVICE ACCOUNT				5,562.00
TOTAL CONTRACTS AND GRANTS DURING 2020 - 2021				2,185,254.00



ARC-Sponsored Distribution Grid Research

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
1.	Thin Film, Low Temperature Solid Oxide Fuel Cells for Personal Power Generation	Rory Roberts	Department of Defense	50,000.00	Not funded
2.	An Integrated Power Generator, Energy Storage, and Aerator	Ahmad Vasselbehagh, Satish M. Mahajan, Charles Van Neste, Steven Anton, Doug Talbert	Department of Energy	1,499,668.00	Not funded
3.	CAREER: Fundamental Geotechnical Behavior of Foamed Glass Aggregate	Daniel VandenBerge	National Science Foundation	501,026.00	Not funded
4.	Collaborative Research: External Field-Induced Nanoscale Interactions Between Functional Nanoparticles and Polarizable Media	Venkat Padmanabhan	National Science Foundation via Stevens Institute of Technology	209,995.00	Not funded
SUBTOTAL, PROPOSALS FOR 2020-2021				2,260,689.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
5.	CAREER: Enabling Programmable Wireless Environments in Next Generation Networks	Muhammad Ismail	National Science Foundation	500,350.00	Not funded
6.	IUSE/EHR: Improving Undergraduate Success Through Effective Critical Thinking (iUSE-CT)	Joe Biernacki	National Science Foundation	295,150.00	Funded
7.	Mesenchymal Stem Cell Derived Antimicrobial Peptides as Novel Antiviral Agents of Cov-2	Liqun Zhang	National Institutes of Health (NIH) via Case Western Reserve University	64,796.00	Not funded
8.	CAREER: Understanding and Modeling of Thermal Transport Processes within Near-Ground Atmosphere in the Presence of Utility-Scale Solar Photovoltaics (PV) Plants	Ahmad Vasselbehagh	National Science Foundation	539,869.00	Not funded
SUBTOTAL, PROPOSALS FOR 2020-2021				1,400,165.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
9.	UFC 3-220-ION Soil Mechanics (DM7.01) - Supplement 3	Daniel VandenBerge	U. S. Navy via Virginia Tech	30,000.00	Funded
10.	Hypersonic Onboard Power and Thermal Management System	Rory Roberts	Department of Defense, Air Force Small Business Technology Transfer (STTR) via Special Power Sources	150,000.00	Funded
11.	Regional Transportation Center on Reducing Congestion, ADMIN, Year 4	Steven Click	Department of Transportation, via University of Florida Transportation Institute (UFTI)	21,294.00	Funded
12.	Regional Transportation Center on Reducing Congestion, K12 STEM in Motion 2021, Year 4	Steven Click, Darek Potter	Department of Transportation, via University of Florida Transportation Institute (UFTI)	26,008.00	Funded
SUBTOTAL, PROPOSALS FOR 2020-2021				227,302.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
13.	Magnitude, Duration, and Profile Depth Effects on the Response of Bridge Structures to Earthquake Ground Motion	Timothy Huff	National Science Foundation	336,347.00	Not funded
14.	Interactive Control Co -Design Approach to Making Sustainable and Resilient Microgrids: The Case of South Pole Lunar Electric Energy System	Rory Roberts	National Aeronautics and Space Administration (NASA) via Massachusetts Institute of Technology (MIT)	498,924.00	Not funded
15.	Lake Observations from Citizen Scientists and Satellites: Validation of Satellite Altimetry to Support Hydrologic Science	Sheikh Ghafoor	National Aeronautics and Space Administration (NASA) via the University of North Carolina	309,449.00	Funded
16.	MRI: Hardware/ Vehicle-in-the-Loop Environment for Verification of Connected and Autonomous Vehicles	Arman Sargolzaei	National Science Foundation via Florida Polytechnic University	170,000.00	Funded

SUBTOTAL, PROPOSALS FOR 2020-2021

1,314,720.00

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
17.	From Can't to Can: Attack Prevention and In-Situ Detection of Advanced Attacks or Controller Area Networks	Sheikh Ghafoor	Oak Ridge National Laboratory	11,978.00	Funded
18.	Typhoon Technology Transfer to TTU	Satish M. Mahajan, Mike Rogers	Appalachian Regional Commission via Upper Cumberland Development District	50,000.00	Funded
19.	Development of a Laser-Based System for Maintenance of Ice Condensers	Ahmad Vaselbehagh, Satish M. Mahajan	Tennessee Valley Authority	185,860.00	Funded at \$185,000
20.	Collaborative Research: RET Site: Cyber Research Teaching Solutions for Middle Tennessee High School Teachers	Akond Rahman, Gerald Gannod, Cory Gleasman	National Science Foundation via MTSU	198,270.00	Pending
SUBTOTAL, PROPOSALS FOR 2020-2021				446,108.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
21. RET Site: Energize Teachers: Immersive Research in Next Generation Energy Generation and Storage Technologies	Indranil Bhattacharya, Joe Biernacki	National Science Foundation	599,889.00	Not funded
22. Understanding the Doping Effects on Nickel Oxide for Performance Optimization of Perovskite	Alice Camuti, Indranil Bhattacharya, Eungkyum Kim	National Science Foundation Graduate Research Fellowship Program	138,000.00	Not funded
23. A Free, Open-Source Approach to Autonomous Vehicle Research	Alice Camuti, Arman Sargolzaei, James Holland	National Science Foundation Graduate Research Fellowship Program	138,000.00	Not funded
24. Deep Reinforcement Learning for Multi-Objective Optimization of Wind Farm Control	Alice Camuti, Ahmad Vasselbehagh, Logan Unser	National Science Foundation Graduate Research Fellowship Program	138,000.00	Not funded
SUBTOTAL, PROPOSALS FOR 2020-2021			1,013,889.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
25.	Cooperative Driving Automation in Contested Environments	Shirin Noei	National Science Foundation	174,995.00	Pending
26.	Collaborative Research: CNS Core: Medium: ICON: Intelligent Cooperative Optimal Networking for Mobile Indoor 5G+ Heterogeneous Wireless Networks	Muhammad Ismail	National Science Foundation	299,998.00	Pending
27.	Developing an Artificial Intelligence Agent to Assist Pilots with Real-Time Decision-Making	Ahmad Vaselbehagh	U.S. Air Force via Minco Technologies	20,000.00	Pending
28.	High Power Density Carbon Neutral Electric Power Generation for Air Vehicles	Rory Roberts	Department of Energy, ARPA-E	1,437,287.00	Funded
29.	Simulation of HF Inverter Circuits for High-Power Wireless Charging - Supplement	Satish M. Mahajan	Oak Ridge National Laboratory	24,210.00	Funded
SUBTOTAL, PROPOSALS FOR 2020-2021				1,956,490.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
30.	Building Critical Thinking Skills Through Geotechnical Assignments	Daniel VandenBerge	United States Universities Council on Geotechnical Education and Research (USUCGER)	5,000.00	Funded
31.	Resilient Cooperative Vehicle-Infrastructure Systems in Contested Environments	Arman Sargolzaei	Oak Ridge Associated Universities (Power Proposal)	5,000.00	Not funded
32.	Collaborative Research: Attack and Defense Strategies Against Joint Cascading Failure in Interdependent Power-Communication Systems	Muhammad Ismail	National Science Foundation	255,998.00	Pending
33.	CyberTraining: Implementation: Small: COMPJP: Core OpenMP Libraries for Java and Python	Sheikh Ghafoor, Mike Rogers, Mohammad Alam	National Science Foundation	499,999.00	Pending
SUBTOTAL, PROPOSALS FOR 2020-2021				765,997.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS
Submitted Between July 1, 2020 through June 30, 2021

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
34.	Tennessee Louis Stokes Alliance for Minority Participation (TLSAMP)	Jessica Oswalt	Tennessee State University (TSU) (Funding from the National Science Foundation)	104,400.00	Pending
35.	Investigating Early Transition Metal Dopant Effects in Cobalt Free Lithium ion Batteries	Indranil Bhattacharya	Oak Ridge National Laboratory	29,430.00	Pending
36.	Planning Grant: Engineering Research Center for Construction and Building Information Modeling	Craig Henderson	National Science Foundation	99,998.00	Not funded
37.	SCC-PG Towards Robust EV Charging Coordination Systems for Smart Communities	Muhammad Ismail, Maanak Gupta, Nicole Henniger	National Science Foundation	149,634.00	Pending
SUBTOTAL, PROPOSALS FOR 2020-2021				383,462.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
38.	SCC-PG: Harnessing Self-Sustainable Energy Efficient Smart Farming Infrastructures for Economically Distressed Rural Communities	Indranil Bhattacharya, Maanak Gupta, Michael Natrass	National Science Foundation	150,000.00	Pending
39.	Going Beyond ACI 332: Commercial/ Residential Enhanced Durability Concrete: Phase III The Effect of Limited Curing	L. K. Crouch	Tennessee Concrete Association (TCA)	6,332.00	Funded
40.	Human Beta Defensin 3 (hBD-3) Interactions with Lipid Membranes and Chemokine Receptor CXCR4	Liqun Zhang	National Institute of Health	415,945.00	Pending
41.	Demonstrate Enhancement of Heat Transfer in Important Components of Grid Operation	Ethan Languri	Industrial Sponsor	361,527.00	Pending
SUBTOTAL, PROPOSALS FOR 2020-2021				933,804.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
42.	CC* Compute: A GPU Cluster for Science Research and Education at Tennessee Tech University	Michael Rogers, Sheikh Ghafoor, Michael Renfro, Syed Hasan, Alfred Kalyanapu	National Science Foundation	399,983.00	Funded
43.	Building Pathways into Civil and Environmental Engineering for First Year Students	Daniel VandenBerge	Tennessee Board of Regents	43,211.00	Funded
44.	National Cybersecurity Teaching Academy: Southeast Consortium	Mohamed Mahmoud	University of Louisville (Funding from the National Security Agency NSA)	60,000.00	Pending
45.	Developing Effective Management Platform in Qatar Against Future Pandemics	Muhammad Ismail	Qatar Foundation	107,998.00	Pending
SUBTOTAL, PROPOSALS FOR 2020-2021				611,192.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
46. Dynamic MES Rescue Control in the Post-Disaster Micro-grid	Nan Chen	SCEEE	28,000.00	Not funded
47. Secure Nonlinear Control Design for Networked Control Systems	Arman Sargolzaei	NSF	361,394.00	Pending
48. Development of a Testbed for Distributed Energy Resources (DER) and Controllable Loads Simulation	Michael Rogers, Sheikh Ghafoor	EPRI	43,665.00	Funded
49. Collaborative Research: Understanding the Antibacterial Mechanisms of Human Beta Defensin-Structure and Dynamics Investigation	Liqun Zhang	NSF	306,211.00	Pending
SUBTOTAL, PROPOSALS FOR 2020-2021			739,270.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

**STATUS OF PROPOSALS
Submitted Between July 1, 2020 through June 30, 2021**

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
50.	ERI: Preparedness for Securing Battery Energy Storage Systems through AI Based Monitoring and Second Life Use	Tarek Elfouly	NSF	197,317.00	Pending
51	ERI: Multi-Resolution Traffic Simulation for connected and Autonomous Vehicles in Contested Environments	Shirin Noei	NSF	200,000	Pending
52	Federated Learning for Intrusion Detection and Mitigation in Smart Distribution Grids	Tarek Elfouly	Qatar Foundation	108,000	Pending
53	ERI: Blockchain-Learning- Based Resilience Control in MES-Integrated Microgrid Network	Nan Chen	NSF	199,311	Pending
SUBTOTAL, PROPOSALS FOR 2020-2021				704,628.00	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2020 through June 30, 2021

TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
54. Genetic Algorithm-Based Material Datamining, Understanding Atomic Scale Mechanisms and Hidden Recombination Pathways in Perovskite Multijunction Solar Cells	Indranil Bhattacharya	DOE	228,485	Pending
55. Enhanced Decision Support Platform for Small and Medium-Sized Farms Using Through the Soil Wireless Power and Data Transfer	Charles Van Neste, Michael John Best, Brian Leckie, Denis Ulybyshev	USDA	649,985	Pending
56. ERI: Empowering Data-Driven Resource Management in Indoor 5G+ Wireless Networks	Muhammad Ismail	NSF	199,454	Pending
SUBTOTAL, PROPOSALS FOR 2020-2021			1,077,924.00	
TOTAL, PROPOSALS FOR 2020-2021			13,835,640.00	

CESR Faculty Publications for 2020-2021 Fiscal Year

Noei, Shirin “Vehicle Powertrain in Traffic Microsimulation”, *99th Transportation Research Board Annual Meeting, Committee on Traffic Simulation, Virtual, Nov 16, 2020*.

Noei Shirin; “A Successful Professional Journey in Academia and Industry”, Invited Presentation to the *Institute of Transportation Engineers Chapter, University of Florida, Dec 3, 2020*.

Noei, Shirin and Xilei Zhao “Longitudinal Control for Autonomous and Connected Vehicles in Traffic Microsimulation”, *99th Transportation Research Board Annual Meeting, Workshop on Transportation Simulation and CAV Modeling, Jan 25–29, 2021*.

Utkarsh D. Kavimandan, V. P. Galigekere, B. Ozpineci, O. Onar, and **Satish M. Mahajan**; “A Sensorless coil detection scheme based on dead-time effect in dynamic wireless power transfer systems,” *IEEE Energy Conversion Congress and Exposition (ECCE), October 2020, pp. 828–833. DOI:10.1109/ECCE44975.2020.9235368*.

Utkarsh D. Kavimandan, V. P. Galigekere, O. Onar, M. Mohammad, B. Ozpineci, and **Satish M. Mahajan**, “The Sensitivity Analysis of Coil Misalignment for a 200-kW Dynamic Wireless Power Transfer System with an LCC-S and LCC-P Compensation,” *2021 IEEE Transportation Electrification Conference & Expo (ITEC), June 2021, pp. 1-8, DOI: 10.1109/ITEC51675.2021.9490035*.

Charles A. Robinson, Brandon T. Nieman, **Robert Craven**, Muhammed Enagi Bima, C.W. Van Neste, “Development of a Wireless Power Transmission System for Agriculture Sensor Devices”, *2020 IEEE International Conference on Big Data, paper ID: s09204, Dec 10-13, 2020*.

None for 2020-2021

Due to COVID-19 restrictions during 2020-2021, there were no seminars.

GRADUATE THESIS/DISSERTATIONS AND OTHER STUDENT PUBLICATIONS**MASTERS****CODY LONG**

Vortex Induced Vibrations of Oscillating Bluff Bodies for Energy Storage/Conversion Applications
Summer 2020
Dr. Ahmad Vasselbehagh
Mechanical Engineering

LINA HUSSEIN ABOUNASSIF

Proxy Reporting and Travel Diary Completion Status and Their Impacts on Reported Trips in National Household Travel Surveys
Fall 2020
Dr. Daniel Badoe
Civil & Environmental Engineering

MICHAEL ROBERT COULTIS

Quasi-Wirelessly Powered Robotics Using Single Wire Kinematic Chains
Fall 2020
Dr. Charles Van Neste
Electrical and Computer Engineering

RICHARD LEON MORROW III

Earthquake Ground Motion Suites for Memphis, Tennessee
Fall 2020
Dr. Timothy Huff
Civil & Environmental Engineering

DANIEL CLARK RIKLI

Comparing Strength and Modulus of Elasticity Values for Prisms Constructed with Lightweight and Normal Weight Grout
Fall 2020
Dr. R. Craig Henderson
Civil & Environmental Engineering

CHARLES AUSTIN LEE ROBINSON

Wireless Power Transmission for Sensor Devices Through the Soil
Fall 2020
Dr. Charles Van Neste
Electrical and Computer Engineering

GRADUATE THESIS/DISSERTATIONS AND OTHER STUDENT PUBLICATIONS**MASTERS (continued)****JONATHAN MICHAEL DEAN**

Resonant Unipolar Capacitive Power Transfer for Wireless Sensor Networks and IOT Devices
Spring 2021
Dr. Charles Van Neste
Electrical and Computer Engineering

JACKSON SCOTT REYNOLDS PENFIELD

Molecular Dynamics Simulation on Human β Defensin Type 3 Binding With CXCR4 Receptor
Spring 2021
Dr. Liqun Zhang
Chemical Engineering

ANDREW P. WORLEY

A Portable Implementation of Partitioned Point-To-Point Communication Primitives
Spring 2021
Dr. Sheikh Ghafoor
Computer Science

Number of MS Students: 9

GRADUATE THESIS/DISSERTATIONS AND OTHER STUDENT PUBLICATIONS

PH.D.

MOATEZ MOHAMMED ALHASSAN

Seismic Performance Assessment of Special Braced and Unbraced Structural
Systems with the Incorporation of Foundation Flexibility

Summer 2020

Dr. Daniel VandenBerge & Dr. Timothy Huff

Engineering

MOHAMED ISMAIL MAHMOUD BAZA

Blockchain-Based Secure and Privacy-Preserving Schemes for Connected Vehicles

Fall 2020

Dr. Mohamed Mahmoud

Engineering

Number of Ph.D. Students: 2

MS STUDENTS

Name	Dept.	Source of Support	Advisor
Abounassif, Lina	CEE	CEE/CESR	Dr. Daniel Badoe
Afolayan, Deborah	ECE	CESR	Dr. Satish M. Mahajan
Alissandrello, Dylan	CEE	NIBS via US Navy	Dr. Daniel VandenBerge
Atoum, Jumanh	ECE	CESR	Dr. Allen MacKenzie
Banik, Trapa	ECE	TVA Endowment/CESR	Dr. Indranil Bhattacharya
Coultis, Michael	ECE	MSU - DOD	Dr. Charles Van Neste
Crispi, Matthew	CEE	CESR	Dr. Jane Liu
Dean, Jonathan	ECE	MSU-DOD	Dr. Charles Van Neste
Edwards, Tyler	ME	Air Force STTR via Industrial Sponsor	Dr. Rory Roberts
Ekechi, Chijioke	ECE	CESR	Dr. Tarek Elfouly
Gollapudi, Anusha Sai	ECE	CESR/ECE	Dr. Ghadir Radman
Hackler, Michael	ME	CESR/TVA	Dr. Ahmed Vasselbehagh
Himes, J. Hunter	CHE	ORNL	Dr. Laura Arias Chavez
Hoegman Moeller, Markus	CEE	CESR	Dr. Daniel VandenBerge
Le, Quy Ton	ECE	CESR	Dr. Satish M. Mahajan
Lina, Debolina Halder	CSC	UNC (NASA)	Dr. Sheikh Ghafoor
Marcum, Tyler	ECE	MSU-DOD	Dr. Charles Van Neste
Miller, Chaz	ME	Air Force STTR via Industrial Sponsor	Dr. Rory Roberts
Mingen, Tanner	ECE	TVA Endowment/CESR	Dr. Charles Van Neste

MS STUDENTS (continued)

Name	Dept.	Source of Support	Advisor
Nieman, Brandon	ECE	NSF/MSU	Dr. Charles Van Neste
Penfield, Jackson	CHE	CESR	Dr. Liqun Zhang
Robinson, Charles	ECE	NSF	Dr. Charles Van Neste
Rucker, George	CHE	CESR	Dr. Liqun Zhang
Shiri, Alireza	CEE	CESR	Dr. Daniel VandenBerge
Staller, Joseph	ME	CESR/Industrial Sponsor	Dr. Stephen Idem
Worley, Andrew	CSC	CESR/NSF via UNC	Dr. Sheikh Ghafoor
Zhao, Yang	ME	TVA	Dr. Ahmed Vasselbehagh

PHD STUDENTS

Name	Dept.	Source of Support	Advisor
Abdelfattah, Sherif	ECE	External Sponsor/NSF	Dr. Mohamed Mahmoud
Abouyoussef, Mahmoud	CSC	CESR./External Sponsor	Dr. Muhammad Ismail
Adeleke, Abayomi	CHE	CESR	Dr. Venkat Padmanabhan
Adepoju, Webster	ECE	CESR	Dr. Indranil Bhattacharya
Adeyemo, Adewale	ECE	CESR/UAE	Dr. Syed Rafay Hasan
Amanzholov, Muzakhir	CSC	CESR/NSF	Dr. Sheik Ghafoor
Bondok, Atef	ECE	External Sponsor	Dr. Mohamed Mahmoud
Darbar, Devendrasinh	ECE	CESR/ORNL	Dr. Indranil Bhattacharya
Ellicott, Andrew	ME	CESR	Dr. Rory Roberts
Elmahallawy, Mohamed	ECE	CESR	Dr. Tarek Elfouly
Emeghara, Chikezie	ECE	CESR	Dr. Satish M. Mahajan
Feng, Qing	ECE	CESR	Dr. Ghadir Radman
Hagan, Ty	ME	TVA	Dr. Ahmed Vasselbehagh
Holland, James	ME	CESR	Dr. Arman Sargolzaei
Kavimandan, Utkarsh	ECE	ORNL/CESR	Dr. Satish M. Mahajan
Kiss, Agoston	CHE	CESR	Dr. Holly Stretz
Mohammad, Abdul Salam	CHE	CESR	Dr. Joseph Biernacki
Nouri, Reza	ME	CESR	Dr. Ahmed Vasselbehagh
Onanuga, Babajide	CHE	CESR/NSF	Dr. Joseph Biernacki
Prabhu, Vinit	ME	CESR	Dr. Ethan Languri
Yilmaz, Ibrahim	CSC	CESR	Dr. Ambareen Siraj

CEE Civil and Environmental Engineering (Tennessee Technological University)

CESR Center for Energy Systems Research (Tennessee Technological University)

CHE Chemical Engineering (Tennessee Technological University)

CSC Computer Science (Tennessee Technological University)

ECE Electrical and Computer Engineering (Tennessee Technological University)

ME Mechanical Engineering (Tennessee Technological University)

MSU DOD Mississippi State University - Department of Defense

NASA National Aeronautics and Space Administration

NIBS National Institute of Building Sciences

NSF National Science Foundation

ORNL Oak Ridge National Laboratory

TDOT Tennessee Department of Transportation

TVA Tennessee Valley Authority

UNC University of North Carolina at Chapel Hill

USUCGER United States Universities Council on Geotechnical Education and Research

Undergraduate StudentsDegree and Major

Brian Bowman	B.S. CEE
Ann Brewer	B.S. CHE
Glen Cathey	B.S. CSC
Ryan Colon	B.S. ECE
Grant Crumpton	B.A. Fine Arts
Rachel Cullison	B.S. Physics
Jackson Dittert	B.S. ME
Adrianna Eastep	B.S. CHE
Ty Hagan	B.S. ME
Nicholas Harris	B.S. ME
Amelia Hawkins	B.S. ECE
Zachary Hinchman	B.S. ME
Samuel Hollifield	B.S. CSC
Caleb Huck	B.S. CSC
Christopher Johnson	B.S. ECE
Sean Jones	B.S. ECE
Brandon (Mina) Kemp	B.S. Physics
Vadim Kholodilo	B.S. CSC
Aaron Kindred	B.S. Physics
Braden Long	B.S. CEE
Samuel Mandody	B.S. ECE
Tyler Marcrum	B.S. ECE
Austin Marler	B.S. ME
Matthew Blake Martin	B.S. ECE
William T. McCarty	B.S. ME
Jimmy Will Meacham	B.S. ME
Emma Mitchell	B.S. Physics
Richard Mitchell	B.S. Physics & CSC
Imran Mohamed	B.S. CSC
Brandon Nieman	B.S. ECE

Undergraduate Students

Rebekah Preshong	B.S. CHE
Isaac Sandoval	B.S. ECE
Ryan Senz	B.S. ECE
Houston Shearin	B.S. CSC
William Stump	B.S. ECE
Kaylaln Truman-Jarrell	B.S. CEE
Kyle Wendt	B.S. CEE
Coby White	B.S. ECE
Jonah White	B.S. CSC
Jacob Whitehead	B.S. ECE
Jeffrey Brock Yeates	B.S. Physics

Degree and MajorM.S. Graduate Students

Lina Abounassif	M.S. CEE
Deborah Afolayan	M.S. ECE
Muzakhir Amanzholov	M.S. CSC
Trey Burks	M.S. CSC
Glen Cathey	M.S. CSC
Matthew Crispi	M.S. CEE
Samuel Dunham	M.S. CEE
Chijioke Ekechi	M.S. ECE
J. Hunter Himes	M.S. CHE
Caleb Huck	M.S. CSC
R. Tyler Hughes	M.S. CEE
Christopher Kaczmarek	M.S. CEE
Agoston Kiss	M.S. CHE
Steven Lambert	M.S. CHE
W. Luke Lambert	M.S. CSC
Nicholas Lawson	M.S. CEE

Degree and Major

M.S. Graduate Students

Quy Ton Le

Debolina Halder Lina

Tyler McCormick

J. Will Meacham

Brandon Miller

Tanner Mingen

Brandon Nieman

Jackson Penfield

George Rucker

Joseph Staller

Jeff Webster

Andrew Worley

Yang Zhao

Degree and Major

M.S. ECE

M.S. CSC

M.S. ECE

M.S. ME

M.S. ME

M.S. ECE

M.S. ECE

M.S. CHE

M.S. CHE

M.S. ME

M.S. ME

M.S. CSC

M.S. ME

Ph.D. Graduate Students

Sherif Abdelfattah

Mahmoud Abouyoussef

Webster Adepoju

Devendrasinh Darbar

Chikezie Emeghara

Thomas Hines

Saanyol Igbax

Utkarsh Kavimandan

W. Luke Lambert

Rajesh Manicavasagam

Tyler Marcum

Degree and Major

Ph.D. ECE

Ph.D. CSC

Ph.D. ECE

Ph.D. ECE

Ph.D. ECE

Ph.D. CSC

Ph.D. ME

Ph.D. ECE

Ph.D. CSC

Ph.D. CSC

Ph.D. ECE

Ph.D. Graduate Students

M. Rayhan Ahmed Mithu

Abdul Salam Mohammad

Ebrahim Nasr Esfahani

Babajide Onanuga

Vinit Prabhu

S. K. Vaibhav Ravinutala

Ahmed Shafee

Hajar Taheri Afarani

Prince Turkson

Carey Wilson

Ibrahim Yilmaz

Degree and Major

Ph.D. CSC

Ph.D. CHE

Ph.D. ECE

Ph.D. CHE

Ph.D. ME

Ph.D. ECE

Ph.D. ECE

Ph.D. CHE

Ph.D. CEE

Ph.D. ED

Ph.D. CSC

2020 - 2021

Undergraduate Student	Sponsor	Program	Faculty Advisor
Brian Bowman	The NCMA Education and Research Foundation	Comparing Strength and MOE for Prisms Constructed with Lightweight and Normal Weight Grout	Dr. Craig Henderson
Ann Brewer	Case Western Reserve University & Center for Energy Systems Research	Novel Endogenous Beta Defensin Based Therapeutics to Treat COVID-19 Patients	Dr. Liqun Zhang
Glen Cathey	National Aeronautics and Space Administration (NASA)	Quasi-Wireless Capacitive (QWIC) Surface Power for Adaptive and Reconfigurable Sensor Elements on Space Infrastructure	Dr. Maanak Gupta
Ryan Colon	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008- Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste
Grant Crumpton	Miami University (Funding from the Tennessee Department of Health)	Implementing a Preference-Based, Person-Centered Communication Tool in Tennessee	Dr. Gerald Gannod

UNDERGRADUATE RESEARCH PROJECTS, continued SM-11

2020 - 2021

Undergraduate Student	Sponsor	Program	Faculty Advisor
Rachel Cullison	Department of Energy	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Dr. Mustafa Rajabali
Jackson Dittert	Department of Energy	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Dr. Mustafa Rajabali
Adrianna Eastep	Case Western Reserve University	Novel Endogenous Beta Defensin Based Therapeutics to Treat COVID-19 Patients	Dr. Liqun Zhang
Ty Hagan	Tennessee Valley Authority	Development of Laser-Based System for Maintenance of Ice Condensers	Dr. Ahmad Vasselbehagh
Nicholas Harris	Industrial Sponsor	Resiliency Tester "Bouncer" for Superior Graphite	Dr. Stephen Idem
Amelia Hawkins	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste

UNDERGRADUATE RESEARCH PROJECTS, continued SM-11

2020 - 2021

Undergraduate Student	Sponsor	Program	Faculty Advisor
Zachary Hinchman	Department of Energy	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Dr. Mustafa Rajabali
Samuel Hollifield	Oak Ridge National Laboratory	Research of Machine- Learning Based Cybersecurity Tools & From Can't to Can: Attack Prevention and In-Situ Detection of Advanced Attacks or Controller Area Networks	Dr. Sheikh Ghafoor
Caleb Huck	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors (Principal Investigator Charles Van Neste, Co-Principal Investigator Satish M. Mahajan)	Dr. Sheikh Ghafoor
Christopher Johnson	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors (Principal Investigator Charles Van Neste, Co-Principal Investigator Satish M. Mahajan)	Dr. Charles Van Neste
Sean Jones	Department of Energy & Center for Energy Systems Research	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Dr. Mustafa Rajabali

UNDERGRADUATE RESEARCH PROJECTS, continued SM-11

2020 - 2021

Undergraduate Student	Sponsor	Program	Faculty Advisor
Brandon Kemp	Miami University (Funding from the Tennessee Department of Health)	Implementing a Preference-Based, Person-Centered Communication Tool in Tennessee	Dr. Gerald Gannod
Vadim Kholodilo	National Aeronautics and Space Administration (NASA)	Quasi-Wireless Capacitive (QWiC) Surface Power for Adaptive and Reconfigurable Sensor Elements on Space Infrastructure	Dr. Denis Ulybyshev
Aaron Kindred	National Science Foundation via the University of Tennessee at Knoxville	MRI: Development of a high-resolution neutron detector for decay and reaction studies with exotic nuclei.	Dr. Mustafa Rajabali
Braden Long	Department of Energy	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Dr. Mustafa Rajabali
Samuel Mandody	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste
Tyler Marcrum	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste

UNDERGRADUATE RESEARCH PROJECTS, continued SM-11

2020 - 2021

Undergraduate Student	Sponsor	Program	Faculty Advisor
Austin Marler	National Science Foundation via the University of Tennessee at Knoxville	MRI: Development of a high- resolution neutron detector for decay and reaction studies with exotic nuclei.	Dr. Mustafa Rajabali
Matthew Blake Martin	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Ele- ments and Networks for Moni- toring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste
William T. McCarty	Tennessee Valley Authority	Development of Laser- Based System for Maintenance of Ice Condensers	Dr. Ahmad Vasselbehagh
Jimmy Meachum	Tennessee Valley Authority	Development of Laser- Based System for Maintenance of Ice Condensers	Dr. Stephen Idem
Jimmy Meachum	Air Force STTR via Special Pow- er Sources	Hypersonic Onboard Power and Thermal Management System (Phase 2)	Dr. Rory Roberts
Emma Mitchell	National Science Foundation via the University of Tennessee at Knoxville	MRI: Development of a high- resolution neutron detector for decay and reaction studies with exotic nuclei.	Dr. Mustafa Rajabali

2020 - 2021

Undergraduate Student	Sponsor	Program	Faculty Advisor
Richard Mitchell	National Science Foundation via the University of Tennessee at Knoxville	MRI: Development of a high-resolution neutron detector for decay and reaction studies with exotic nuclei.	Dr. Mustafa Rajabali
Imran Mohamed	National Science Foundation via the University of Tennessee at Knoxville	MRI: Development of a high-resolution neutron detector for decay and reaction studies with exotic nuclei.	Dr. Mustafa Rajabali
Brandon Neiman	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste
Rebekah Preshong	Department of Energy	The Structure of Neutron-Rich Deformed Nuclei Studied via Beta Decay	Dr. Mustafa Rajabali
Isaac Sandoval	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste

2020 - 2021

Undergraduate Student	Sponsor	Program	Faculty Advisor
Ryan Senz	CESR	Smart Grid	Robert Craven
Houston Shearin	The University of North Carolina at Chapel Hill (Funding from NASA)	Tracking Water Storage in Lakes: Citizens and Satellites Implementation Phase	Dr. Sheikh Ghafoor
William Stump	Mississippi State University (Funding from the Department of Defense) and Center for Energy Systems Research, Tennessee Technological University	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste
Michael Tidwell	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste
Kaylaly Truman-Jarrell	National Science Foundation	EAGER SitS: A Multi-Sensor Probe Network for Continuous Monitoring of the Soil Health	Dr. Charles Van Neste
Kyle Wendt	Industrial Sponsor	Going Beyond ACI 332: Commercial/Residential Enhanced Durability Concrete: Phase III The Effect of Limited Curing	Dr. Lewis K. Crouch

2020 - 2021

Undergraduate Student	Sponsor	Program	Faculty Advisor
Coby White	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste
Jonah White	National Aeronautics and Space Administration (NASA)	Quasi-Wireless Capacitive (QWiC) Surface Power for Adaptive and Reconfigurable Sensor Elements on Space Infrastructure	Dr. Denis Ulybyshev
Jacob Whitehead	Mississippi State University (Funding from the Department of Defense)	SimBRS II TO008-Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Dr. Charles Van Neste
Jeffrey Brock Yeates	National Science Foundation via the University of Tennessee at Knoxville	MRI: Development of a High Resolution Neutron Detector for Decay and Reaction Studies with Exotic Nuclei	Dr. Mustafa Rajabali

Total Count: 45

ACTUAL, PROPOSED, AND REQUESTED BUDGET SCHEDULE 7

CENTERS OF EXCELLENCE ACTUAL, PROPOSED, AND REQUESTED BUDGET

Institution	Tennessee Technological University						Center	Center for Energy Systems Research		
	FY 2020-21 Actual			FY 2021-22 Proposed			FY 2022-23 Requested			
	Matching	Appropriations	Total	Matching	Appropriations	Total	Matching	Appropriations	Total	
Expenditures										
Salaries										
Faculty	\$ 350,723	\$ 312,964	\$ 663,687	\$ 104,023	\$ 267,725	\$ 371,748	\$ 87,152	\$ 281,135	\$ 368,287	
Other Professional	\$ 34,323	\$ 121,698	\$ 156,021	\$ 5,693	\$ 141,815	\$ 147,508	\$ 5,559	\$ 141,815	\$ 147,374	
Clerical/ Supporting	\$ -	\$ 41,537	\$ 41,537	\$ -	\$ 79,711	\$ 79,711	\$ -	\$ 79,711	\$ 79,711	
Assistantships	\$ 217,630	\$ 189,045	\$ 406,675	\$ 143,155	\$ 130,000	\$ 273,155	\$ 158,503	\$ 155,000	\$ 313,503	
Hourly Students	\$ 105,398	\$ 81,387	\$ 186,785	\$ 21,800	\$ 30,000	\$ 51,800	\$ 16,540	\$ 33,080	\$ 49,620	
Total Salaries	\$ 708,074	\$ 746,631	\$ 1,454,705	\$ 274,671	\$ 649,251	\$ 923,922	\$ 267,754	\$ 690,741	\$ 958,495	
Fringe Benefits	\$ 102,941	\$ 147,095	\$ 250,036	\$ -	\$ 195,000	\$ 195,000	\$ 98,475	\$ 210,264	\$ 308,739	
Grad Tuition/Fees	\$ 121,027	\$ 166,491	\$ 287,518	\$ 99,736	\$ 130,000	\$ 229,736	\$ 62,368	\$ 124,736	\$ 187,104	
Total Personnel	\$ 932,042	\$ 1,060,216	\$ 1,992,258	\$ 374,407	\$ 974,251	\$ 1,348,658	\$ 428,597	\$ 1,025,741	\$ 1,454,338	
Non-Personnel										
Travel	\$ 93,167	\$ 1,831	\$ 94,998	\$ 35,661	\$ 10,000	\$ 45,661	\$ 15,000	\$ 10,000	\$ 25,000	
Software	\$ -	\$ 1,706	\$ 1,706	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Books & Journals	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Other Supplies	\$ 79,695	\$ 38,568	\$ 118,263	\$ 21,660	\$ 40,549	\$ 62,209	\$ 20,275	\$ 40,549	\$ 60,824	
Equipment	\$ 383,303	\$ 38,092	\$ 421,395	\$ 37,285	\$ 5,000	\$ 42,285	\$ 32,500	\$ 5,000	\$ 37,500	
Maintenance	\$ -	\$ 14,259	\$ 14,259	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Scholarships for Service	\$ 159,144		\$ 159,144	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Consultants/Subcontracts	\$ 184,000	\$ 14,585	\$ 198,585	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Renovation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Seminars/Workshops/Con	\$ 36,237	\$ -	\$ 36,237	\$ 45,987	\$ -	\$ 45,987	\$ 44,273	\$ -	\$ 44,273	
Total Non-Personnel	\$ 935,546	\$ 109,041	\$ 1,044,587	\$ 140,593	\$ 55,549	\$ 196,142	\$ 112,048	\$ 55,549	\$ 167,597	
GRAND TOTAL	\$ 1,867,588	\$ 1,169,258	\$ 3,036,846	\$ 515,000	\$ 1,029,800	\$ 1,544,800	\$ 540,645	\$ 1,081,290	\$ 1,621,935	
Revenue	NOTE: Actual Matching Funds do not include Indirect Costs of \$455,802 for FY 2020-2021.									
New State Appropriation		\$ 989,500	\$ 989,500		\$ 1,029,800	\$ 1,029,800		\$ 1,081,290	\$ 1,081,290	
Carryover State Appropriation		\$ 820,286	\$ 820,286		\$ 640,528	\$ 640,528				
New Matching Funds	\$ 1,867,588		\$ 1,867,588	\$ 515,000		\$ 515,000	\$ 540,645			
Carryover from Previous Matching Funds						\$ -			\$ -	
Total Revenue	\$ 1,867,588	\$ 1,809,786	\$ 3,677,374	\$ 515,000	\$ 1,670,328	\$ 2,185,328	\$ 540,645	\$ 1,081,290	\$ 1,081,290	

JUSTIFICATION FOR 2022-2023 APPROPRIATIONS REQUEST

The Center for Energy Systems Research (CESR) is requesting a 5% increase in anticipation of additional expenses during 2022-2023. The increased expenses include additional cost for personnel appointments of the second Research Assistant Professor, and funding for additional undergraduate and graduate students to participate in the research activities of the CESR.

