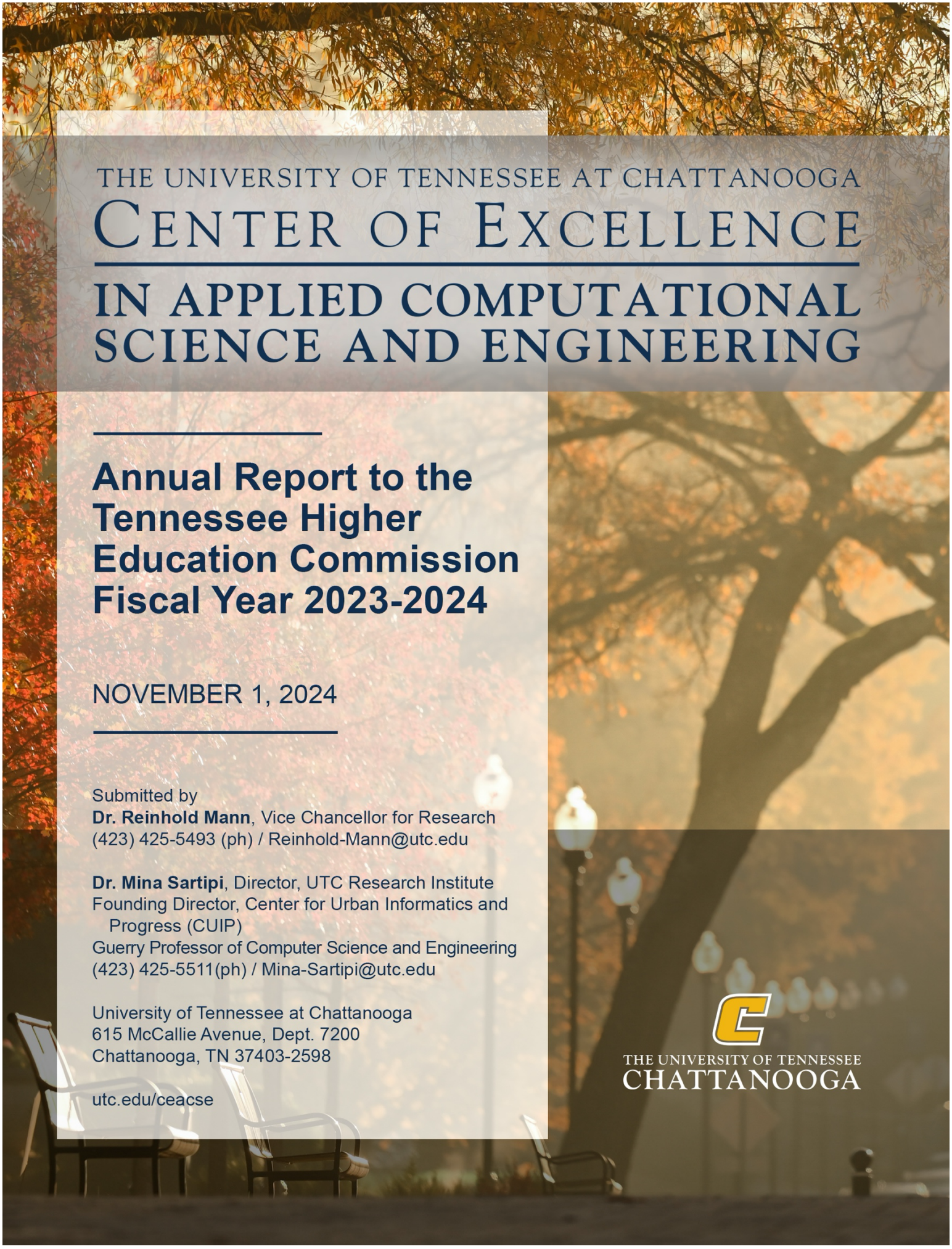

THE UNIVERSITY OF TENNESSEE AT CHATTANOOGA

CENTER OF EXCELLENCE

IN APPLIED COMPUTATIONAL SCIENCE AND ENGINEERING

Annual Report to the Tennessee Higher Education Commission Fiscal Year 2023-2024

NOVEMBER 1, 2024

Submitted by
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THE UNIVERSITY OF TENNESSEE
CHATTANOOGA

MISSION STATEMENT

To establish, expand, and sustain a cohesive multidisciplinary effort in applied computational sciences through mentoring of students and faculty, seed funding in key thrust areas, and providing state-of-the-art research computing facilities.

VISION STATEMENT

CEACSE makes impacts across UTC to help generate sustained growth in faculty research funding, excellence in integrated education and research, and growth in the number of Ph.D. graduates in these applied areas. We investigate, design, and deliver solutions to problems of importance to society in advanced modeling and simulation, high-performance computing, and data sciences. We train undergraduate and graduate students at UTC to become knowledge workers who help drive economic growth both locally and nationally. Our cohesive multidisciplinary efforts in applied computational sciences are recognized for their contributions to the community, the state of Tennessee, the region, and the nation.

EXECUTIVE SUMMARY

The University of Tennessee at Chattanooga's (UTC) Center of Excellence in Applied Computational Science and Engineering (CEACSE) completed its second decade in 2023 of invigorating scientific inquiry, bolstering the learning environment, broadening participation, and establishing sustainable research pathways that benefit our institution, faculty and students, and the State of Tennessee. We look to a future of continued excellence as we begin our 23rd year in Fall 2024.

With our previous report for FY2023, CEACSE marked its 21st year of growing UTC's first Center of Excellence into a critically important incubator for inquiry and experimentation across a diverse array of computational science and engineering endeavors. This report for FY2024 follows up our previous report with CEACSE's focused priority areas, highlights the ongoing strengths of its visionary leadership team, and notes greater impacts across a range of stakeholder groups. CEACSE comprises the indispensable factor that enables UTC to recruit, retain, and engage outstanding professors and equally outstanding students through research experiences for undergraduates up to and including PhD students.

CEACSE research and advanced development activities enhance education at all academic levels at UTC, including through the PhD program in Computational Sciences. Graduate and undergraduate students alike participate in a variety of research activities and experiential learning as a result of current and prior CECSE funding. Companies in our community and region continue to grow their interest in the educational programs impacted by CEACSE initiatives, largely because of the applied R&D supported by CEACSE. The Multidisciplinary Research Building (formerly SimCenter building), the central site of CEACSE, continues to broaden and deepen efforts to partner with companies in the Chattanooga region and beyond. Because of increasing capabilities in high-performance computing and the overarching importance of modeling, simulation, and advanced computing in research and education, the efforts and outcomes of our researchers and their students continue to serve as research anchors that attract students from across the nation and internationally. These students represent a valuable contribution to the future workforce of knowledge workers for the community and the state of Tennessee. Company leaders tell us time and again how important the core competencies of our Center of Excellence are and how valuable our graduates are to their business enterprises, including local high-tech startups. Significantly, the number of industrial and national lab internships and full-time jobs landed by graduating UTC students is growing. The continued success of prior CEACSE-funded professors in growing their science, engineering inquiries, and external funding is also notable.

Some notable outcomes in FY2024 include these highlights:

- PI Barbee's research manuscript is in progress, and the goal is to submit it to *Polymer Chemistry* in 2025.

- PI Barbee was awarded the ACS Petroleum Research Undergraduate New Investigator Fellowship in August 2024, titled “Expanding covalent mechanochemistry to commonly used polymer materials.”
- PI Barbee taught a new polymer chemistry class (CHEM 4040) at UTC.
- PI Barbee’s undergraduate student graduated, was accepted into a PhD chemistry program at Northwestern University and was awarded an NSF GRFP fellowship while being mentored by PI Barbee.
- PI Barisik’s undergraduate students collaborated with researchers from the “National Institute of Standards and Technology” (NIST), an ongoing project to develop open-source tools and algorithms for thermodynamic characterization of different materials.
- PI Barisik was involved in multiple activities to improve STEM education and educator development in local Title 1 schools, supporting and promoting STEM education in elementary schools with large numbers of underrepresented minority groups.
- PI Barisk’s master’s student received the “Best Graduate Research” poster award through the College of Engineering and Computer Science.
- PI Barisik received NSF funding using preliminary data from his CEACSE project.
- PI Kong's research was presented at the UTC Math Department Colloquium Series, the American Mathematical Society Regional meeting, and the annual UTC ReSEARCH Dialogues Conference.
- PI Li is planning to use research findings to improve the Chattanooga Quantum Network.
- PI Ofoli’s master's student graduated and completed their master's thesis using data from the CEACSE project.
- PI Ofoli had an invention disclosure titled “Machine Vision Application for Damaged Solar Panels Detection.”
- PI Yuan plans to collaborate with the City of Chattanooga to incorporate the designed algorithm with the implemented 311 systems.
- PI Yuan is planning of applying to external grants (US EPA and NSF), as well as expand collaborations (current collaborators include Alabama A&M University, Florida State University, and the University of Texas at Arlington)

Also, from CEACSE funds for FY2024-2025, we awarded four core awards (maximum of $150,000 over two years).

In collaboration, the UTCRI and the Office of the Vice Chancellor for Research continue to foster a rapidly expanding and enhancing culture of securing external funding as an outcome of seed research funding provided by CEACSE. We recognize the challenges for faculty to excel in attracting extramural funding while meeting all aspects of meritorious scholarship. We provide support through the Office of Research and Sponsored Programs (ORSP), through a focus on opportunities that are designed to lead to larger funding awards, and through the development of

strategic partnerships. CEACSE is maturing in its role at UTC as a nexus of research incubation, HPC, and data science, as well as a key provider of faculty resources that complement and supplement ORSP's offerings and those of faculty home departments.

This document constitutes the Annual Report for Fiscal Year 2023 of CEACSE activities and efforts. On behalf of UTC, Research Institute, our community partners and stakeholders, and our CEACSE-funded scientists, engineers, and students, we express our deep appreciation to THEC for this critically important support of the CEACSE at the University of Tennessee at Chattanooga.

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FACULTY & STAFF

The Center of Excellence in Applied Computational Science and Engineering benefits from institutional leaders who are deeply committed to enriching and expanding computational science as a research area and as an enabler of innovative research across academic departments. The THEC Chair of Excellence for this reporting period was Dr. Mina Sartipi. CEACSE also partners with Dr. Reinhold Mann, UTC's Vice Chancellor for Research. Please see the **Leadership Contact Information and Bios** section for details of leadership personnel.

CEACSE FY2024 Awardees

The following faculty and staff were integral to the strategic direction of CEACSE during the 2022–2024 competition cycle on both core and Faculty Initiation/Opportunity Awards. As noted below, these individuals served as Lead PI and/or Co-PI on projects that advanced the CEACSE mission and vision. Biosketches for all faculty may be found in **Appendix A.**

Dr. Meredith Barbee

Dr. Meredith Barbee is an assistant professor of chemistry at the University of Tennessee at Chattanooga. Dr. Barbee earned her doctoral degree in Professor Stephen Craig's lab at Duke University in Durham, NC, in 2019, where she was an NDSEG fellow. Her doctoral research focused on taking advantage of the typically destructive process of mechanical deformation in polymer materials as an avenue for constructive chemical reactions and material responses using organic chemistry. Prior to joining the faculty at UTC, Dr. Barbee conducted postdoctoral research at the University of North Carolina at Chapel Hill with Professor Abigail Knight. Dr. Barbee joined the faculty at UTC in 2021. Her teaching responsibilities in the UTC Chemistry and Physics Department focus on organic chemistry and polymer chemistry. Dr. Barbee and her undergraduate students conduct research in polymer chemistry with a focus on molecular-level control of polymer materials. Their interests include single-chain polymer nanoparticles, polymer network topology, hydrogel materials, and mechanochemistry.

*Lead PI: "*Exploring entanglements in polymer network topologies with single-chain nanoparticles.*"*

Dr. Murat Barisik

Dr. Murat Barisik is an Assistant Professor and the director of the Micro/Nano Engineering Group at the University of Tennessee at Chattanooga. He received his B.S. and M.S. in Mechanical Engineering from Middle East Technical University, Turkey. He obtained his Ph.D. (2012) in Aerospace Engineering from Old Dominion University, USA, where he graduated in the first rank and received the "Faculty Award in Aerospace Engineering." He received the "Brain Circulation Scheme" award from the European Union Marie-Curie program in 2015. His research focuses on micro/nano-scale gas and liquid transport, heat transfer, surface wetting, electrokinetic phenomena, and functional nanomaterials/systems. He performs multiscale/ multiphysics modeling using computational fluid dynamics, computational chemistry, molecular dynamics, and density functional theory, as well as experiments on nanosecond laser ablation, electrospinning, and mesoporous material characterizations. He is the author of 3 book chapters and 50 scientific papers in reputable journals and received more than 2000 citations as his h-index reached 25. He received the "Career Award" from The Scientific and Technological Research Council of Turkey and the "Outstanding Young Scientist Award" from the Turkish Academy of Sciences given by the President of Turkey.

Lead PI: "Modeling heat generation and temperature variation in supercapacitors"

Dr. Vahid Disfani

Dr. Vahid R. Disfani is a UC Foundation Associate Professor in the Department of Electrical Engineering at the University of Tennessee at Chattanooga (UTC). He earned his Ph.D. in Electrical Engineering from the University of South Florida in 2015, with a research focus on optimization and control in microgrids and power electronic converters. He also holds an M.Sc. from Sharif University of Technology and a B.Sc. from Amirkabir University of Technology, both in Electrical Engineering. Dr. Disfani's research interests include smart grids, energy management, and the integration of distributed energy resources, with significant contributions to electric vehicle charging infrastructures and renewable energy optimization. Additionally, he has industry experience as a postdoctoral scholar at the University of California San Diego and as an intern at NEC Laboratories America, focusing on energy management. As founder and CEO of SABAVA LLC, he leads projects in sustainable energy solutions, and his work has been published extensively in IEEE journals and conference proceedings, contributing to advances in power systems research.

Co-Investigator: "Machine Vision & AI Application for Damaged Solar Panels Detection"

Dr. Joseph (Joe) Dumas

Dr. Joe Dumas is a professor in the College of Engineering and Computer Science with 30+ years of experience in the UTC faculty. Courses he frequently teaches include CPSC 5700, Advanced Computer Architecture; CPEN 4700, Computer Architecture; CPEN 4710, Advanced Computer Systems; CPEN 3710, Computer System Organization and Assembly Language programming; and CPSC 2800, Introduction to Operating Systems. My areas of interest include computer architecture, microprocessors, embedded systems, real-time simulation, and virtual environments.

Co-Investigator: "Creating a Socially Aware, Efficient, Transparent, and Equitable 311 System for Smart Cities"

Dr. Feng Guo

Dr. Feng Guo is an assistant professor in the Department of Psychology at the University of Tennessee at Chattanooga**.** He received his master's degree in statistics and PhD in I/O psychology from Bowling Green State University. His research interests lie in the areas of machine learning, psychometrics, and research methods. Particularly, his research focuses on the future of work, and he is interested in applying novel machine learning and big data methods to advance the understanding of workplace behavior and performance. For instance, his research involves applying natural language processing (NLP) and novel psychometrics techniques to address practical challenges in selection, testing, and performance appraisal. On the applied side, he has years of working experience as a data analyst and a consultant.

Co-Investigator: "Creating a Socially Aware, Efficient, Transparent, and Equitable 311 System for Smart Cities"

Dr. Lingju Kong

Dr. Lingju Kong is a Professor in the Department of Mathematics at UTC. His research is in applied mathematics, differential equations, and their applications. He has published three research monographs and over 175 research papers in refereed journals. His work has drawn extensive attention worldwide, and according to Researchgate, it has been cited over 2000 times.

Lead PI: "Dynamics Analysis of Online Social Network Models"

Dr. Tian Li

Dr. Tian Li is an Assistant Professor of Physics at the University of Tennessee at Chattanooga (UTC), specializing in experimental quantum information science. Dr. Li also serves as the CTO of the UTC Quantum Center and is leading quantum networking and communications research in the UTC Quantum Node Lab, which provides access to the world's first software-programmable quantum network – the EPB Bohr-IV Quantum Network in downtown Chattanooga. Dr. Li's research is funded by the NSF ExpandQISE and NIST STRS programs, both as Principal Investigator.

Lead PI: "Recovery of Quantum Correlations Using Machine Learning"

Dr. Mohammed Mahtabi

Dr. Mohammed Mahtabi is an associate professor of mechanical engineering at UTC. He received his PhD in mechanical engineering from Mississippi State University in 2017. Dr. Mahtabi has extensive experience in computational and experimental research on mechanical behavior, fatigue and fracture of metals, shape memory alloys, and additive manufacturing materials. He has published several journal articles and conference papers on these topics, two of them being review articles. In addition, he serves on the editorial board of two journals, has organized several symposia, and has edited multiple special journal issues in his area of expertise.

Co-Investigator: "Exploring entanglements in polymer network topologies with single-chain nanoparticles"

Dr. Abdul Ofoli

Dr. Abdul R. Ofoli is a Professor and Interim Department Head of Electrical Engineering at the University of Tennessee at Chattanooga (UTC). He holds a B.Sc. in Electrical and Electronic Engineering from Kwame Nkrumah University of Science and Technology (1999), where he graduated with first-class honors, an M.Eng. (2003), and a Ph.D. (2006) in Electrical Engineering from Howard University, specializing in advanced control systems. His research spans power electronics, sustainable energy, and intelligent control applications, and he has contributed significantly to developing control algorithms for automotive and renewable energy systems. Dr. Ofoli's expertise in machine learning and computer vision applications is evidenced by his leadership in multiple funded projects, including advanced AI applications for solar panel damage detection. A dedicated educator, he has received multiple awards for teaching and advising excellence, and he is actively involved in mentoring future engineers through various university and community robotics programs. His work has earned him multiple patents, and he is a Senior Member of IEEE, with a strong record of publications in IEEE Transactions and conference proceedings.

*Lead PI: "*Machine Vision & AI Application for Damaged Solar Panels Detection"

Dr. Donald Reising

Dr. Donald R. Reising is a Guerry and UC Foundation Associate Professor of Electrical Engineering at the University of Tennessee at Chattanooga (UTC). Dr. Reising received a B.S. degree in electrical engineering from the University of Cincinnati, Cincinnati, Ohio, in 2006 and M.S. and Ph.D. degrees in electrical engineering from the Air Force Institute of Technology (AFIT), Wright-Patterson Air Force Base (WPAFB), Ohio, in 2009 and 2012, respectively. Before joining UTC's faculty in 2014, Dr. Reising served as an electronics engineer and researcher at the U.S. Air Forces Aeronautical System Center (2006 – 2009) and Research Laboratory (AFRL) Sensors Directorate (2009 – 2014). His research interests include digital communications and signal processing; Specific Emitter Identification (SEI) and Radio Frequency (RF) fingerprinting; next generations communications systems; automation of smart grid electrical disturbance categorization, identification, and learning; as well as the use of SEI, machine learning, and signal processing in radiation effects characterization. Dr. Reising is a member of Eta Kappa Nu, Tau Beta Pi, and a Senior Member of IEEE. His honors include IEEE Chattanooga Chapter's Outstanding Engineer Award (2022), UTC's Outstanding University Service Award (2018), AFRL Sensors Directorate Dr. Samuel M. Burka Award (2013), Association of Old Crows Research Excellence Award (2009), and the Measurement and Signature Intelligence (MASINT) Committee Academic Excellence Award (2009).

Co-Investigator: "Recovery of Quantum Correlations Using Machine Learning

Dr. Junrong Shi

Dr. Junrong Shi had five years of post-master social work experience working with non-profit organizations on community-based participatory programs to serve vulnerable children, the elderly, and people living in poverty. Dr. Shi's research interests are aging health disparity and caregiver support. She has presented her research regularly at conferences and published some articles in these areas of her interest. Dr. Shi has taught social work research and Human Behaviors and Social Environment courses.

Co-Investigator: "Creating a Socially Aware, Efficient, Transparent, and Equitable 311 System for Smart Cities"

Dr. Yukun Yuan

Dr. Yukun Yuan is a tenure-track assistant professor of the Department of Computer Science & Engineering, University of Tennessee at Chattanooga. He obtained his Ph.D. degree in Computer Engineering at Stony Brook University. He earned his bachelor's of science from Shanghai Jiao Tong University (SJTU) in 2015, majoring in computer science. His research interests are broadly in the areas of Cyber-Physical Systems, Internet of Things, Control, and Data Science.

Lead PI:" Creating a Socially Aware, Efficient, Transparent, and Equitable 311 System for Smart Cities"

FY2024 STUDENTS

Project Title: "Exploring entanglements in polymer network topologies with single-chain nanoparticles"

Lead PI: Meredith Barbee

Students Impacted:

Graham Ford worked full-time on this project in the Summer and Fall of 2022. He started learning relevant lab skills when he was enrolled in CHEM 4997 (research) during the Spring of 2022 and in the early Summer of 2022 while funded by a research and creative activity grant. His project focused on the development of single-chain polymer nanoparticles with internal silyl ether cross-links (aim 2). He presented his work at the annual Undergraduate Research Program (URP) oral presentations in May and July 2022. He also presented a poster titled "Single-chain polymer nanoparticles with silyl ether crosslinks" at the Southeastern Regional American Chemical Society (SERMACS) meeting in San Juan, Puerto Rico, in October 2022. He earned his B.S. in Biology in December 2022 and is currently working as a paramedic and firefighter while applying to medical school. CEACSE was his only research experience at UTC and allowed him to build valuable critical thinking skills and independence that will help him accomplish his goal of becoming a doctor.

Kelly Hooper worked full-time on this project in the Fall of 2022 and Summer of 2023 and continued working on this grant through the project end. Kelly began working with Dr. Barbeein in the Spring of 2022 on a different project but shifted her focus to CEACSE in 2022. Her project focused on the development of a strategy for incorporating single-chain nanoparticles into polymer networks (aim 2). She presented her work at the annual Undergraduate Research Program (URP) oral presentations in May and July 2023 and a poster titled "Synthetic Strategies for Single Chain Polymer Networks" at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023. She earned her B.S. in Chemistry in December 2023. Before Kelly began research on this project, she was considering going straight to the job market or pursuing a master's degree and focusing on forensics. CEACSE allowed her to realize how much she enjoys research. After graduation, Kelly worked on the grant as a post-baccalaureate student. This gave her the opportunity to devote a significant amount of time to the project, and she developed expertise in both computational simulations (aim 1) and wet-lab experiments. Kelly is currently pursuing a Ph.D. in chemistry at the University of North Carolina at Chapel Hill.

Samuel Robinson began working to develop a new intrachain crosslinking methodology for single-chain nanoparticles when he was enrolled in CHEM 4997 (research) during the Spring and Summer of 2022 while funded by the Undergraduate Research Program (URP). He presented his work at the annual Undergraduate Research Program (URP) oral presentations in May and July 2022. In the Fall of 2022, he began focusing on work funded by the CEACSE grant. He presented a poster titled "Biomimetic Design of Single Chain Polymer Networks" at the Southeastern Regional American Chemical Society (SERMACS) meeting in San Juan, Puerto Rico, in October 2022. He also worked full-time on CEACSE during the Summer of 2023 and presented his work at the annual Undergraduate Research Program (URP) oral presentations in May and July 2023. He presented a poster titled "Biomimetic design of mechanochromic SCNP networks" at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023. He will earn his B.S. in Chemistry in May 2025 and he is planning to pursue a PhD in Chemistry after graduation. The CEACSE grant has allowed him to grow as a scientist and learn to take ownership of a project. The opportunity for him to work with Dr. Barbee for an

extended period of time has given him practical experience with challenges that are faced in research and how to overcome them. He will be writing his honors thesis on his work in 2024-2025.

Dallas Donovan joined the team in May 2023. He worked part-time on CEACSE during the Summer of 2023 and presented his work at the annual Undergraduate Research Program (URP) oral presentations in May and July 2023. He presented a poster titled “SCNP networks through reinitiating RAFT polymerization” at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023 and at SERMACS in Atlanta, GA. He will be writing his honors thesis on his work in 2024-2025. He will earn his B.S. in Chemistry in May 2025 and he is planning to pursue a PhD in Chemistry after graduation. Receiving funding from CEACSE allowed him to work fewer hours at an off-campus job and to be paid for research, which allowed him to build research experience.

Christine Rukeyser joined the team in August 2023. She synthesized an anthracene monomer for SCNP crosslinking (aim 2). She graduated from UTC in December 2023 with a B.S. in Chemistry and worked at Oak Ridge National Lab in a research position until August 2024. She is currently pursuing a PhD in Chemistry at Northwestern University and was awarded an NSF GRFP fellowship that she wrote while Dr. Barbee was her mentor through CEACSE.

Project Title: “Modeling heat generation and temperature variation in supercapacitors”

Lead PI: Murat Barisik

Students Impacted:

Through this project, multiple graduate and undergraduate students received valuable training support in both research and coursework. The grant facilitated hands-on experience in advanced modeling techniques and high-performance computing. One MS student demonstrated significant progress, excelling in the “Computational Fluid Dynamics” course with a grade of A. As part of the “Advanced Thermodynamics” course, this student prepared and presented a literature summary on supercapacitors, emphasizing their critical role in energy storage and management for applications requiring rapid charge and discharge cycles. The review underscored the importance of ongoing development and integration of supercapacitors in sectors such as transportation and renewable energy, contributing to technological advancement. This MS student also achieved an A in the course.

In addition, two undergraduate students dedicated 20 hours per week to research on material modeling using molecular dynamics, gaining insight into both molecular dynamics and high-performance computing. To further their experience, the Principal Investigator (PI) established a connection with researchers from the National Institute of Standards and Technology (NIST), which is conducting an ongoing project to develop open-source tools and algorithms for thermodynamic characterization of various materials (https://www.nist.gov/programs-projects/nist-standard-reference-simulation-website). NIST welcomed potential contributions to the project, allowing the undergraduate students to benefit from NIST’s resources and methodologies, including thermodynamic characterization and related algorithms. These students excelled in the “ENME3030 Thermodynamics” and “ENME3090 Heat Transfer” courses, achieving grades of A. They also simulated the thermodynamic behavior of argon and nitrogen and presented their results at the “UTC Spring Research and Arts Conference,” where they acknowledged support from CEACSE.

Project Title: “Dynamics Analysis of Online Social Network Models”

Lead PI: Lingju Kong

Students Impacted:

Two graduate student researchers, **Michael Downs** and **Uyen Nguyen**, were involved in the project. Working on research projects helped the students to gain valuable skills such as creative thinking, independent problem solving, and self-confidence.

Project Title: “Recovery of Quantum Correlations Using Machine Learning”

Lead PI: Tian Li

Students Impacted:

Edward W. Steele, Computational Science Ph.D. student

Landon Boone, Physics undergraduate student

Project Title: “Machine Vision & AI Application for Damaged Solar Panels Detection”

Lead PI: Abdul Ofoli

Students Impacted:

Two graduate students and three undergraduate students were impacted directly through this project. One of the graduate students completed his program in the spring of 2024, doing his thesis work on part of this research. The second one is working to complete his program in the fall semester. The three undergraduate students worked on various aspects of the research, such as using ROS to control multiple drones, setting up X8 drones with cameras, sensors, and microcontrollers, debugging and retrieving data from cameras, etc.

Project Title: “Creating a Socially Aware, Efficient, Transparent, and Equitable 311 System for Smart Cities”

Lead PI: Yukun Yuan

Students Impacted:

Firas Elhag : a computer science graduate student conducting data analysis on human behavior and service quality across the City of Chattanooga. He also developed a prototype of a mobile application.

Zephirin Rob Schmidt: an undergraduate student in the computer science department, working on data analysis tasks.

PROGRAM OVERVIEW & ACCOMPLISHMENTS

The value proposition for multidisciplinary and interdisciplinary research, education, and training in the rapidly advancing field of Computational Science and Engineering (CSE) has grown stronger since the start of CEACSE in 2005. Today, modeling, simulation, High-Performance Computing (HPC), High-Throughput Computing (HTC), and so-called "Big Data" and "Machine Learning" are considered the third pillar of research, development, and scientific inquiry (in addition to theory and experiment) in a broad spectrum of scientific and technical areas. The THEC investment in CEACSE continues to be critically important for UTC to strengthen ongoing interdisciplinary CSE efforts and to continue to improve competitiveness with respect to extramural funding. The primary objectives of CEACSE are as follows:

- Expand CSE capabilities at UTC,
- Support startup of new research and educational work that broadens and expands the CEACSE base of research expertise, and
- Realize significant return on investment by attracting new extramural funding from our affiliated faculty's efforts, and direct funding efforts of the CEACSE director and partners.

FY2024 has been another year of growth and enhancement for CEACSE. The leadership team comprises Drs. Reinhold Mann (Vice Chancellor for Research) and Mina Sartipi (Director of Research Institute). Strong collaborative interactions with UTC faculty and administrators underpin this program.

The FY2024 portfolio of CEACSE projects accomplished a number of foundational advancements in R&D for transportation and mobility as well as quantum technologies.s. Importantly, we were able to fund appropriate research projects in all of the identified research foci (highlighted below).

Some notable outcomes in FY2024 include these highlights:

- PI Barbee's research manuscript is in progress, and the goal is to submit it to *Polymer Chemistry* in 2025.
- PI Barbee was awarded the ACS Petroleum Research Undergraduate New Investigator Fellowship in August 2024, titled "Expanding covalent mechanochemistry to commonly used polymer materials."
- PI Barbee taught a new polymer chemistry class (CHEM 4040) at UTC.
- PI Barbee's undergraduate student graduated, was accepted into a PhD chemistry program at Northwestern University, and was awarded an NSF GRFP fellowship while being mentored by PI Barbee.
- PI Barisik's undergraduate students collaborated with researchers from the "National Institute of Standards and Technology" (NIST), an ongoing project to develop open-source tools and algorithms for thermodynamic characterization of different materials.
- PI Barisik was involved in multiple activities to improve STEM education and educator development in local Title 1 schools, supporting and promoting STEM education in elementary schools with large numbers of underrepresented minority groups.
- PI Barisk's master. Student received the "Best Graduate Research" poster award through the College of Engineering and Computer Science.
- PI Barisik received NSF funding using preliminary data from his CEACSE project.

- PI Kong's research was presented at the UTC Math Department Colloquium Series, the American Mathematical Society Regional meeting, and the annual UTC ReSEARCH Dialogues Conference.
- PI Li is planning to use research findings to improve the Chattanooga Quantum Network.
- PI Ofoli's master's student graduated and completed their master's thesis using data from the CEACSE project.
- PI Ofoli had an invention disclosure titled "Machine Vision Application for Damaged Solar Panels Detection."
- PI Yuan plans to collaborate with the City of Chattanooga to incorporate the designed algorithm with the implemented 311 systems.
- PI Yuan is planning of applying to external grants (US EPA and NSF), as well as expand collaborations (current collaborators include Alabama A&M University, Florida State University, and the University of Texas at Arlington)

PROGRAM STRATEGY AND ORGANIZATION

The scientific, technical, and programmatic objectives of CEACSE are aligned with the strategic directions of the research and educational programs at UTC. CEACSE plays a central role in capability and program development potentially impacting all Colleges at UTC. These strategies intersect with problems of global, national, and regional importance in seven primary focus areas:

- Transportation and Mobility
- Quantum Technologies

These application focus areas were selected based on three important criteria:

- The presence of significant scientific and technical challenges for which there was interest, expertise, and the potential to excel at UTC;
- Clear alignment with educational and workforce development missions of UTC; and
- Opportunities to establish extramural R&D funding that can be realized by UTC researchers in strategic partnerships with collaborators at other institutions.

CEACSE proposals that fit these focus areas are reviewed for technical merit and strategic alignment, including scrutiny of a plan to develop extramural funding. Beginning in FY2019, further important advances in proposal content, process, selection, and peer review were applied across the CEACSE program. All CEACSE proposals in this past cycle underwent rigorous, double-blind, external review with reviewers chosen outside of UTC from among national and international subject matter experts. This enhanced review for all applicants encourages growth whether the proposal is funded or not, providing useful feedback for the project and future proposals in addition to honing the connection between seed-funding investments and their potential for meaningful follow-on extramural funding. We have observed a successful transition of CEACSE awardees to extramural funding during FY2024/FY2025 as well, and CEACSE awardees are significant producers of external research proposals to several federal agencies and other funding sources.

While these focus areas span a wide area of science and technology, all meritorious research concepts that appear outside of these stated areas are considered as long as they have substantial CSE content—particularly those that address computational experimentation and design, data analytics, and/or machine learning, which are, broadly speaking, all classes of modeling and simulation-driven by big data and big computation capabilities.

OVERVIEW OF FY2024 PROJECTS

For FY2024, these are the projects that were awarded or completed due to extensions from prior years. No projects ending in this fiscal year are continuing into the next cycle. We have awarded four new CEACSE awards which began January 2024 and will end December 2026.

The funded projects key to the CEACSE/CRI priority areas active in FY2024: Transportation and Mobility and Quantum technologies. Projects could also align with the Center for Urban Informatics and Progress (UTC) priority areas. Not all thrusts are represented in these awards, but certain projects have elements that cross-cut multiple areas.

Appendix B provides the full PI-submitted reporting on each of the grants, including detailed final reports articulating the accomplishments, outcomes, and impacts of each award.

Initiation/Opportunity Awards

Project Title: "Exploring entanglements in polymer network topologies with single-chain nanoparticles"

Lead PI: Meredith Barbee

Co-PI(s): Mohammed Mahtabi

Summary: The focus of our research was on two main goals: 1) understanding how entanglements in polymer network chains influence the mechanical properties of materials and 2) developing a synthetic design for polymer networks that include single-chain polymer nanoparticles. Through a combination of simulations and synthesis of polymer materials, we aimed to uncover fundamental relationships important in designing polymer networks. We are especially interested in applying this concept to hydrogels, which have many potential biomedical applications but are limited by their brittle nature.

During the first year of our grant, four undergraduate students were trained as researchers. We were able to obtain preliminary results from our efforts towards synthesizing the networks of single-chain nanoparticles and have developed a plan for future synthetic and computational work in the second year of the grant. During the second year of the grant, Professor Mohammed Mahtabi was added as a collaborator for his computational expertise. Three of the four students continued to work on the project, one additional undergraduate joined the project, and one student was hired into a post-baccalaureate research position and worked 25 hours per week for a semester. This student worked closely with both PIs on synthesis and computation. Our work has been presented at 2 ACS regional meetings (5 student posters in total), one ACS national meeting (1 student poster), and one polymer chemistry conference (Tosoh Polymer conference faculty poster), with an additional two student posters, one faculty talk accepted for a regional meeting in Fall 2024. The PI has been invited to contribute a manuscript to a young investigator issue of the journal Polymer Chemistry and plans to submit this work for consideration in 2025 following some additional experiments.

Project Title: “Modeling heat generation and temperature variation in supercapacitors”

Lead PI: Murat Barisik

Co-PI(s): N/A

Summary: Energy storage needs are expected to grow substantially in the coming years. Batteries are the most common solution, but they have multiple downsides, such as short lifetime, low performance at low temperatures, and high fire/explosion hazard risks. New-generation supercapacitors are promising candidates owing to their lightweight, fast charging, safe use, and non-toxic content. Supercapacitors are expected to satisfy high energy needs as well (to replace batteries), and their market size is expected to increase four times over the next six years. However, the thermal behavior of new-generation nanoporous supercapacitors designed to work at high potentials is not well understood, hindering their potential use. This project investigated the influence of temperature on supercapacitors to make them more reliable and support their transformation for future needs.

Project Title: “Dynamics Analysis of Online Social Network Models”

Lead PI: Lingju Kong

Co-PI(s): N/A

Summary: In this project, by developing the data-driven deterministic differential equation compartment models, the PI proposes to study the online social network (OSN) dynamics from two aspects: (a) User traffic dynamics of a single OSN and (b) Competition and coexistence principle of users among multiple OSNs. The proposed project consists of multiple research objectives. The first objective is the development of the user adoption and abandonment model for a single OSN. The model will contain a generalized nonlinear incidence, which is a function of the number of current OSN users. The second objective is to study the competitive exclusion and coexistence of users among multiple OSNs. Due to the physical meanings of the models, conditions for competitive exclusion and coexistence when one OSN is initially dominant will be the main research focus. A theoretical and numerical analysis will be conducted to understand the model dynamics. The phenomenon of various bifurcations (supercritical, subcritical, or Hopf et al.), as well as optimal control of the models, will also be studied in detail. Case studies combining the developed models and the real-world data will be carried out. These findings will be further applied to predict the evolution of OSN dynamics and derive actionable policies.

Project Title: “Recovery of Quantum Correlations Using Machine Learning”

Lead PI: Tian Li

Co-PI(s): Donald Reising

Summary: Quantum information science and engineering (QISE) leverages the core principles of quantum mechanics to handle and process information in ways that outperform classical techniques, paving the way for significant advancements in quantum computing, communication, and sensing. Central to these breakthroughs are quantum correlations, which provide the non-classical resources essential for QISE. However, these correlations are intrinsically fragile and highly sensitive to environmental disturbances. Disruptive processes, namely decoherence and loss, can severely degrade these correlations, resulting in the loss of the unique quantum behaviors that distinguish QISE systems from their classical counterparts. As a result, addressing these processes’ adverse effects is paramount for practically realizing QISE protocols. Strategies to protect quantum correlations from disruptive environments are crucial for deploying robust quantum systems in real-world applications. Thus, successfully mitigating decoherence and loss

will enhance the stability of quantum systems and expedite the deployment of QISE protocols in real-world settings.

Among the most extensively studied quantum systems, squeezed states of light have consistently demonstrated their utility as reliable quantum resources for numerous QISE protocols, especially in the continuous variable (CV) regime. Complementary to PI Li's recent work [PRX Quantum 5 (3), 030351 (2024)], where he demonstrated the mitigation of scattering effects using a simple hardware solution—an integrating sphere (IS)—we now turn our attention to a software-based approach to mitigate the adverse effects caused by scattering. This is particularly crucial for QISE as scattering contributes to both decoherence and loss, the two key challenges in maintaining quantum coherence and correlations. This study uses a two-mode squeezed state of light produced through the four-wave mixing (FWM) process in warm rubidium vapor as the quantum source to explore how machine learning (ML) algorithms can mitigate the disruptive effects on quantum correlations.

In this project, we introduce a scatterer—a ground glass diffuser—to one of the two modes of the squeezed state to simulate a realistic disruptive environment. In contrast to the hardware-based approach detailed in [PRX Quantum 5 (3), 030351 (2024)], this work achieves mitigation using Long Short-Term Memory (LSTM), a recurrent neural network (RNN) architecture in ML. Using the time sequence difference between the two quantum-correlated modes before the scatterer was introduced and the time sequence of the undisrupted mode, the LSTM model is employed to reconstruct the disrupted mode, effectively restoring the quantum correlations.

Project Title: "Machine Vision & AI Application for Damaged Solar Panels Detection"

Lead PI: Abdul Ofoli

Co-PI(s): Vahid Disfani

Summary: In this project, machine vision and artificial intelligence solutions were developed to detect damaged solar panels in huge solar farms to increase the reliability of power cultivated from these solar farms and help significantly reduce the farms' maintenance costs. An intake and staging platform was developed, which was robust using extensive data. The data used came from different stakeholders' websites, including national labs, the government, manufacturers, distributors, developers, system owners, and recyclers.

This was followed by a data storage & processing platform developed due to the volume of data that needs to be stored and then processed. The data processing included sizing, formatting, and labeling for object detection. A working Artificial Intelligence (AI) model was then built to detect damaged sections of a solar panel from images presented at an accuracy rate of more than 95%. Leveraging convolutional neural networks (CNNs), the model is trained on a diverse dataset, capturing various environmental conditions and solar panel configurations.

After the AI model had been developed and tested, it was converted into a TensorFlow Lite model, which is optimized for deploying models on mobile devices, microcontrollers, and other edge devices. The code was then transitioned to a Raspberry Pi 4 and Nvidia Jetson Nano for further testing and implementation in a lab environment. This resulted in a trained model running smoothly on prototype hardware for damaged PV detection.

Two graduate students and three undergraduate students were impacted directly through this project. One of the graduate students completed his program in the spring of 2024, doing his thesis work on part of this research. The second one is working to complete his program in the fall semester. The three undergraduate students worked on various aspects of the research, such as using ROS to control multiple drones, setting up X8 drones with cameras, sensors, and microcontrollers, debugging and retrieving data from cameras, etc.

Project Title: “Creating a Socially Aware, Efficient, Transparent, and Equitable 311 System for Smart Cities”

Lead PI: Yukun Yuan

Co-PI(s): Joe Dumas, Feng Guo, Junrong Shi

Summary: Urban 311 services have already been widely used by residents to report non-emergency service requests, e.g., graffiti removal. Researchers have accumulated extensive knowledge on the bias of submitting service requests resulting from persistent spatial, racial, and economic inequalities in cities. However, for residents with diverse social backgrounds, studies on the service quality provided by city departments are lacking. This project develops a data-driven approach to promote efficient, transparent, and equitable 311 services for diverse communities in a city by leveraging multi-source data from public socioeconomic and demographic data, city infrastructure, historical service requests, and self-reported survey findings. There are four tasks of this project: i) modeling residents' behavior profiles, ii) analyzing community-level social disparity, iii) predicting response time of addressing issues, and iv) designing a socially aware learning-based resource scheduling algorithm. Our project has a broader impact on both training students and enhancing service quality for residents in real cities.

FY 2024 BUDGET

NEW CORE AWARDS 2024				
Lead PI	**Project Title**	**CEACSE Priority Area**	**Amount Awarded**	**Amount Expended**
Meredith Barbee*	Exploring	Health and Biological Systems**	$100,000	$99,713.75
Murat Barisik	Modeling heat generation and temperature variation in supercapacitors	Advanced Modeling and Simulation**	$100,000	$56,266.33
Lingju Kong	Dynamics Analysis of Online Social Network Models	Advanced Modeling and Simulation **	$96,940	$90,206.96
Tian Li	Recovery of Quantum Correlations Using Machine Learning	Quantum Technologies	$100,000	$96,113.56
Abdul Ofoli	Machine Vision & AI Application for Damaged Solar Panels Detection	Critical Infrastructure Protection, including energy grid**	$97,983	$86,209.71
Yukun Yuan	Creating a Socially Aware, Efficient, Transparent, and Equitable 311 System for Smart Cities	Cybersecurity and Cyber-secure systems**	$99,297	$68,137.88

** Dr. Barbee was out for a semester for maternity leave and her grant was extended until 6/30/2024*

*** Continued focus area from previous year*

FY2024 PUBLICATIONS AND PRESENTATIONS (of CEACSE Seed-Funded Research)

Conference Presentations, Posters, and Proceedings

"Single-chain polymer nanoparticles with silyl ether crosslinks" presented by Graham Ford at the Southeastern Regional American Chemical Society (SERMACS) meeting in San Juan, Puerto Rico, in October 2022. (**M. Barbee**)

"Biomimetic Design of Single Chain Polymer Networks" presented by Sam Robinson at the Southeastern Regional American Chemical Society (SERMACS) meeting in San Juan, Puerto Rico, in October 2022. (**M. Barbee**)

"Biomimetic design of mechanochromic SCNP networks" presented by Sam Robinson at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023. (**M. Barbee**)

"Synthetic Strategies for Single Chain Polymer Networks" presented by Kelly Hooper at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023. (**M. Barbee**)

"SCNP networks through reinitiating RAFT polymerization" presented by Dallas Donovan at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023. (**M. Barbee**)

"Synthesis and Computational Design of Single-chain Polymer Nanoparticle Networks" presented by Kelly Hooper at the ACS national meeting in New Orleans, LA, April 2024. (**M. Barbee**)

"Designing Single-chain Nanoparticle Embedded Hydrogels" presented by **Meredith Barbee** at the Tosoh Polymer Conference in Raleigh, NC, in June 2024.

"Single-chain polymer nanoparticles with silyl ether crosslinks" presented by Graham Ford at the URP symposium. (**M. Barbee**)

"Biomimetic Design of Single Chain Polymer Networks" presented by Sam Robinson at the URP symposium. (**M. Barbee**)

"Biomimetic Design of Single Chain Polymer Networks" presented by Sam Robinson at the URaCE conference, 2023. (**M. Barbee**)

"Synthetic Strategies for Single Chain Polymer Networks" presented by Kelly Hooper at the URaCE conference, 2024. (**M. Barbee**)

"SCNP networks through reinitiating RAFT polymerization" presented by Dallas Donovan at the URaCE conference, 2024. (**M. Barbee**)

L. Kong. Modeling user adoption and abandonment dynamics of a product. Invited Talk in the Special Session on Mathematical Models for Population and Methods for Parameter Estimation in Epidemiology, American Mathematical Society 2024 Spring Southeastern Sectional Meeting, Florida State University, Tallahassee, FL, March 23–24, 2024.

L. Kong. Modeling the dynamics of product adoption and abandonment. UTC Spring Research and Arts Conference, April 10, 2024. Poster.

L. Kong. Modeling the Dynamics of Product Adoption and Abandonment, January 26, 2024. Colloquium at the UTC Mathematics Department

“Quantum Sensing and Quantum Control on a Deployed Metro-Scale Quantum Network,” Southeast Quantum Workshop 2024, November 15-17, 2024, University of Tennessee, Knoxville, Tennessee. (**T. Li**)

“Quantum Sensing of Local & Nonlocal Quantities: from image contrast to global phase,” Neuromorphic Computing Meets Quantum Mechanics (NCMQM) 2024, May 15-17, 2024, University of Georgia, Athens, Georgia. (**T. Li**)

Refereed Publications

Masuduzzaman M, Bakli C, **Barisik M**, Kim BH (2024) “Applied Electric Field Effects on Diffusivity and Electrical Double-Layer Thickness”, Small, 10.1002/smll.202404397

Karim KE, **Barisik M**, Bakli C, Kim B, (2024) “Estimating water transport in carbon nanotubes: A critical review and inclusion of scale effects”, Physical Chemistry Chemical Physics, 10.1039/D4CP01068J

L. Kong, “Modeling the dynamics of product adoption and abandonment”, Proc. R. Soc. A 480 (2024), 20240034, 25 pp.

R. Chen, **L. Kong**, and M. Wang, “Modeling the dynamics of adoption and abandonment of multiple products” submitted for publication.

“Recovery of quantum correlations using machine learning,” E. W. Steele, D. R. Reising, **Tian Li**, In review, available now on arXiv:2410.02818 (2024)

“Resident Perceptions, Experiences, and Utilization of City Services: A Latent Profile Analysis” (In progress). (**Y. Yuan**)

“Human Preference-aware Rebalancing and Charging for Shared Electric Micromobility Vehicles” (In ICRA 2024). (**Y. Yuan**)

“Fairness-aware Electric Taxi Fleet Coordination under Short-term Power System Failures” (In ACC 2024). (**Y. Yuan**)

“Joint Rebalancing and Charging for Shared Electric Micromobility Vehicles with Energy-defined Demand” (In CIKM 2024). (**Y. Yuan**)

Inventions Disclosures

Invention Disclosure with a UTRF Number 23049-02 titled "Machine Vision Application for Damaged Solar Panels Detection." (**A. Ofoli**)

EXTERNAL FUNDING

Meredith Barbee, Lead PI

Co-PI(s): N/A

Other Personnel: Mohammed Mahtabi

Proposal Submissions

- ACS PRF proposal was awarded. It is not directly connected to this work, but the CEACSE project helped the PI develop the idea and the experience necessary. It will fund Lead PI work from 2024-2026.
- NSF CAREER and Cottrell Scholars applications will be submitted in 2025 using preliminary data from CEACSE.

Contracts/Awards Received

- N/A

Sponsored Program Capacity Building Activities

- The PI met with Ashley Ledford (Research Development Specialist) at the start of the project to develop an individual strategic plan for upcoming external grant applications.
- The PI attended the NSF Virtual Grants Conference for Spring 2023 to learn about opportunities to submit external grants.
- The PI attended the Tosoh Polymer Conference in June 2024, where there was an opportunity for networking and feedback on the CEACSE project presentation from others in the field.

Murat Barisik, Lead PI

Co-PI(s): N/A

Other Personnel: N/A

Proposal Submissions

- “Multiscale characterization of heat transfer in nanoporous materials assisted by machine learning” M Barisik (PI), NSF-CAREER $596,510
- “Multiscale characterization of heat transfer in nanoporous materials by machine learning” M Barisik (PI), DOE-ECRP $800,000
- “Molecular characterization of thermal effects on capacitance behavior of supercapacitors” M Barisik (PI), NSF-ERI $200,000
- “DMREF: Role of ordered interfacial water layers in condensation heat transfer” A. Kota (PI), M Barisik (co-PI), S. Bingham (co-PI), L. Velarde (co-PI), NSF $2,000,000
- “LEAPS-MPS: Molecular characterization of thermal effects on capacitance behavior of supercapacitors” M Barisik (PI), NSF-LEAPS-MPS $250,000

Contracts/Awards Received

- “Molecular characterization of thermal effects on capacitance behavior of supercapacitors”. M Barisik (PI), NSF-ERI $200,000 (08/24-present).

Sponsored Program Capacity Building Activities

- N/A

Lingju Kong, Lead PI

Co-PI(s): N/A

Other Personnel: N/A

Proposal Submissions

- The lead PI is planning to submit an external proposal in the future.

Contracts/Awards Received

- N/A

Sponsored Program Capacity Building Activities

- N/A

Tian Li, Lead PI

Co-PI(s): Donald Reising

Other Personnel: N/A

Proposal Submissions

- NSF ExpandQISE: Track 1: Deep Learning Aided Distributed Quantum Phase Sensing with Squeezed States. 2023
- NSF ENG-QUANT: CCSS: Demonstration of Sub-Shot-Noise Limited Distributed Quantum Sensing on a Commercial Metropolitan-Scale Quantum Network via Deep Learning Aided Noise Suppression 2024

Contracts/Awards Received

- None to date. However, the NSF ENG-QUANT: CCSS proposal was recommended for funding by the review panel but was ultimately declined by the Program Manager due to the late submission of NSF budget cuts.
- PI and Co-PI will be re-submitting the NSF ENG-QUANT: CCSS proposal by October 16th, 2024, with the goal of securing funding for FY 2024-2025.

Sponsored Program Capacity Building Activities

- N/A

Abdul Ofoli, Lead PI

Co-PI(s): Vahid Disfani

Other Personnel: N/A

Proposal Submissions

- PI submitted a DOE proposal in 2022 under the solicitation DE-FOA-0002606 titled "Machine Vision & AI Application for Damaged Solar Panels Detection" but was unsuccessful due to a lack of preliminary data. This was under the topic area: Small Innovative Projects in Solar (SIPS): PHOTOVOLTAICS.
- A new proposal will be submitted when the hardware setup with the drone is completed and tested on a solar farm by the end of the year.

Contracts/Awards Received

- N/A

Sponsored Program Capacity Building Activities

- An on-campus workshop/meeting of EE faculty with Mr. Corbid Cawood from MDRB will cover an overview and some depth of the computational resources available through the UTC Research Institute.

Yukun Yuan, Lead PI

Co-PI(s): Joe Dumas, Feng Guo, Junrong Shi

Other Personnel: N/A

Proposal Submissions

- PI submitted an NSF and an EPA proposals

Contracts/Awards Received

- N/A

Sponsored Program Capacity Building Activities

- N/A

OVERVIEW OF FY24-26 PROJECTS

The following awardees and projects, selected for funding in December 2023, are currently supporting CEACSE's strategic goals and future plans for FY2024-2026.

Title: Development of Blockchain-based Secure Data-Sharing Framework for Automated Guided Vehicles and Collaborative Robots
Investigator: Erdemir Gokhan
Thrust: Transportation & Mobility
Amount: 124,772
Abstract: Automated Guided Vehicles (AGVs) and Collaborative Robots (cobots) are increasingly getting more roles to streamline operations and enhance efficiency, especially in the modern manufacturing and warehousing industries. Cobots are a new generation of robotic systems that have the ability to work simultaneously and collaboratively with humans and other systems. Also, cobots have started to find more space in industrial applications, mainly due to their ability to do these. AGVs play a critical role in various industries by transporting materials, aiding manufacturing processes, and reducing manual handling. To optimize the performance of AGVs, they need to be interconnected seamlessly and assigned tasks efficiently. AGVs and cobots, becoming increasingly widespread due to their advantages in industrial applications, require highly efficient software and hardware infrastructure to communicate and cooperate. This project focuses on developing a high-performance blockchain-based secure data-sharing and communication framework tailored for AGVs and cobots to work together in the same secure platform. The project aims to maximize the potential and security of AGVs and cobots in industries through the proposed blockchain-based high-performance connectivity framework. With an efficient, fast, robust, and safe system, companies will be able to utilize the full potential of AGVs and cobots to increase operational efficiency and productivity. The novelty and timeliness of this area of research are some of the reasons that prompted us to embark on this project.

Title: Intelligent Reconfigurable Battery System for Enhanced and Robust Electric Mobility
Investigator: Dalei Wu
Thrust: Transportation & Mobility
Amount: $124,985
Abstract: Existing electric vehicle (EV) batteries are designed in a way that battery cells are assembled by a combination of fixed parallel and series connections, making them unsuitable for efficient battery power management to improve the overall battery operating time. This project proposes to develop a novel dynamic graph-based deep reinforcement learning approach to intelligent reconfigurable large-scale EV batteries to prolong battery cycle life while considering safety, thermal management, and source/load dynamics. The techniques are of interest to multiple electric mobility applications, including EVs, electric planes, electric boats/ferries, and green transportation. The proposed research is interdisciplinary and integrates sensing, communication, computing, optimization, control, and hardware design, drawing on techniques from computer science, computer engineering, electrical engineering, and electrochemistry. The team members have the necessary expertise in the related areas to conduct the research. The PI and Co-PIs plan to collaborate closely with the Battery Engineering Lab at Volkswagen Chattanooga. Leveraging the findings from this pilot study, the team will actively secure external

funding from the identified future extramural funding opportunities. The long-term version of the collaboration is to develop effective solutions for high-capacity and cost-effective large-scale battery systems for robust and enhanced electric mobility and green transportation through sustainable research.

Title: Enhancing the Capacity of Quantum Key Distribution Research and Education through an Integrated Approach
Investigator: Mengjun Xie
Thrust: Quantum Technologies
Amount: $124,867
Abstract: This proposal aims to significantly bolster the research and educational capabilities of UTC in the realm of quantum key distribution (QKD). By leveraging the UTC Quantum Node Lab and EPB Quantum Network, we strive to develop cutting-edge QKD-based cybersecurity solutions and establish UTC as a leader in QKD education and training in the long run. Our research focuses on QKD, a cryptographic method that uses quantum mechanics to securely generate and distribute cryptographic keys. This research focus makes our proposal well aligned with one FY24 priority area—Quantum Technologies. We plan to investigate semi-quantum key distribution (SQKD) due to its practical importance in reducing quantum resources in key distribution. We aim to either develop a new SQKD protocol or enhance the existing Mirror protocol with an emphasis on improving security and reducing quantum resource requirements. Our research also includes setting up quantum experiments with photon-based SQKD implementations and deploying our SQKD protocol in a real-world quantum communication environment for evaluation. Our interdisciplinary research team possesses strong and complementary expertise in cybersecurity, quantum optics, and quantum communication. This proposal also includes robust educational and community engagement components, e.g., organizing workshops and collaborating with industry and education partners.

Title: Power and Transportation System Co-Optimization with Renewable Energy and Electric Vehicles via Dynamic Pricing and Charging Rate Control
Investigator: Yukun Yuan
Thrust: Transportation and Mobility
Amount: $124,519

Abstract: We are witnessing an ongoing evolution of power and transportation systems driven by sustainability, i.e., renewable energy for power systems and increasing penetration of electric vehicles (EV). The operational efficiency of the two systems is intricately intertwined.

The existence of high and dynamic power loads from electrified transportation systems requires a more flexible and ample power supply, which further enhances the operational cost of power systems. Meanwhile, EVs are heavily reliant on the power system to charge batteries, thereby altering the distribution of EVs. In this project, we propose a novel approach to co-optimize power and transportation systems wherein power systems indirectly coordinate the EVs' charging activities through a dynamic pricing mechanism and control the charging rate of EVs, while ensuring a high-quality charging experience for drivers.

The research team from UTC and Volkswagen has the expertise spanning interdisciplinary domains, e.g., human behavior modeling from Psychology, machine learning and control from Computer Science, and engineers from VW with expertise in EV battery status extraction.

The long-term objective of the collaboration is to resolve the challenges of charging EV batteries and seek external funding support from federal agencies.

CONCLUSION

CEACSE continues to contribute greatly to the enhancement and expansion of significant and innovative research in computational simulation and applied computational science and engineering. Through THEC's support, CEACSE researchers effectively recognize the special opportunity afforded to UTC to provide leadership in computational applications-driven research and education needed for future competitiveness in the high-technology sector of the global economy. That factor is crucial in their recruitment and retention, as well as professional growth toward tenure and promotion. Significantly, this funding provides a fertile ground to create nationally competitive scholars and research proposals through a peer-reviewed selection process of proposals that are significant enablers of follow-on efforts with extramural funding from NSF, DOD, NASA, and NIH, among others, as well as the potential for industrial sponsorship in certain situations. Those non-federal opportunities appear to be growing with the faculty's growing intellectual property, respective regional/national reputations, and expertise.

Through this seed funding for research activities, undergraduate and graduate students are engaged in a diverse range of topics at the cutting edge of R&D, and they experience a high level of interaction and involvement with UTC faculty and external collaborators. In the coming years, we will also strengthen CEACSE outreach to pre-college students and their teachers (this outreach has been delayed over the past two-plus years by COVID-19).

CEACSE-supported initiatives have already formed the basis of several collaborations and partnerships with other institutions of higher education and with business and industry partners. A number of Memoranda of Understanding and Non-Disclosure Agreements have been executed or are in the works between UTC and a variety of partners and potential sponsors to explore how CEACSE can support engineering enhancements, address regional and state priority areas, and bolster robust economic growth.

A key related outcome, leveraging the THEC center's computational resources and reputation, is the strong involvement in Exascale computing R&D through the NNSA/DOE-funded Center for Understandable, Performant Exascale Communication Systems (together with the University of New Mexico and the University of Alabama), which provides opportunities to enhance the opportunities for students at UTC in high performance computing. This additional funding source and affiliation has led to internships and career opportunities for UTC students in FY2023.

In conclusion, advancing computational science and engineering to strengthen the education, workforce development, and R&D missions at UTC continues to be a high-value investment for the State of Tennessee and the U.S. The CEACSE multidisciplinary team of faculty and graduate students in collaboration with their strategic partners in Chattanooga, the region, and elsewhere has been focused on the three primary objectives for the Center listed in the introductory segment of this report, namely to

- Expand CSE capabilities at UTC,
- Support startup of new research and educational work that broadens and expands the CEACSE base of research expertise, and
- Realize appropriate return on investment by attracting new extramural funding.

We are convinced that the work accomplished in FY2024 and the strategic vision we have laid out for the future have positioned UTC and CEACSE to continue to positively impact, enhance, and accelerate the growth and advancement of Tennessee's scientific and engineering capabilities and resources.

LEADERSHIP CONTACT INFORMATION AND BIOS

Dr. Reinhold Mann

Vice Chancellor for Research

Reinhold-C-Mann@utc.edu

Reinhold Mann has been the Vice Chancellor for Research (VCR) at the University of Tennessee in Chattanooga (UTC) since January 2024. He joined UTC in July 2015 to support program development activities in the VCR Office, most recently in Quantum Information Science and Engineering.

Prior to joining UTC, Dr. Mann held leadership positions at the Associate Laboratory Director level at Oak Ridge National Laboratory, Pacific Northwest National Laboratory, and Brookhaven National Laboratory, and he was the Senior Vice President for Research and Development at the former Battelle Science and Technology Malaysia Sdn. Bhd. in Kuala Lumpur, Malaysia.

Mann's work has been at the intersection of the physical and computational sciences with the life and environmental sciences. He has been leading multi-disciplinary R&D teams since 1986 and has developed several R&D efforts in intelligent robotics, human-machine interactions, advanced information processing, computational biology, bioinformatics, systems biology, and bioenergy.

He is a Senior Member of the IEEE and a member of the APS and the AAAS. He obtained a Diplom Mathematiker degree (MS in Mathematics) and a Dr. rer. nat. degree (PhD equivalent, in Physics) from the Johannes Gutenberg University in Mainz, Germany. He was an Alexander von Humboldt Foundation Feodor Lynen Fellow in 1981 and 1982, performing research at ORNL.

Dr. Mina Sartipi

Director of the UTC Research Institute

Founding Director of the Center for Urban Informatics and Progress (CUIP)

Guerry Professor of Computer Science and Engineering

Mina-Sartipi@utc.edu

Dr. Mina Sartipi is the Executive Director of the University of Tennessee at Chattanooga (UTC) Research Institute and the Founding Director of the Center for Urban Informatics and Progress (CUIP) at UTC. She is also the Guerry Professor in the Computer Science and Engineering Department at UTC and maintains a joint appointment at Oak Ridge National Laboratory, focusing her expertise on improving urban mobility and safety through advanced technology. Her goal as the director is to advance R&D and experiential learning profiles in key cross-disciplinary areas leveraging Chattanooga and UTC's unique assets such as city-wide R&D testbed for the future of mobility and the first commercially available quantum network.

In recent years, Dr. Sartipi has led projects as Principal Investigator (PI) or Co-Principal Investigator (Co-PI) that have secured over $25 million in grants from organizations including the U.S. Department of Transportation, U.S. Department of Energy, National Science Foundation, and others. She has received the 2024 UT President's Award in the "Nimble and Innovative" category and the 2024 Thomas B. Ballard Advanced Energy Leadership Award. Her contributions to smart city initiatives earned her recognition as a 2019 Chattanooga Influencer, and her work has been honored with the 2019-2023 Smart 50 Awards and the 2019-2021 and 2024 International Data Corporation (IDC) Smart Cities North America Award. Dr. Sartipi earned her bachelor's degree in electrical engineering from Sharif University of Technology and her master's and doctoral degrees in electrical and computer engineering from Georgia Tech.

Appendix A
Faculty Biosketches

Meredith H. Barbee
CURRICULUM VITAE
meredith-barbee@utc.edu

Professional Experience

Assistant Professor of Chemistry, August 2021-present
The University of Tennessee at Chattanooga

Teaching Responsibilities: Organic Chemistry I (CHEM 3010 and CHEM 3010L), Organic Chemistry II (CHEM 3020 and CHEM 3020L), Polymer Chemistry (CHEM 4040 with lab), How to Learn Chemistry (CHEM 1999r).

Research Program: The current research program is focused on molecular-level control of polymer materials, with a focus on polymer network topology, hydrogels, and mechanochemistry. The current lab group size is 4 undergraduate students.

Postdoctoral Scholar, May 2019-May 2021
The University of North Carolina at Chapel Hill
PI: Prof. Abigail Knight

Education

Ph.D. Chemistry, May 2019
Duke University, Durham, NC
PI: Prof. Stephen Craig
Dissertation: “Controlling and exploiting spiropyran-based mechanochromism”
Certificate in College Teaching from the Graduate School

B.S. Chemistry, Mathematics minor, May 2013
Meredith College, Raleigh, NC
Magna Cum Laude
Thesis: “Metal coordination polymer networks: a modular approach”

Honors, Awards, and Fellowships

Early Career Grantsperson of the Year, UTC College of Arts and Sciences	2024
GPC 2019 Conference 3rd place poster	2019
Kathleen Zielik Departmental Fellowship	2019
GAANN (Department of Education) Fellowship	2018
National Defense Science and Engineering (NDSEG) Fellowship	2015-2018
Research Triangle Materials Science and Engineering Center Fellow	2015-2017
Best Poster, 8th annual Triangle Soft Matter Workshop	2015
Sensor Safety Research Award (Meredith College)	2013
ACS PMSE Undergraduate Travel Award	2012

Grants Awarded

1.) American Chemical Society Petroleum Research Fund (ACS PRF) Undergraduate New Investigator (UNI) grant, "Expanding covalent mechanochemistry to commonly used polymer materials", Role: PI, Funding amount: $55,000, Grant period: August 2024-July 2026
2.) UTC SIM Center (CEACSE) Grant, “Exploring entanglements in polymer network topologies with single-chain nanoparticles,” Role: PI, Funding amount: $100,000, Grant period: July 2022-June 2024
3.) Internally funded grant for a new NMR spectrometer (Originally a NSF Major Research Instrumentation (MRI) Program application), "MRI: Acquisition of a 400 MHz Superconducting

Nuclear Magnetic Resonance Spectrometer with a ROYALPROBE HFX," Role: co-PI, Funding amount: $400,000

4.) UTC Faculty Development Grant Spring 2022, "Covalent mechanochemistry for polymeric rubbers, adhesives, and foams," Role: PI, Funding amount: $2,117.49

5.) UTC College of Arts and Sciences Research and Creative Activity (RCA) Grant Spring 2022, "Investigating silyl ether cross-linking in single-chain nanoparticles," Role: PI, Funding amount: $5,000

Publications

** indicates co-first authorship,* ***bold and italics*** *denotes undergraduate co-author*

1.) **MH Barbee**,* ZM Wright,* BP Allen, HF Taylor, EF Patteson, AS Knight. "Protein-mimetic self-assembly with synthetic macromolecules", *Macromolecules*, **2021**, *54*, 3585.

2.) LS Shannahan, Y Lin, JF Berry, **MH Barbee**, M Fermen-Coker, SL Craig. "Onset of Mechanochromic Response in the High Strain Rate Uniaxial Compression of Spiropyran Embedded Silicone Elastomers", *Macromolecular Rapid Communications*, *just accepted*.

3.) **MH Barbee**, J Wang, ***M Lu***, T Kouznetsova, SL Craig. "Mechanochemical Ring-Opening of Allylic Epoxides", *Macromolecules*, **2019**, *52*, 6234.

4.) ***RC Rohde***, A Basu, LB Okello, **MH Barbee**, Y Zhang, OD Velev, A Nelson, SL Craig. "Mechanochromic composite elastomers for additive manufacturing and low strain mechanophore activation", *Polym. Chem.*, **2019**, *10*, 5985.

5.) J Park*, Y Lee*, **MH Barbee***, S Cho, R Shanker, J Kim, J Myoung, MP Kim, C Baig, SL Craig, H Ko, "Hierarchical nanoparticle-in-micropore architecture for enhanced mechanosensitivity and stretchability in mechanochromic electronic skins", *Adv. Mater*., **2019**, *31,* 1808148*.*

6.) L Shannahan, J Berry, Y Lin, **MH Barbee**, SL Craig, D Casem, M Fermen-Coker, "A mechanochemistry-based technique for early material damage detection in high strain rate processes", *Army Research Laboratory Technical Report*, **2019**, ARL-TR-8629.

7.) X Zhiyong, VD Alphonse, DB Trigg, TP Harrigan, JM Paulson, QT Luong, EP Lloyd, **MH Barbee**, SL Craig, "Seeing strain in soft materials", *Molecules*, **2019**, *24*, 542.

8.) **MH Barbee**, T Kouznetsova, ***SL Barrett***, GR Gossweiler, Y Lin, S Rastogi, WJ Brittain, SL Craig, "Substituent effects and mechanism in a mechanochemical reaction" *J. Am. Chem. Soc.* **2018**, *140*, 12746.
Featured in a JACS Spotlight: *J. Am. Chem. Soc.*, **2018**, *140*, 14527.

9.) Y Lin, **MH Barbee**, C Chang, SL Craig, "Regiochemical effects on mechanophore activation in bulk materials", *J. Am. Chem. Soc.*, **2018**, *140*, 15969.

10.) **MH Barbee**, K Mondal, ***JZ Deng***, V Bharambe, TV Neumann, JJ Adams, MD Dickey, SL Craig, "Mechanochromic stretchable electronics", *ACS Appl. Mat. Interfaces*, **2018**, *10*, 29918.
Featured by the Duke Chronicle, Printed Electronics World, and the NSF Science 360.

11.) **MH Barbee***, RG Carden*, JHR Johnson, CL Brown, DA Canelas, SL Craig, "A single reaction thread ties multiple core concepts in an introductory chemistry course" *J. Chem. Educ.* **2018**, *95*, 939–946.

12.) CL Brown, **MH Barbee**, JH Ko, HD Maynard, SL Craig, "Writing without ink: A mechanically and photochemically responsive PDMS polymer for Science Outreach" *J. Chem. Educ.*, **2017**, *94*, 1752–1755.

Selected Presentations

1.) ACS Local Meeting, Chattanooga, TN, November 2021, **invited speaker**, "*Molecular-level control of polymer properties: From mechanochemistry to protein-mimetic macromolecules*"

2.) ACS National Meeting, Philadelpia, PA, March 2020, **invited speaker**, Oral Symposium in honor of Katherine Franz: ACS Award for Encouraging Women into Careers in the Chemical Sciences, "*Bioinspired evolution of synthetic polymers for selective metal ion separations*"- cancelled due to COVID-19.

3.) GPC Conference, Tosoh Bioscience, New Orleans, LA, July 2019, **third place poster**, "*Controlling and exploiting spiropyran-based mechanochromism*"

4.) Southeastern Regional ACS Meeting, Polymer Chemistry Oral Symposium, Augusta, GA, November 2018, *"Hammett relationships in mechanochemical reactions"*

5.) Southeastern Regional ACS Meeting, Chemical Education Oral Symposium, Augusta, GA, November 2018, *"A single reaction thread ties multiple core concepts in an introductory chemistry course"*

6.) Southeastern Regional ACS Meeting, Mechanochemistry Oral Symposium, Charlotte, NC, November 2017, *"Mechanochromic liquid metal soft electronics"*

7.) Converse College seminar, Spartanburg, SC, May 2017, **invited speaker**, *"Mechanochemistry for stress sensing in silicone elastomers"*

8.) ACS National Meeting, Philadelphia, PA, August 2016. PMSE division poster session, **selected for Sci-mix**, *"Mechanochemistry for stress sensing in bulk elastomers"*

9.) Triangle Soft Matter Workshop poster session, Raleigh, NC, May 2015, **awarded best graduate student poster**, *"Mechanochemistry for soft, active materials"*

Mentoring

Mattie Purcell, UTC undergraduate student, August 2024-present
Lillie Poarch, UTC undergraduate student, January 2024-present
Dallas Donovan, UTC undergraduate student, May 2023- present
Samuel Robinson, UTC undergraduate student, January 2022-present
Kelly Hooper, UTC undergraduate student, January 2022-May 2024
Next position: graduate school in chemistry, UNC Chapel Hill

Christine Rukeyser, UTC undergraduate student, August 2022-December 2023 (won NSF GRFP in 2023)
Next position: Oak Ridge National Lab Internship, graduate school in chemistry, Northwestern University
Evan Gibson, UTC undergraduate student, August 2023-December 2023
Next position: industry

Graham Ford, UTC undergraduate student, January 2022-December 2022
Next position: paramedic planning to apply to medical school
Jackie Warren, UNC-CH undergraduate student, May 2019-2021
Next position: UNC-CH medical school
Jeshurun Luke, UNC-CH undergraduate student, August 2019-2021
Tianlin Wang, Duke University graduate student, January 2019-May 2019
Next position: Duke University Masters in Materials Science program
Rachel Rohde, Duke University undergraduate, October 2017-May 2019
Next position: graduate student, University of California at Berkley
John Deng, Duke University undergraduate, October 2015-May 2018
Next position: Clinical Research Coordinator at Stanford, medical student at UCLA
Scott Barrett, Texas State undergraduate, MRSEC-REU, June 2016-May 2017
Next position: graduate student, UT Austin
Vivian Lu, Duke University undergraduate, June 2016-December 2016
Next position: undergraduate student, research in Prof. David Beratan's lab

Research and Scientific Experience prior to UTC

Postdoctoral Researcher, University of North Carolina at Chapel Hill (May 2019-May 2021)
Principal Investigator: Abigail Knight

- Designing polymers with functions inspired by biological materials with the tunability of synthetic materials
- Developing a platform for the evolution of polymers capable of binding and separating metals via dynamic combinatorial chemistry
- Mentoring 6 graduate and 2 undergraduate students as the lab's first postdoctoral researcher

Graduate Research Assistant, Duke University (August 2014-April 2019)
Principal Investigator: Stephen Craig

- Designed and conducted experiments to quantify the impact of structure-activity relationships in small molecules on force-rate behavior in single polymers
- Advanced chemistry and methods for characterization of mechanical reactivity and force distributions within bulk filled elastomers
- Applied research findings to emerging technologies for strain visualization in engineering and materials science including soft electronics and brain injury
- Significant scientific stature and communication record demonstrated by 4 first-author publications (11 total, 4 with undergraduate co-authors), 7+ poster/oral presentations, and ~$250,000 in fellowship support won
- Established track record of mentoring (4 undergraduates, numerous graduate students) and collaboration, working with scientists and engineers at institutions including the John Hopkins Applied Physics Lab, the Army Research Lab, UNIST Korea, and NC State

Quality Control Analyst, AkzoNobel, Salisbury, NC (2013-2014)

- Conducted analytical testing to support onsite manufacturing
- Calibrated analytical instruments and completed validation testing and statistical analysis of new methodology
- Trained 2 employees on standard operating procedures and wet chemistry technique

Teaching Experience prior to UTC

General Chemistry Honors Teaching Assistant, Duke University (Fall 2016)

- Facilitated discussions in a ~100 student team-based learning (TBL) flipped classroom and held class when the instructor was absent
- Led student discussion in small groups during office hours and review sessions
- Developed and refined inquiry-based learning exercises and discussed learning objectives and formative assessments with the instructor to improve instruction
- Critically evaluated on my teaching by participating in peer evaluations through the Certificate in College Teaching
- Led a team of 4 graduate students in publishing a paper on a new course module

Organic Chemistry II Teaching Assistant, Duke University (Fall 2014-Spring 2015)

- Prepared and delivered short pre-experiment lectures for 3 sections of 15 students each
- Supervised lab experiments and instructed students during hands-on work
- Maintained a safe and organized laboratory environment
- Graded student work and discussed student learning at weekly TA meeting

Professional Activities and Service

Service in the UTC Chemistry and Physics Department

- Social Media Coordinator, August 2021-present
- Publicity Committee, August 2021-present, chair August 2022-present
- NMR Committee, August 2022- present
- NSF GRFP writing group leader August 2023-present
    - 3 members, 2 applicants, 1 awardee
- NTT organic search committee member, January 2024-March 2024
- University course learning evaluations committee, August 2022-August 2024
- University athletics committee, August 2024-present
- Recruitment Committee, August 2021-August 2023

Highlighted Chattanooga Area Outreach

- Developed a hydrogel demonstration for the general public based on my research and presented it at "Smart is Cool" day at the Chattanooga Market, October 2023
- Gave tours of the Department of Chemistry and Physics to local high school students, March 2024

Highlighted Service to the Profession

- Field testing for the ACS exam in polymer chemistry (April 2024)
- Peer reviewer for Green Chemistry, the Journal of Chemical Education, and the Journal of Materials Science (2021- present)

Professional Development

- Completed UTC Walker Center's Teaching and Learning Institute Class, August-December 2021
- Completed Race Talk Discussion Group (UTC), October-November 2021
- Accepted to attend the Polymer Future Faculty Workshop, Princeton University, July 2019
- Attended Wyatt Technology's Light Scattering University, July 2016

UNC Chapel Hill Future Chemistry Faculty at Primarily Undergraduate Institutions

- Served on officer board as vice president (2020-present)

PRATTically Speaking Toastmasters

- Earned Competent Leader (CL) award by participating in and leading meetings and hosting an open house event
- Awarded Competent Communicator (CC) certification by completing 10 peer-evaluated speeches
- Served on the officer board as secretary (2017), president (2017-2018), and immediate past president (2018-2019)

Science and Chemistry Outreach, RTP region, 2010-present

- Developed "Writing Without Ink" outreach demonstration with a team of fellow graduate students to introduce the broader community to our research
- Presented polymer chemistry demonstrations such as polyurethane foam smoothies, synthesis of nylon, slime, ect. at events around the region including the NC State Fair and Duke University's "Science under the Stars" event
- Planned a field trip with chemistry demonstrations for elementary students from my hometown

Duke University Chemistry Department Hill Lecture Co-chair, 2015-2017

- Planned the department's student-selected lecture

Murat Barisik, PhD - Assistant Professor - Marie Curie COFUND Fellow
Mechanical Engineering Department, University of Tennessee at Chattanooga
murat-barisik@utc.edu

Experienced in micro/nanoscale heat transfer, fluid flow, and material science. Performed multiscale/multiphysics modeling using molecular dynamics, computational chemistry, and machine learning, in addition to experiments on functional nanomaterials. Developed self-sustained externally supported research with experience in developing proposals for NSF, DOE, ACS, NIH and XSEDE. As of August 2024, secured over $2 million research fund, published 52 articles in Q1/Q2 journals, and received 2000 citations with h-index: 25 and i10-index: 38. Over 10 years of experience teaching thermal-fluid sciences and advising students.

Education

Ph.D. Aerospace Engineering, Old Dominion University, Norfolk, VA, USA, May 2012

M.S. Mechanical Engineering, Middle East Technical University, Ankara, Turkey, June 2008

B.S. Mechanical Engineering, Middle East Technical University, Ankara, Turkey, June 2006

Awards

- "*Young Scientist of the Year Award*" from the Science Heroes Association (2021)
- Included on the top 2% scientists list published by the Stanford researchers (2020 -doi:10.17632/btchxktzyw.2)
- "*Research Incentive Award*" from the METU Parlar Foundation (2020)
- "*Young Scientist*" award from the Science Academy (BAGEP-2020)
- "*Outstanding Young Scientist*" award from the Turkish Academy of Sciences (TUBA-GEBIP-2017)
- "*Brain Circulation Scheme*" award from the European Union Marie-Curie COFUND program (2014)
- Ranked 1st in graduate program of Old Dominion University "*Faculty Award in Aerospace Engineering 2012"*

Academic Positions

Assistant Professor: University of Tennessee Chattanooga, Mechanical Eng., USA (***08/22 to present***).

Associate Professor: Izmir Institute of Technology, Mechanical Eng., Turkey (***11/18 to 08/22***).

Assistant Professor: Izmir Institute of Technology, Mechanical Eng., Turkey (***8/14 to 11/18***).

Assistant Research Professor: Southern Methodist University, Mechanical Eng., USA (***8/13 to 8/14***).

Research Scientist: Old Dominion University, Institute of Micro/Nanotechnology, USA (***8/12 to 8/13***).

Postdoctoral Researcher: Old Dominion University, Institute of Micro/Nanotechnology, USA (***5/12 to 8/12***).

Research Assistant: Old Dominion University, Mechanical & Aerospace Eng., USA (***8/08 to 5/12***).

Teaching Assistant: Middle East Technical University, Mechanical Eng., Turkey (***8/06 to 8/08***).

RESEARCH

Research Projects

1. "Multiscale characterization of heat transfer in nanoporous materials assisted by machine learning" **M Barisik (PI)**, NSF-CAREER ***$596,510*** (*under review*).
2. "Molecular characterization of thermal effects on capacitance behavior of supercapacitors" **M Barisik (PI)**, NSF-ERI ***$200,000*** (*08/24-present*).
3. "First principles multiphase modeling of mesoscale gas transport in porous reactive systems" **M Barisik (PI)**, R Ranjan (co-PI), R. Sankaran -ORNL (co-PI), S. Irle (co-PI), DOE-FAIR ***$750,000*** (*08/23-present*).
4. "Modeling heat generation and temperature variation in supercapacitors" **M Barisik (PI)**, UTC-CEACSE FY2024, ***$125,000*** (*08/23-08/24*).
5. "Development of innovative approaches for joining structural components in aerospace applications" M Tanoglu (PI), **M Barisik (co-PI)**, E. Aktas (co-PI), *collaborating with Turkish Aerospace Industries*, TUBITAK-1003, 218M701, ***$450,000*** (*11/19 to 03/23*).

6. "Characterization of Surface Electric Charges and Electrostatic Force Interactions of Mesoporous Silica Particles," **M Barisik (PI)**, TUBITAK-1001, 118M710, ***$120,000*** (*11/18 to11/20*).
7. "Wetting and Flow Control using Biomimicked Nano Surface Structures," **M Barisik (PI)**, TUBITAK-3501, ***Career Award,*** 217M460, ***$100,000*** (*05/18 to 08/20*).
8. "Wetting and Heat Transfer Control by Meta-materials," **M Barisik (PI)**, Outstanding Young Scientist program of the Turkish Academy of Sciences, ***$25,000*** (TUBA-GEBIP-2017), (*11/17 to 06/20*).
9. "Molecular Level Investigation of Nano-Scale Gas Flows," **M Barisik (PI)**, EU Marie-Curie COFUND under Grant No:115C026 ***$200,000*** (*04/15 to 02/18*).
10. "Efficiency Increase Using Adsorption Bed Type Heat Pump," **M Barisik (PI)**, Turkish Ministry of Science, Industry and Technology (SAN-TEZ) Grant No: 0290.STZ.2013-2, ***$50,000*** (*04/15 to 09/15*).
11. "Molecular Modeling of Silicon/Water Interface," **M Barisik (PI)**, Extreme Science and Engineering Discovery Environment (XSEDE) under Grant No: TG-CTS130001 ***1M CPU hours*** (*10/12 to 10/13*).

Book Chapters

1. **Barisik M**, Beskok A (2016) Interface Resistance and Thermal Transport in Nano-Scale Confined Liquids. Microscale and Nanoscale Convective Heat Transfer: Concepts, Analysis, and Applications, CRC Taylor and Francis, ***opening chapter and cover design***.
2. Mobedi M, **Barisik M**, Nakayama A (2016) Characterization of Volume-averaged Transport Properties for Micro-scale Porous Media at Slip-flow Regime. Microscale and Nanoscale Convective Heat Transfer: Concepts, Analysis, and Applications, CRC Taylor and Francis.
3. Beskok A, **Barisik M** (2015) Molecular Dynamics Studies on Nanoscale Gas Transport. Encyclopedia of Microfluidics and Nanofluidics, Springer.

Journals

1. AC Ozdemir, M Barisik (2024) Interfacial Heat Transfer Characterization of Silica Nanoparticles at different Ionic Solutions under Active Surface Charge Regulation, ***International Journal of Heat and Mass Transfer*** (*under review*)
2. Oz M, Uz UC, Tanoglu G, Tanoglu M, **Barisik M** (2024) Investigating the Effects of Functionalized Single Wall Carbon Nanotubes on the Cure Behavior for a Carbon /Epoxy Prepreg System by an Optimized Parameter Approach, ***Polymer Composites***, (*under review*)
3. Masuduzzaman M, Bakli C, **Barisik M**, Kim BH (2024) Applied Electric Field Effects on Diffusivity and Electrical Double-Layer Thickness, ***Small***, 10.1002/smll.202404397
4. Sabet S, **Barisik M** (2024) Macroscopic modeling of Gas Permeability in Hierarchical Micro/Nano Porous Media: A Unified Characterization of Rarefaction using Klinkenberg Theory and Equivalent Diameter. ***Physics of Fluids***, 31:112001.
5. Karim KE, **Barisik M**, Bakli C, Kim B, (2024) Estimating water transport in carbon nanotubes: A critical review and inclusion of scale effects, ***Physical Chemistry Chemical Physics***, 10.1039/D4CP01068J
6. Yeke M, **Barisik M**, Tanoglu M, Ulasli ME, Nuhoğlu K, Esenoglu G, Martin S, Türkdoğan C, İplikçi H, Aktaş E, (2024) Influence of Reduced Graphene Oxide Incorporation to Polyamide 6,6 for Electrospun Nanofiber Coating within an Adhesive Composite Joint. ***Composite Structures***, 337, 118026
7. Nuhoğlu K, Aktaş E, Tanoğlu M, **Barisik M**, Esenoğlu G, Martin S, Iplikci H, Yeke M, Türkdoğan C, (2024) Multi-scale Analysis of Adhesive Bonding Behavior of Laser Surface-Treated Carbon Fiber Reinforced Polymer Composite Structures. ***International Journal of Adhesion and Adhesives***, 103643.
8. Esenoglu G, Tanoglu M, **Barisik M**, İplikçi H, Yeke M, Nuhoğlu K, Türkdoğan C, Martin S, Aktaş E, Dehneliler S, (2023) Investigating the Effects of PA66 Electrospun Nanofibers Layered within an Adhesive Composite Joint Fabricated under Autoclave Curing. ***ACS Omega***, 8 (36), 32656-32666
9. Nuhoğlu K, Aktaş E, Tanoğlu M, Martin S, İplikçi H, **Barisik M**, Yeke M, Türkdoğan C, Esenoğlu G, Dehneliler S, İriş ME (2023) Analysis of adhesively bonded joints of laser surface treated composite primary components of aircraft structures. ***International Journal of Adhesion and Adhesives*** 126, 103456
10. Iplikci H, **Barisik M**, Turkdogan C, Martin S, Yeke M, Nuhoglu K, Esenoglu G, Tanoglu M, Aktas E, Dehneliler S, Iris M E, (2023) Effects of nanosecond laser ablation parameters on surface modification of carbon fiber reinforced polymer composites. ***Journal of Composite Materials***, 00219983231178892

11. Esenoglu G, **Barisik M**, Tanoglu M, Yeke M, Turkdogan C, Iplikci H, Martin S, Nuhoglu K, Aktas E, Dehneliler S, (2022) Improving adhesive behavior of fiber reinforced composites by incorporating electrospun Polyamide-6-6 nanofibers in joining region. ***Journal of Composite Materials*** 56(29),4449-459
12. Yenigün O, **Barisik M** (2022) Active Heat Transfer Enhancement by Interface-Localized Liquid Dielectrophoresis Using Interdigitated Electrodes. ***Carbon***, 189:339-348.
13. Sabet S, **Barisik M**, Buonomo B, Manca O (2022) Thermal and Hydrodynamic Behavior of Forced Convection Gaseous Slip Flow in a Kelvin Cell Metal Foam, ***International Communications in Heat and Mass Transfer***, 131:105838.
14. Alan O, **Barisik M** (2021) Size and Roughness Dependent Temperature Effects on Surface Charge of Silica Nanoparticles, ***Colloids and Surfaces A: Physicochemical and Engineering Aspects***, 629:127407.
15. Yenigün O, **Barisik M** (2021) Local Heat Transfer Control using Liquid Dielectrophoresis at Graphene/Water Interfaces. ***International Journal of Heat and Mass Transfer***, 166:120801.
16. Ozcelik GH, Satiroglu E, **Barisik M** (2020) Size Dependent Influence of the Contact Line Pinning on Wetting of Nano-textured/patterned Silica Surfaces. ***Nanoscale***, 12:21376-21391.
17. Sen T, **Barisik M** (2020) Slip Effects on Ionic Current of Viscoelectric Electroviscous Flows through Different Length Nanofluidic Channels, ***Langmuir***, 36(31):9191–9203. ***Selected as the cover art***.
18. Ozcelik GH, Ozdemir AC, Kim B, **Barisik M** (2020) Wetting of Single Crystalline and Amorphous Silicon Surfaces: Effective Range of Intermolecular Forces for Wetting. ***Molecular Sim***, 46 (3), 224-234
19. Ozcelik GH, Sozen Y, H Sahin, **Barisik M** (2020) Parametrizing Nonbonded Interactions between Silica and Water from First Principles. ***Applied Surface Science***, 504, 144359.
20. Yakin FE, **Barisik M**, Sen T (2020) Pore Size and Porosity Dependent Zeta Potentials of Mesoporous Silica Nanoparticles, ***Journal of Physical Chemistry C***, 124(36),19579-19587.***Selected as the cover art***.
21. Alan O, **Barisik M**, Ozcelik GH (2020) Roughness Effects on Surface Charge Properties of Silica Nanoparticles, ***Journal of Physical Chemistry C***, 124 (13), 7274-7286.
22. Yenigün O, **Barisik M** (2019) Electric Field Controlled Heat Transfer through Silicon and Nano-confined Water. ***Nanoscale and Microscale Thermophysical Engineering***, 23:304-316.
23. Yenigün O, **Barisik M** (2019) Effect of nano-film thickness on thermal resistance at water/silicon interface. ***International Journal of Heat and Mass Transfer***, 134, 634-640.
24. Sabet S, **Barisik M**, Mobedi M, Beskok A (2019) An Extended Kozeny-Carman-Klinkenberg Model for Gas Permeability in Micro/Nano-Porous Media. Physics of Fluids, 31:112001.
25. Sen T, **Barisik M** (2019) Internal surface electric charge characterization of mesoporous silica. ***Nature Scientific Reports***, 9(1), 137.
26. Sen T, **Barisik M** (2019) Pore connectivity effects on the internal surface electric charge of mesoporous silica, ***Journal of Colloid and Interface Science***, 297, 10:1365–1373.
27. Ozcelik GH, **Barisik M** (2019) Surface Charge of Nano-patterned Silica Surfaces. ***Physical Chemistry Chemical Physics***, 21:7576-7587.
28. Celebi AT, **Barisik M**, Beskok A (2018) Surface charge-controlled transport of water in graphene nano-channels. ***Microfluidics Nanofluidics***, 22(1):7.
29. Nguyen CT, **Barisik M**, Kim BH (2018) Wetting of Chemically Heterogeneous Striped Surfaces: Molecular Dynamics Simulations. ***AIP Advances***, 8, 065003.
30. Sabet S, Mobedi M, **Barisik M**, Nakayama A (2018) Heat Transfer Enhancement by Aligned Solid Blocks with Intraparticle Parallel Pores. ***Int. J. of Num. Met. for Heat&Fluid Flow***, 28(11):2716-2733.
31. **Barisik M** (2018) Modelling Wetting Behavior of Silica Surfaces by Molecular Dynamics. Journal of The Faculty of Engineering and Architecture of Gazi University, 33(1), 337-344.
32. Sen T, **Barisik M** (2018) Size Dependent Surface Charge Properties of Silica Nano-Channels: Double Layer Overlap and Inlet/Outlet Effects. ***Physical Chemistry Chemical Physics***, 20:16719-16728.
33. Celebi AT, **Barisik M**, Beskok A (2017) Electric field-controlled transport of water in graphene nano-channels. ***The Journal of Chemical Physics***, 147(16):164311.
34. Kalyoncu G**, Barisik M** (2017) Analytical solution of micro-/nanoscale convective liquid flows in tubes and slits. ***Microfluidics Nanofluidics***, 21(9):147.

35. Kalyoncu G**, Barisik M** (2016) The extended Graetz problem for micro-slit geometries; analytical coupling of rarefaction, axial conduction and viscous dissipation. ***International Journal of Thermal Sciences***, 110: 261–269.
36. **Barisik M**, Beskok A (2016) 'Law of the Nano-Wall' in Nano-Channel Gas Flows. ***Microfluidics Nanofluidics***, 20(3): 46.
37. Pham TA, **Barisik M**, Kim BH (2016) Interfacial Thermal Resistance between The Graphene-Coated Copper and Liquid Water**.** ***International Journal of Heat and Mass Transfer***, 97: 422–431.
38. Vo T, **Barisik M**, Kim BH (2016) Atomic Density Effects on Temperature Characteristics and Thermal Transport at Grain Boundaries through a Proper Bin Size Selection. ***Physical Review E***,144,194707.
39. **Barisik M**, Beskok A (2015) Molecular Free Paths in Nano-Scale Gas Flows. ***Microfluidics Nanofluidics***, 18(5-6):1365-1371.
40. Vo T, **Barisik M**, Kim BH (2015) Near Surface Viscosity Effects on Capillary Rise of Water in Nano-tubes. ***Physical Review E***, 92, 053009.
41. **Barisik M**, Yazicioglu AG, Cetin B, Kakac S (2015) Analytical Solution of Thermally Developing Microtube Heat Transfer Including Axial Conduction, Viscous Dissipation, and Rarefaction Effects. ***International Communications in Heat and Mass Transfer***, 67: 81–88.
42. **Barisik M**, Beskok A (2014) Scale Effects in Gas Nano Flows. ***Physics of Fluids***, 26:052003.
43. **Barisik M**, Atalay S, Qian S, Beskok A (2014) Size dependent surface charge properties of silica nanoparticles. ***Journal of Physical Chemistry C***, 118(4):1836–1842.
44. Pham TA, **Barisik M**, Kim BH (2014) Molecular Dynamics Simulations of Kapitza Length for Argon-Silicon and Water-Silicon Interfaces. ***Int. J. of Precision Eng. and Manuf***.,15(2):323-329.
45. Atalay S, **Barisik M**, Qian S, Beskok A (2014) Surface Charge of a Nanoparticle Interacting with a Flat Substrate, ***Journal of Physical Chemistry C***, 118(20):10927–10935.
46. Pham TA, **Barisik M**, Kim BH (2013) Pressure Dependence of Kapitza Resistance at Gold/Water and Silicon/Water Interfaces. ***Journal of Chemical Physics***, 139:244702.
47. **Barisik M**, Beskok A (2013) Temperature Dependence of Thermal Resistance at the Water/Silicon Interface. ***International Journal of Thermal Sciences***, 77:47–54.
48. **Barisik M**, Beskok A (2013) Wetting Characterization of Silicon (1,0,0) Surface. ***Molecular Simulation***, 39(9):700–709. ***Selected as the cover article***.
49. **Barisik M**, Beskok A (2012) Surface–Gas Interaction Effects on Nanoscale Gas Flows. ***Microfluidics Nanofluidics***,13(5):789–798.
50. **Barisik M**, Beskok A (2012) Boundary Treatment Effects on Molecular Dynamics Simulations of Interface Thermal Resistance. ***Journal of Computational Physics***, 231:7881–7892.
51. Shi Z, **Barisik M**, Beskok A (2012) Molecular dynamics modeling of thermal resistance at argon-graphite and argon-silver interfaces. ***International Journal of Thermal Sciences***, 59:29–37.
52. **Barisik M**, Beskok A (2011) Molecular Dynamics Simulations of Shear Driven Gas Flows in Nano-Channels. ***Microfluidics Nanofluidics***, 11(5):611–622.
53. **Barisik M**, Beskok A (2011) Equilibrium Molecular Dynamics Studies on Nanoscale-confined Fluids. ***Microfluidics Nanofluidics***, 11(3):269-282.
54. **Barisik M**, Kim B, BeskokA (2010) Smart Wall Model for Molecular Dynamics Simulations of Nanoscale Gas Flows. ***Communications in Computational Physics*** 7:977–993.

Invited Talks

1. **Barisik M** (2022) "Law of the Nano-wall" in Nano-channel Gas Flows, The 32nd International Symposium on Rarefied Gas Dynamics, Seoul, South Korea, July.
2. **Barisik M** (2021) Interfacial heat transfer in small scale systems: solids, liquids, gases and their interfaces, The 29nd International Materials Research Congress, Cancun, Mexico, August.
3. **Barisik M** (2018) Calculating and Modeling Micro/nano-scale Effects in Fluid Transport, Symposium on Advances in Thermal and Fluid Sciences, Urla, Turkey, June.
4. **Barisik M** (2018) Molecular Level Investigation of Nanoscale Interface Thermal Resistance, 7th Condense Matter Physics Meeting, Urla, Turkey, Nisan.

5. **Barisik M** (2017) Molecular Level Investigation of Nanoscale Interface Thermal Resistance, Recent Progress in the Physics of Thermal Transport, Urla, Turkey, June.
6. **Barisik M** (2017) Molecular Level Investigation of Nanoscale Interface Thermal Resistance, Sabanci University, Istanbul, Turkey, June.

TEACHING

Courses

- *Heat and Mass Transfer*, ENME3090 (2023-Spring, 2024-Spring)
- *Thermodynamics*, ENME3030 (2022-Fall, 2023-Spring, 2023-Fall, 2024-Spring, 2024-Fall)
- *Heat Transfer*, ME340 (2021-Fall, 2020-Fall, 2020-Spring, 2019-Fall, 2018-Fall, 2017-Fall, 2016-Spring)
- *Fluid Dynamics I & II*, ME301&ME303 (2019-Spring, 2018-Spring, 2016-Fall, 2017-Fall, 2016-Spring)
- *Heat Exchangers*, ME425 (2016-Spring, 2015-Spring)
- *Manufacturing Engineering and Processes*, ME323&ME328 (2016-Spring, 2015-Fall)
- *Introduction to Microfluidics*, ME444 (2021- Spring, 2018-Fall, 2017-Fall, 2016-Fall, 2015-Fall)
- *Microfluidic Theory*, ME555 (2020-Spring, 2019-Fall 2018-, 2017-, 2016-, 2015-, 2014-Spring).

Directed Graduate Theses – Ongoing

- Ezgi Satiroglu, PhD in Computer Science at UTC, "*Room Temperature Phase Change Characterization of Water under Electric Field for Energy Storage Applications.*", (*08/24*).
- Amirehsan Ghasemi, PhD in Data Science and Engineering at UTK, "*Machine Learning Assisted Molecular Dynamic Characterization of Nanoscale Heat Transfer in Aerogels* ", (*06/24*).
- Khowshik Dey, MS in Mechanical Engineering at UTC, "*Nanoscale Heat Transfer and Differential Capacitance Characterization of Electric Double Layer in Supercapacitors*", (*08/24*).
- Ege Can Ek, MS in Mechanical Engineering at UTC, "*Reactive Rarefied Gas Flows within Micro/nano-porous Systems during Chemical Vapor Infiltration Processes*", (*01/24*).
- Atal Bhowmik, MS in Mechanical Engineering at UTC, "*Quantum Chemistry Characterization of Dehydrogenation Reactions of Hydrocarbon during Chemical Vapor Infiltration Processes*", (*08/23*).

Directed Graduate Theses – Completed

- Safa Sabet, PhD in Mechanical Engineering at IZTECH, "*Characterization of Heat and Mass Transport through Micro/nano-scale Porous Media*", (*11/21*).
- Ezgi Satıroglu, MS in Energy Engineering at IZTECH, "*Investigations on Nanoscale Wetting, Fluid Transport, and Droplet Evaporation at Nanostructured Surfaces by Molecular Dynamics*", (*08/21*).
- Onur Yenigun, PhD in Mechanical Engineering at IZTECH, "*Molecular Dynamics Studies on Interface Heat Transfer Control Using Electric Field*", (*07/21*).
- Tumcan Sen, PhD in Mechanical Engineering at IZTECH, "*Multiphysics Modeling of Surface Charge and Pressure-driven Electrokinetic Flow in Micro/nano Scale Porous Media* ", (*04/21*).
- Celal Can Ozen, MS in Mechanical Engineering at IZTECH, "*Molecular Dynamics Studies on Heat Transfer Control between Water and Silica Using Nanoscale Surface Patterns* ", (*12/20*).
- A. Cihan Ozdemir, MS in Mechanical Engineering at IZTECH, "*MD Studies on Wetting Behavior of Silicon Surfaces and Heat Transfer Characteristics of Electrolyte Solution Filled Nano-channels*", (*07/20*).
- F. Esin Yakin, MS in Bioengineering at IZTECH, "*Numerical and Experimental Investigations on the Zeta Potential of Different Size Mesoporous Silica Nanoparticles with Different Porous Properties*", (*07/20*).
- B. Oyku Alan, MS in Mechanical Engineering at IZTECH, "*Investigations on Surface Electric Charge of Silica Nanoparticles with Different Surface Roughnesses*", (*01/20*).
- H. Gokberk Ozcelik, MS in Mechanical Engineering at IZTECH, *"Molecular Dynamics Studies on Manipulation of Surface Wetting Using Nanoscale Surface Structures"* (*09/19*).
- Orhan Oral, MS in Mechanical Engineering at IZTECH,*"Numerical Investigations of Flash-Boiling Gasoline Direct Injection Sprays"*(*07/19*).
- Gulce Kalyoncu, MS in Energy Engineering at IZTECH, *"Investigation of Liquid Transport in Micro and Nanoscale Porous Media at Different Pore to Throat Size Ratios"* (*08/17*).
- Safa Sabet, MS in Mech. Eng. at IZTECH, *"Numerical Determination of Permeability and Interfacial Convective Heat Transfer Coefficient for Non-Isotropic and Periodic Dual Scale Porous Medium"* (*08/15*).

- Gizem Arslan, MS in Mechanical Engineering at IZTECH, *"A study on COP improvement of a household refrigerator by using an adsorption heat pump"* (*08/15*).

Co-advised Graduate Theses - Completed

- Truong Quoc Vo, PhD in University of Ulsan - Korea, "*Near-surface viscosity effects on capillary rise of water in nanotubes*", (*01/15 to 06/18*).
- Alper Tunga Celebi, PhD in Southern Methodist University - USA, "*Molecular Dynamics Studies on Nanoscale Confined Liquids* ", (*09/14 to 05/18*).
- Chinh Thanh Nguyen, MS in University of Ulsan - Korea, "Wetting of chemically heterogeneous striped surfaces: Molecular dynamics simulations", (*01/14 to 06/16*).
- An Truong Pham, MS in University of Ulsan - Korea, "*Interfacial thermal resistance between the graphene-coated copper and liquid water*", (*01/12 to 06/14*).

SERVICE ACTIVITIES

Services for "American Society of Thermal and Fluids Engineers (ASTFE)"

- Member of Thermal Science Technical Committee.
- Supported organization of the "9TH Thermal and Fluids Engineering Conference 2024

Services for "Scientific and Technological Research Council of Turkey (TUBITAK)"

- Evaluator in Research Proposals Review Panels (Research Support Programs - ARDEB) (2021-Fall, 2021-Spring, 2020-Fall, 2020-Spring, 2019-Fall, 2019-Spring, 2018-Fall, 2018-Spring, 2017-Fall, evaluated 40 research proposals in Thermal-fluid Sciences with $240,000 max budget each)
- Evaluator for Industrial Proposals (Technology and Innovation Support Programs - TEYDEB) (2014-present, evaluated 11 industrial proposals in Thermal-fluid Sciences with $300,000 max budget each)
- Evaluator of Ongoing Industrial Projects (Technology and Innovation Support Programs - TEYDEB) (2015-present, tracked and evaluated term reports of 7 industrial projects in Thermal-fluid Sciences with $300,000 max budget each)

Services for "Small and Medium Enterprises Development and Support Administration (KOSGEB)

- Evaluator in Business Proposals Panels (Business Development, Growth and Internationalization Support Program) (2018-Spring, 2017-Spring, 2016-Spring, evaluated over 60 technical proposals in Mechanical Eng. fields with $100,000 max budget each)

Referee for the Following Professional Journals

- Nature Communications
- Microfluidics and Nanofluidics
- Chemical Physics Letters
- Physics of Fluids
- International Journal of Thermal Sciences
- Langmuir
- Physical Review E
- Colloids and Surfaces A
- Material Chemistry and Physics
- The Journal of Chemical Physics
- International Journal of Heat and Mass Transfer
- The Journal of Physical Chemistry
- Physical Chemistry Chemical Physics
- ASME Journal of Fluids Engineering
- IEEE Electron Device Letters
- International Journal of Thermophysics
- Computers and Fluids
- Nanoscale

Organizer of the Following International Conferences

- Engineering Thermal Transport in Nanoscale Materials: Recent Advances in Nanoscale Metrology and Computationally Informed Material Development" track at 31st International Material Research Congress, Mexico, August 2023.
- International Porous and Powder Materials Symposium and Exhibition, Mugla, Turkey, September 2019
- 14th Nanoscience and Nanotechnology Conference, Cesme, Turkey, September 2018
- Symposium on Advances in Thermal and Fluid Sciences, Urla, Turkey, June 2018
- International Porous and Powder Materials Symposium and Exhibition, Aydın, Turkey, September 2017

Vahid Disfani

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Last update: June 12, 2024

Education

- **University of Tennessee at Knoxville** — **Knoxville, TN**
  Doctoral of Philosophy, Business Analytics — *2025 Expected*
- **University of South Florida** — **Tampa, FL**
  Doctoral of Philosophy, Electrical Engineering — *2015*
  Dissertation Title: Optimization and Control for Microgrid and Power Electronic Converters
- **Sharif University of Technology** — **Tehran, Iran**
  Master of Science, Electrical Engineering — *2008*
- **Amirkabir University of Technology** — **Tehran, Iran**
  Bachelor of Science, Electrical Engineering — *2006*

Professional Experience

- **University of Tennessee at Chattanooga (UTC), Department of Electrical Engineering** — **Chattanooga, TN**
  UC Foundation Associate Professor — *2023–Present*
- **SABAVA LLC** — **Chattanooga, TN**
  Founder & CEO — *2021-Present*
- **University of Tennessee at Chattanooga (UTC), Department of Electrical Engineering** — **Chattanooga, TN**
  Assistant Professor — *2017–2023*
- **University of California San Diego (UCSD), Center for Energy Research** — **San Diego, CA**
  Postdoctoral Scholar — *2015–2017*
- **NEC Laboratories America (NECLA), Energy Management Department** — **Cupertino, CA**
  Research Assistant (Intern) — *Summer 2014*
- **University of South Florida (USF), Department of Electrical Engineering** — **Tampa, FL**
  Research and Teaching Assistant — *2012–2015*
- **Iran Azad University (IAU), Karaj and Damavand Branches** — **Karaj and Damavand, Iran**
  Lecturer — *2009–2012*
- **Iran Grid Management Company (IGMC), Market Monitoring Department** — **Tehran, Iran**
  Electricity Market Analyst — *2008–2012*

Publications

Key: **BOLD** indicates my name; UNDERLINE indicates name of student authors working under my supervision.

Book and Book Chapters

[B1] S. Wasti, P. Macedo, S. Afshar, J. Griffin, V. R. **Disfani**, and P. Siano, *Distributed Dynamic Algorithm for Energy Management in Smart Grids. Book chapter*. 2021.

Patents

[P1] A. Habib, R. De Callafon, V. R. **Disfani**, J. Kleissl, J. Holmes, and E. Ratnam, "Shared power generation to improve electric grid system reliability," US Patent App. 16/484,382, Jun. 2020.

Dissertation

[D1] V. R. **Disfani**, *Optimization and control for microgrid and power electronic converters*, 2015.

Peer-Reviewed Journal Articles

[J1] S. Afshar, S. Pazouki, M.-R. Haghifam, V. **Disfani**, and P. Siano, "Optimal planning of residential energy hubs considering customer desire function," *Electric Power Components and Systems*, vol. 50, no. 18, pp. 1113–1129, 2022.

[J2] S. Afshar, Z. K. Pecenak, M. Barati, and V. **Disfani**, "Mobile charging stations for ev charging management in urban areas: A case study in chattanooga," *Applied Energy*, vol. 325, p. 119 901, 2022.

[J3] S. Afshar, V. R. **Disfani**, and P. Siano, "A distributed electric vehicle charging scheduling platform considering aggregators coordination," *IEEE Access*, 2021.

[J4] S. Afshar, P. Macedo, F. Mohamed, and V. **Disfani**, "Mobile charging stations for electric vehicles—a review," *Renewable and Sustainable Energy Reviews*, vol. 152, p. 111 654, 2021.

[J5] C. Li, V. R. **Disfani**, H. V. Haghi, and J. Kleissl, "Coordination of oltc and smart inverters for optimal voltage regulation of unbalanced distribution networks," *Electric Power Systems Research*, vol. 187, p. 106 498, 2020.

[J6] Z. K. Pecenak, H. V. Haghi, C. Li, M. J. Reno, V. R. **Disfani**, and J. Kleissl, "Aggregation of voltage-controlled devices during distribution network reduction," *IEEE Transactions on Smart Grid*, 2020.

[J7] R. Hanna, V. R. **Disfani**, H. V. Haghi, D. G. Victor, and J. Kleissl, "Improving estimates for reliability and cost in microgrid investment planning models," *Journal of Renewable and Sustainable Energy*, vol. 11, no. 4, p. 045 302, 2019.

[J8] C. Li, V. R. **Disfani**, Z. K. Pecenak, S. Mohajeryami, and J. Kleissl, "Optimal oltc voltage control scheme to enable high solar penetrations," *Electric Power Systems Research*, vol. 160, pp. 318–326, 2018.

[J9] Z. K. Pecenak, V. R. **Disfani**, M. J. Reno, and J. Kleissl, "Inversion reduction method for real and complex distribution feeder models," *IEEE Transactions on Power Systems*, vol. 34, no. 2, pp. 1161–1170, 2018.

[J10] O. Babacan, E. L. Ratnam, V. R. **Disfani**, and J. Kleissl, "Distributed energy storage system scheduling considering tariff structure, energy arbitrage and solar pv penetration," *Applied Energy*, vol. 205, pp. 1384–1393, 2017.

[J11] A. H. Habib, V. R. **Disfani**, J. Kleissl, and R. A. de Callafon, "Optimal switchable load sizing and scheduling for standalone renewable energy systems," *Solar Energy*, vol. 144, pp. 707–720, 2017.

[J12] A. H. Habib, V. R. **Disfani**, J. Kleissl, and R. A. de Callafon, "Market-driven energy storage planning for microgrids with renewable energy systems using stochastic programming," *IFAC-PapersOnLine*, vol. 50, no. 1, pp. 183–188, 2017.

[J13] Z. K. Pecenak, V. R. **Disfani**, M. J. Reno, and J. Kleissl, "Multiphase distribution feeder reduction," *IEEE Transactions on Power Systems*, vol. 33, no. 2, pp. 1320–1328, 2017.

[J14] D. Yang, H. Quan, V. R. **Disfani**, and L. Liu, "Reconciling solar forecasts: Geographical hierarchy," *Solar Energy*, vol. 146, pp. 276–286, 2017.

[J15] D. Yang, H. Quan, V. R. **Disfani**, and C. D. Rodriguez-Gallegos, "Reconciling solar forecasts: Temporal hierarchy," *Solar Energy*, vol. 158, pp. 332–346, 2017.

[J16] V. R. **Disfani**, L. Fan, Z. Miao, and Y. Ma, "Fast model predictive control algorithms for fast-switching modular multilevel converters," *Electric Power Systems Research*, vol. 129, pp. 105–113, 2015.

[J17] H. Nafisi, H. M. Roudsari, S. H. Hosseinian, H. A. Abyaneh, and V. R. **Disfani**, "Active and reactive power transmission loss allocation to bilateral contracts through game theory techniques," *Turkish Journal of Electrical Engineering & Computer Sciences*, vol. 23, no. 4, pp. 1111–1126, 2015.

[J18] D. A. Nguyen, P. Ubiratan, M. Velay, R. Hanna, J. Kleissl, J. Schoene, V. Zheglov, B. Kurtz, B. Torre, and V. **Disfani**, "Impact research of high photovoltaics penetration using high resolution resource assessment with sky imager and power system simulation," *CSI RD&D3 Subtask 4.3 Final Report*, 2015.

[J19] V. R. **Disfani**, L. Fan, L. Piyasinghe, and Z. Miao, "Multi-agent control of community and utility using lagrangian relaxation based dual decomposition," *Electric Power Systems Research*, vol. 110, pp. 45–54, 2014.

[J20] Z. Miao, L. Xu, V. R. **Disfani**, and L. Fan, "An soc-based battery management system for microgrids," *Ieee transactions on smart grid*, vol. 5, no. 2, pp. 966–973, 2013.

[J21] V. Khorani, F. Razavi, and V. R. **Disfani**, "A mathematical model for urban traffic and traffic optimization using a developed ica technique," *IEEE Transactions on intelligent transportation systems*, vol. 12, no. 4, pp. 1024–1036, 2011.

Conference Papers

[C1] S. Payne, J. Shober, M. Craig, N. Saied, R. Ahmed, V. **Disfani**, and A. Karrar, "Method for decoupling and simulation of power distribution networks using a raspberry pi multi-agent system," in *2023 IEEE PES Innovative Smart Grid Technologies Latin America (ISGT-LA)*, IEEE, 2023, pp. 330–334.

[C2] S. Afshar, Z. K. Pecenak, and V. **Disfani**, "Mobile charging station: A complementary charging technology for electric vehicles," in *2022 IEEE Transportation Electrification Conference & Expo (ITEC)*, IEEE, 2022, pp. 953–957.

[C3] S. Afshar and V. **Disfani**, "A distributed ev charging framework considering aggregators collaboration," in *2021 IEEE Madrid PowerTech*, IEEE, 2021, pp. 1–6.

[C4] P. Ubiratan, S. Wasti, and V. **Disfani**, "Frequency deviation controller for inter-area oscillations damping in smart grids," in *2021 IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT)*, IEEE, 2021.

[C5] S. Afshar, P. Macedo, F. Mohamed, and V. **Disfani**, "A literature review on mobile charging station technology for electric vehicles," in *2020 IEEE Transportation Electrification Conference and Expo (ITEC)*, IEEE, 2020, pp. 1–6.

[C6] S. Afshar, S. Wasti, and V. **Disfani**, "An admm-based miqp platform for the ev aggregation management," in *2020 International Conference on Smart Grids and Energy Systems*, IEEE, 2020, pp. 1–6.

[C7] S. Khanal and V. **Disfani**, "Modular multilevel converter design for grid integration of solar photovoltaic systems," in *2020 IEEE Power and Energy Society General Meeting (PESGM)*, IEEE, 2020, pp. 1–5.

[C8] F. Mohamed, S. Khanal, and V. **Disfani**, "Mmc-based grid integration of pv-bess with power grid support capabilities," in *2020 North American Power Symposium (NAPS)*, IEEE, 2020, pp. 1–6.

[C9] F. Mohamed, S. Wasti, S. Afshar, P. Macedo, and V. **Disfani**, "Mmc-based distributed maximum power point tracking for photovoltaic systems," in *2020 IEEE Power and Energy Society General Meeting (PESGM)*, IEEE, 2020, pp. 1–5.

[C10] P. Ubiratan, S. Wasti, and V. **Disfani**, "Distributed inter-area oscillation damping control via dynamic average consensus algorithm," in *2020 IEEE International Conference on Smart Grid Communications (SmartGridComm)*, IEEE, 2020.

[C11] S. Wasti, P. Ubiratan, S. Afshar, and V. **Disfani**, "Distributed dynamic economic dispatch using alternating direction method of multipliers," in *2020 Applied Energy Symposium MIT A+B*, Applied Energy, 2020.

[C12] S. Khanal and V. R. **Disfani**, "A novel optimal modulation strategy for modular multilevel converter based hvdc systems," in *2019 IEEE 2nd International Conference on Renewable Energy and Power Engineering (REPE)*, IEEE, 2019, pp. 10–14.

[C13] S. Khanal and V. R. **Disfani**, "Reduced switching-frequency modulation design for model predictive control based modular multilevel converters," in *2019 IEEE 2nd International Conference on Renewable Energy and Power Engineering (REPE)*, IEEE, 2019, pp. 1–5.

[C14] C. Li, V. R. **Disfani**, H. V. Haghi, and J. Kleissl, "Optimal voltage regulation of unbalanced distribution networks with coordination of oltc and pv generation," in *2019 IEEE Power & Energy Society General Meeting (PESGM)*, IEEE, 2019, pp. 1–5.

[C15] R. Hanna, V. R. **Disfani**, and J. Kleissl, "Reliability evaluation for microgrids using cross-entropy monte carlo simulation," in *2018 IEEE International Conference on Probabilistic Methods Applied to Power Systems (PMAPS)*, IEEE, 2018, pp. 1–6.

[C16] G. Wang, V. **Disfani**, and J. Kleissl, "Scenario based stochastic optimization of probabilistic ev charging scheduling," in *2018 IEEE Innovative Smart Grid Technologies-Asia (ISGT Asia)*, IEEE, 2018, pp. 552–557.

[C17] A. H. Habib, V. R. **Disfani**, J. Kleissl, and R. A. de Callafon, "Optimal energy storage sizing and residential load scheduling to improve reliability in islanded operation of distribution grids," in *2017 American Control Conference (ACC)*, IEEE, 2017, pp. 3974–3979.

[C18] R. Hanna, V. R. **Disfani**, J. Kleissl, and D. G. Victor, "A new simulation model to develop and assess business cases for commercial microgrids," in *2017 North American Power Symposium (NAPS)*, IEEE, 2017, pp. 1–6.

[C19] Z. K. Pecenak, J. Kleissl, and V. R. **Disfani**, "Smart inverter impacts on california distribution feeders with increasing pv penetration: A case study," in *2017 IEEE Power & Energy Society General Meeting*, IEEE, 2017, pp. 1–5.

[C20] V. R. **Disfani**, P. Ubiratan, and J. Kleissl, "Model predictive on-load tap changer control for high penetrations of pv using high resolution resources assessment with sky imager," in *2016 IEEE Power and Energy Society General Meeting (PESGM)*, IEEE, 2016, pp. 1–5.

[C21] A. H. Habib, V. R. **Disfani**, J. Kleissl, and R. A. de Callafon, "Quasi-dynamic load and battery sizing and scheduling for stand-alone solar system using mixed-integer linear programming," in *2016 IEEE Conference on Control Applications (CCA)*, IEEE, 2016, pp. 1476–1481.

[C22] A. H. Habib, Z. K. Pecenak, V. R. **Disfani**, J. Kleissl, and R. A. de Callafon, "Reliability of dynamic load scheduling with solar forecast scenarios," in *2016 Annual IEEE Systems Conference (SysCon)*, IEEE, 2016, pp. 1–7.

[C23] A. H. Habib, E. L. Ratnam, V. R. **Disfani**, J. Kleissl, and R. A. de Callafon, "Optimization-based residential load scheduling to improve reliability in the distribution grid," in *2016 IEEE 55th Conference on Decision and Control (CDC)*, IEEE, 2016, pp. 2419–2424.

[C24] R. Hanna, V. R. **Disfani**, and J. Kleissl, "A game-theoretical approach to variable renewable generator bidding in wholesale electricity markets," in *2016 North American Power Symposium (NAPS)*, IEEE, 2016, pp. 1–6.

[C25] V. R. **Disfani**, L. Fan, and Z. Miao, "Distributed dc optimal power flow for radial networks through partial primal dual algorithm," in *2015 IEEE Power & Energy Society General Meeting*, IEEE, 2015, pp. 1–5.

[C26] J. Khazaei, L. Piyasinghe, V. R. **Disfani**, Z. Miao, L. Fan, and G. Gurlaskie, "Real-time simulation and hardware-in-the-loop tests of a battery system," in *2015 IEEE Power & Energy Society General Meeting*, IEEE, 2015, pp. 1–5.

[C27] Y. Ma, Z. Miao, V. R. **Disfani**, and L. Fan, "A one-step model predictive control for modular multilevel converters," in *2014 IEEE PES General Meeting| Conference & Exposition*, IEEE, 2014, pp. 1–5.

[C28] V. R. **Disfani**, F. Razavi, B. Kashanizadeh, and S. Dargahi, "Transmission loss allocation of bilateral contracts using load flow permutations average method," in *2009 IEEE Bucharest PowerTech*, IEEE, 2009, pp. 1–5.

Technical Reports

[R1] V. **Disfani**, Z. Miao, L. Fan, and B. Zeng, "Dual decomposition-based privacy-preserving multi-horizon utility-community decision making paradigms," 2015.

[R2] V. **Disfani**, P. Ubiratan, and J. Kleissl, "Model predictive on-load tap changer control for high penetrations of pv using sky imager solar forecast," 2015.

[R3] V. R. **Disfani**, M. Chehreghani Bozchalui, and R. Sharma, "Sdp-based state estimation of multi-phase active distribution networks using micro-pmus," 2015, arXiv–1504.

Grants and Proposals

Active and Completed Grants

13. Osama Osman, Mina Sartipi, **Vahid R. Disfani (co-PI)**, Ignatius Fomunung, *An End-to-End Decision Support System for Integrated Transportation System and Grid Management*, US Department of Transportation, 2023-2026, $984,614. The grant is led by the City of Chattanooga for a total of $9,200,000.

12. **Vahid R. Disfani (PI)**, University of Tennessee Chattanooga (UTC) *Expansion of the Real-time Testbed for Multi-agent Optimization and Control Algorithms,* UTC Faculty Development Grant, Research and Creative Activity, 2021, $2,500.

11. **Vahid R. Disfani (PI)**, Shahab Afshar, University of Tennessee Chattanooga (UTC) *A Multilayer Distributed Optimization Platform for EV Charging Scheduling,* UTC Search Award, 2020-2021, $1,000.

10. **Vahid R. Disfani (PI)**, Raga Ahmed, *Real-Time Optimal Allocation of Adaptive Virtual Inertia in Power Systems with High Penetration of Distributed Energy Resources*, Tennessee Higher Education Commission (THEC) through Center of Excellence in Applied Computational Science and Engineering (CEACSE), 2020-2021, $92,942.

9. **Vahid R. Disfani (PI)**, University of Tennessee Chattanooga (UTC) *Grid Integration of Distributed Energy Resources Through Modular Multilevel Converters,* Faculty Pre-Tenure Enhancement Program (PREP), 2020, $12,965.

8. **Vahid R. Disfani (PI)**, Abdul Ofoli, *Deep AI Based Home Energy Management System*, GridEd Undergraduate Research Grant, Electric Power Research Institute (EPRI), 2020, $5,000.

7. **Vahid R. Disfani (PI)**, Mina Sartipi, Mo Ahmadi, *Urban Electric Vehicle Charging Market: Computational Modeling and Optimal Design*, Tennessee Higher Education Commission (THEC) through Center of Excellence in Applied Computational Science and Engineering (CEACSE), 2018-2019, $96,108.

6. **Vahid R. Disfani (PI)**, *Battery Life Extension for Wireless Sensors*, Tennessee Valley Authorities (TVA), 2018-2019, $33,210.

5. **Vahid R. Disfani (PI)**, *Reliability Evaluation for Microgrids Using Cross-Entropy Monte Carlo Simulation,* UTC Faculty Development Grant, Personal Development, $1,500.

4. Raga Ahmed, Jennifer Ellis, Mbakisya Onyango, **Vahid R. Disfani (Senior Personnel)**, Weidong Wu, Wolday Abrha, Louie Elliott, *RET Site: Engineering and Data Analytics in Smart Cities,* National Science Foundation, 2019-2023, $595,936.

3. Jan Kleissl, David Victor, **Vahid R. Disfani (Senior Personnel)** *The Economic Value of Reliability for Microgrid Business Models*, Electric Power Research Institute (EPRI), 2016-2017, $195,000.

2. Nuuve Corporation, Jan Kleissl, **Vahid R. Disfani (Senior Personnel)** *Intelligent Electric Vehicle Integration (INVENT)*, California Energy Commission (CEC), 2017-2020, $4,200,000.

1. Charge Bliss, Inc., Jan Kleissl, **Vahid R. Disfani (Senior Personnel)** *A Comprehensive Smart Inverter Testing Facility and Pilot Demonstration Project*, California Energy Commission (CEC), 2017-2020, $3,000,000.

Prior Research Experience

As Postdoctoral Scholar at UC San Diego

- **Distributed grid control of flexible loads and DERs for optimized provision of synthetic regulating reserves, funded $2.3M by U.S. Department of Energy (ARPA-E NODES):** *Task 4, Testing and quantification of the impact of DERs for control algorithms and context engine (Sep 2016-August 2017).*
- **Solar forecast based optimization of distributed energy resources in the Los Angeles Basin and UC San Diego microgrid, funded $1M by California Energy Commission (EPC-14-005):** *Task 3, Develop use cases; submitted the results as a technical report to CEC (Jan-May 2016). Task 4, Optimization of controllable loads and aggregation to virtual power plants (May 2016-August 2017).*
- **Smart inverter interoperability standards and open testing framework to support high-penetration distributed photovoltaics and storage, funded $2M by California Energy Commission (PON 14-303):** *Task 3, Demonstration and evaluation of impact of high PV penetration using smart inverter with energy storage on the Southern California Edison (SCE) grid; submitted the results as a journal article to IEEE Transactions on Power Systems (Nov 2015-Jan 2017).*
- **High-fidelity solar forecasting demonstration for grid integration, funded $1.5M by California Public Utilities Commission (California Solar Initiative Round 3):** *Task 4.4, Model predictive on-load tap changer control for high penetrations of PV using sky imager solar forecast; published the results as a technical report and a conference paper (Aug-Dec 2015).*

As Research Assistant at University of South Florida

- **Modeling of large-scale battery systems with SOC prediction capability and development of SOC-based battery management system for both grid-connected and islanding operations of microgrid;** *published the results as a journal article (Fall 2012).*
- **Community power system modeling and PV/battery remote/optimal operations, sponsored by Duke Energy;** *submitted the final technical report to Duke Energy (Fall 2012-Spring 2013).*
- **Development of novel distributed and multi-agent algorithms for ac and dc optimal power flow problems;** *published the results as one journal and one conference paper (Spring 2013-Fall 2014).*
- **Development of a model predictive control structure and efficient solution for fast-switching model predictive control;** *published the results as a conference paper along with a journal article (Fall 2013-Spring 2014).*
- **Big data analysis on one-year data acquired from a real PV-battery testbed in St. Pete, Florida for battery degradation study;** *submitted the final technical report to Duke Energy (Spring 2014).*
- **Establishment of a Java-based multi-agent platform using JADE for multi-agent and distributed algorithms cases studies** *(Fall 2014).*
- **Development of moving-horizon multi-agent optimal power flow considering microgrids with storage and renewable systems integration;** *submitted the results as a journal article (Fall 2014-Spring 2015).*

As Research Assistant (Intern) at NEC Laboratories America

- **Distribution system state estimation using MATLAB, python, OpenDSS, and SDPA.** *Developed novel system observability reasoning for semidefinite state estimations; submitted an invention record in August 2014.*

As Market Analyst at Iran Grid Management Company

- **Data analysis on electricity market participants' behaviors to evaluate market performance;** *co-authored seasonal Iran power market efficiency reports; authored several market procedures on annual market audit and alternative dispute resolution in Iran power market to mitigate possible market power practices.*

Teaching Experience

Teaching Certificates

- Quality Matters: Independent Applying the QM Rubric (APPQMR) Fifth Edition (10/2017)

Courses at UT Chattanooga

- ENEE 7997R,5910R, 4999R - Data Analytics for Power Systems (Fall 2022)
- ENEE 7997R - Stochastic and Distributed Optimization (Spring 2021)
- ENEE 5910R, 4999R - Distributed Energy Resources (Fall 2019, Spring 2021, Fall 2024)
- ENEE 5610, 4999R - Power Electronics and Drives (Spring 2018, Spring 2019, Fall 2020, Fall 2023)
- ENEE 5910R, 4999R - Power System Optimization and Smart Grid (Fall 2018, Spring 2020, Spring 2022)
- ENEE 5997R - Modular Multilevel Converters (Fall 2018)
- ENEE 4600L - Power Electronics Laboratories (Spring 2022, Spring 2023, Spring 2024)
- ENEE 4600 - Power Electronics (Spring 2018, Spring 2019, Spring 2020, Spring 2021, Spring 2022, Spring 2023, Spring 2024)
- ENEE 3800 - Electrical Energy Conversion (Fall 2019, Fall 2020, Fall 2021, Fall 2022, Fall 2023, Spring 2024, Fall 2024)
- ENEE 2700 - Electrical Circuits (Fall 2017)
- ENEE 2710L - Electrical Circuits Laboratories (Fall 2017, Spring 2018, Fall 2018, Spring 2019)
- Guest Lecturer: ENEE 5000 - Graduate Seminar (Spring 2018, Spring 2019, Spring 2020, Spring 2021, Spring 2022, Spring 2023, Spring 2024)
- Guest Lecturer: ENEE 5910, 4999 - Modern Substations (Spring 2020, Fall 2021)
- Guest Lecturer: ENEE 5660, 4670 - Smart Distribution Systems (Spring 2018, Spring 2019, Spring 2020, Spring 2021, Spring 2022, Spring 2023, Spring 2024)
- Guest Lecturer: ENEE 1010 - Introduction to Electrical Engineering (Fall 2019, Fall 2020, Fall 2021, Fall 2022, Fall 2023)

Courses at UC San Diego

- Power Systems in Brief (developed and delivered about 30 lectures to graduate students on various topics in power systems such as power systems analysis, economics, control, reliability, and power electronics)

Courses at University of South Florida

- Co-Instructor: Power System Analysis I (Fall 2014)
- Guest Lecturer: Power System Analysis II (Fall 2014-Spring 2015)
- Teaching Assistant: Electromechanical Systems (Fall 2012-Spring 2013), Power Electronics (Fall 2013), Power System Analysis II (Fall 2013)
- Lab Instructor: Electromechanical Systems (Fall 2012-Spring 2013), Power Electronics (Spring 2014), Power System Analysis II (Spring 2015)

Courses at Iran Azad University (IAU)

- Lecturer: MATLAB (Spring 2009), Electric Circuits (Fall 2009), Industrial Electronics (Spring 2011), Electric Machines (Fall 2011), Power System Analysis (Spring 2012), Power System Protection and Relays (Spring 2012).

Courses at Sharif University

- Teaching Assistant: Engineering Probability and Statistics (Spring-Fall 2007)
- Lab Instructor: Electric Machines (Spring 2008)

Student Advising

Graduate Students

- **Atefeh Alirezazadeh, Ph.D. Student** (admitted in January 2024)
  - Multi-objective peer-to-peer optimization solutions for energy and emission management in microgrids
- **James Griffin, Ph.D. Candidate** (admitted in January 2020)
  - Reinforcement learning for optimal charging scheduling of electric vehicles
  - Online web-Based test platform for distributed power system optimization algorithms
  - Data-driven power system inertia estimation
  - Publications: One book chapter published as co-author.
- **Shahab Afshar, Ph.D. Student** (admitted in August 2019; graduated in August 2022)
  - Operation and planning of EV mobile charging stations
  - Application of distributed optimization techniques in EV aggregation coordination
  - Optimization modeling for urban electric vehicle charging market in Chattanooga
  - Publications: Three journal articles and six conference papers published as first author; One book chapter and several conference papers published as co-author.
  - Next destinations: Project Manager at North Carolina's Electric Cooperatives
- **Pablo Macedo Ubiratan, M.S.** (admitted in August 2019; graduated in August 2021)
  - Power system stability enhancement through distributed control algorithms
  - Eigensystem analysis of interarea oscillations in large-scale power systems
  - Optimization modeling for urban electric vehicle charging market in Chattanooga.
  - Publications: Two conference papers published as first author; one book chapter, one journal article, and several conference paper published as co-author.
  - Next destinations: Power System Engineer at Smart Wires Inc., Power System Engineer at Siemens.
- **Shailesh Wasti, M.S.** (admitted in August 2018; graduated in December 2020)
  - Thesis: Distributed Online Algorithms for Energy Management in Smart Grids.
  - Publications: One book chapter and one conference paper published as first author; several conference papers published as co-author; One journal paper in preparation.
  - Next destinations: Ph.D. Student and Research Assistant at Pennsylvania State University.
- **Farog Mohamed, M.S.** (graduated in August 2020)
  - Thesis: Modular Multilevel Converters for Solar Photovoltaic - Battery Energy Storage System Integration.
  - Publications: Two conference papers published as first author; one journal article and several conference papers published as co-author.
  - Next destinations: Engineering Associate at Mesa Associates, Inc.
- **Saroj Khanal, M.S.** (graduated in August 2019)
  - Thesis: Optimal Modulation and Topology Design of Modular Multilevel Converter for Grid Integration of Solar Photovoltaic Systems
  - Publications: Two conference papers published as first author; several conference papers published as co-author.

- Next destinations: Power system engineer at National Renewable Energy Laboratories; Energy Market Advisory Consultant at Hitachi Energy, Ph.D. Student and Research Assistant at John Hopkins University.

- **Changfu Li, Ph.D. co-advised with Dr. Kleissl at UCSD** (Graduated in 2020)
  - Dissertation: Coordinated Voltage Regulation of Distribution Networks.
  - Publications: Two journal articles and one conference paper published.
- **Zachary Pecenak, Ph.D. co-advised with Dr. Kleissl at UCSD** (Graduated in 2018)
  - Dissertation: Comprehensive Reduction of Real and Complex Distribution Feeder Models.
  - Publications: Three journal articles and one conference paper published.
- **Ryan Hanna, Ph.D. co-advised with Dr. Kleissl at UCSD** (Graduated in 2018)
  - Dissertation: Business cases for microgrids: Modeling interactions of technology choice, reliability, cost, and benefit.
  - Publications: One journal article and three conference papers published.
- **Abdulelah Habib, Ph.D. co-advised with Dr. Kleissl at UCSD** (Graduated in 2017)
  - Dissertation: Modeling and Optimization Techniques for Sizing and Scheduling Applications in Power and Energy.
  - Publications: One U.S. Patent, two journal articles, and five conference papers published.
- **Davood Haghshenas, M.S. co-advised with Dr. Razavi at Iran Azad University** (Graduated in 2012)
  - Thesis: Reliability assessment to determine the hotspots of combined cycle power plant and propose consolidated reliability enhancement solutions
- **Zahra Kalhori, M.S. co-advised with Dr. Razavi at Tafresh University** (Graduated in 2011)
  - Thesis: Identifying optimal operating mode for distributed generation considering reliability indices.
- **Mohammad Ali Zahmatkesh, M.S. co-advised with Dr. Razavi at Tafresh University** (Graduated in 2010)
  - Thesis: Optimal capacitor placement in electrical network of Arak telecommunication center

Undergraduate Students

- **Christopher Harmon, Stephen Lawrence, Deimer Ordonez Gomez,** (Graduated in August 2023)
  - Senior Design Project: ECS-Smart: A Smart Building Project Toward UTC as a Microgrid.
- **Tim Mannon, Jordan Suggs, Harley Dukes** (Graduated in August 2020)
  - Senior Design Project: AI Based Residential Microgrid EMS – Simulation Software Technical Overview.
  - One grant proposal funded by EPRI through GridEd program.
- **Abdulrahman Albalawi, Abdulrahman Alenezi, Othman Makkouk, Hadwan Alhadrami, Nawar Alotaibi** (Graduated in August 2019)
  - Senior Design Project: Design and implementation of incremental conductance based maximum power point tracking control for photovoltaic systems.

Services

Professional Services

- Journal Editorial Board Member
  - Journal of Electronics and Advanced Electrical Engineering
- Special Issue Guest Editor
  - IET Generation, Transmission, Distribution; Renewable Energy Sources (RES) Hosting Capacity in Distribution Networks.
- Conference Publication Chair
  - 2024 9th International Conference on Energy System, Electricity and Power(ESEP 2024)
- Conference Publication Track Chair
  - 2021 IEEE Transportation Electrification Conference and Expo (ITEC 2021)
  - 2020 IEEE Transportation Electrification Conference and Expo (ITEC 2020)
- Conference Technical Committee Member
  - 2025 9th International Conference on Sustainable Energy Engineering (ICSEE 2025)
  - 2024 International Conference on Sustainable Development and Energy Resources (SDER 2024)
  - 2024 6th International Conference on Energy Management and Applications Technologies (ICEMAT 2023)
  - 2024 12th International Conference on Smart Grid and Clean Energy Technologies (ICSGCE 2024)
  - 2024 5th International Conference on Power, Energy and Electrical Engineering (PEEE 2024)
  - 2023 IEEE 6th International Conference on Renewable Energy and Power Engineering(REPE 2023)

- 2023 4th International Conference on Power, Energy and Electrical Engineering(PEEE 2023)
- 2023 11th International Conference on Smart Grid and Clean Energy Technologies (ICSGCE 2023)
- 2023 5th International Conference on Energy Management and Applications Technologies (ICEMAT 2023)
- 2022 3rd International Conference on Power, Energy and Electrical Engineering (PEEE 2022)
- 2022 4th International Conference on Smart Power & Internet Energy Systems (SPIES 2022)
- 2022 IEEE 10th International Conference on Smart Grid and Clean Energy Technologies (ICSGCE 2022)
- 2021 IEEE 4th International Conference on Renewable Energy and Power Engineering (REPE 2021)
- 2021 IEEE 9th International Conference on Smart Grid and Clean Energy Technologies (ICSGCE 2021)
- 2020 International Conference on Smart Grids and Energy Systems (SGES 2020)
- 2020 IEEE 3rd International Conference on Renewable Energy and Power Engineering (REPE 2020)
- 2020 IEEE 8th International Conference on Smart Grid and Clean Energy Technologies (ICSGCE 2020)

- Conference Session Chair

- *Session 1: Electronics and Electrical Engineering*, IEEE 2nd International Conference on Renewable Energy and Power Engineering (REPE 2019)
- *Grid Impacts of Vehicle Charging I*, IEEE Transportation Electrification Conference (ITEC 2019)

- Review Services
  - Journal of Renewable and Sustainable Energy, 2019-present.
  - Journal of Solar Energy (Elsevier), 2015-present.
  - IEEE Transactions on Smart Grid, 2015-present.
  - IEEE Transactions on Power Systems, 2015-present.
  - Journal of Electric Power System Research (Elsevier), 2015-present.
  - Journal of Test and Evaluation (ASTM), 2015-present.
  - IEEE Transactions on Sustainable Energy, 2014-present.
  - IEEE Transportation Electrification Conference and Expo (ITEC), 2019-2021.
  - IEEE International Conference on Industrial Technology (ICIT), 2016.
  - IEEE Power and Energy Society General Meetings (PESGM), 2014-2020.
  - 11th and 12th International Conferences on Environment and Electrical Engineering (EEEIC), 2012-2013.

University Services at UT Chattanooga

- University Level
  - Faculty grants committee Member, 8/2020-present
- College Level
  - Ad-Hoc Strategic Plan Research & Innovation Committee member, 1/2022-present.
  - Governance and assessment committee member, 8/2019-present.
  - Department head search committee member for the Department of Electrical Engineering, 10/2019-4/2020.
  - Faculty search committee member for the Department of Chemical and Civil Engineering, 10/2018-4/2019.
- Department Level
  - ABET accreditation committee member, 8/2020-6/2021.
  - Undergraduate curriculum subcommittee member, Fall 2020.
  - Lecturer search committee member for the Department of Electrical Engineering, 10/2019-4/2020.
  - Preparation of departmental strategic plan, 8/2018-5/2020.
  - ABET assessment of student learning, 4/2018-present

Memberships, Awards, and Honors

1. Outstanding Faculty Teaching Award, UTC Electrical Engineering Department, 2021-2022.
2. Faculty Member, UTC SimCenter, Energy Thrust, July 2020-May 2023.
3. IEEE Member, 2013-Present.
4. IEEE Power and Energy Society Member, 2013-Present.
5. IEEE Power Electronics Society Member, 2017-Present.
6. IEEE Industrial Electronics Society Member, 2017-Present.
7. M.Sc. Fellowship, Sharif University of Technology, 2006-2008.
8. B.Sc. Fellowship, Amirkabir University of Technology, 2002-2006.
9. Ranked 13, Iran nationwide M.S. admission test, among more than 15000 applicants, 2006.
10. Ranked 405, Iran nationwide B.S. admission test, among more than 500,000 applicants, 2002.

NSF BIOGRAPHICAL SKETCH

NAME: Dumas, Joseph

POSITION TITLE & INSTITUTION: UC Foundation Professor, University of Tennessee at Chattanooga

(a) PROFESSIONAL PREPARATION -(see PAPPG Chapter II.C.2.f.(a))

INSTITUTION	LOCATION	MAJOR / AREA OF STUDY	DEGREE (if applicable)	YEAR YYYY
University of Southern Mississippi	Hattiesburg, MS	Electronics Engineering Technology	BS	1984
Mississippi State University	Starkville, MS	Electrical Engineering	MS	1989
University of Central Florida	Orlando, FL	Computer Engineering	PHD	1993

(b) APPOINTMENTS -(see PAPPG Chapter II.C.2.f.(b))

1993 - present UC Foundation Professor, University of Tennessee at Chattanooga, Computer Science and Engineering, Chattanooga, TN

2001 - 2001 Summer Faculty Fellow, NASA Marshall Space Flight Center, Huntsville, AL

2000 - 2000 Summer Faculty Fellow, NASA Marshall Space Flight Center, Huntsville, AL

1997 - 1997 Summer Faculty Fellow, NASA Marshall Space Flight Center, Huntsville, AL

1996 - 1996 Summer Faculty Fellow, NASA Marshall Space Flight Center, Huntsville, AL

1993 - 1993 Graduate/Postdoctoral Research Assistant, University of Central Florida, Institute for Simulation and Training, Orlando, FL

1989 - 1993 Graduate Research/Teaching Assistant, University of Central Florida, Department of Computer Engineering, Orlando, FL

1986 - 1989 Graduate Research/Teaching Assistant, Mississippi State University, Department of Electrical Engineering, Starkville, MS

1985 - 1986 Visiting Instructor, University of Southern Mississippi, Department of Engineering Technology, Hattiesburg, MS

1984 - 1985 Product Line Engineer, Seismic Engineering Company, Dallas, TX

1981 - 1983 Part-Time Faculty Replacement, Department of Engineering Technology, Hattiesburg, MS

(c) PRODUCTS -(see PAPPG Chapter II.C.2.f.(c))

Products Most Closely Related to the Proposed Project

1. Dumas J, McCullough C. Effects of Gender on Student Performance in an Introduction to Operating Systems Course. Journal of Computing Sciences in Colleges. 2018 December; 34(2).
2. Dumas J. From Introduction to Operating Systems to Computer Architecture: Does an Online Prerequisite Course Prepare Students Better?. Journal of Computing Sciences in Colleges. 2017 December; 33(2).
3. Dumas JD. Computer Architecture: Fundamentals and Principles of Computer Design (Second Edition). 2 ed. Boca Raton, FL: CRC/Taylor & Francis Group; 2017. 440p.

4. Dumas J. Online vs. Face-To-Face Student Performance in an Introduction to Operating Systems Course. Journal of Computing Sciences in Colleges. 2016 December; 32(2).
5. Computing Handbook, Third Edition: Computer Science and Software Engineering. 3 ed. Gonzalez T, Diaz-Herrera J, Tucker A, editors. Boca Raton, FL: Chapman and Hall/CRC; 2014. Chapter 22Chapman and Hall/CRC, Performance Enhancements. 2326p.

Other Significant Products, Whether or Not Related to the Proposed Project

1. Dumas J. Accuracy of Garmin GPS Running Watches over Repetitive Trials on the Same Route. International Journal of Computer Science and Information Technology. 2022 February; 14(1).
2. McPherson C, Dumas J, McCullough C. Mutually Exclusive: A Survey of Ethical Decision Making in Technology. Journal of Computing Sciences in Colleges. 2021 January; 36(5).

(d) SYNERGISTIC ACTIVITIES -(see PAPPG Chapter II.C.2.f.(d))

1. Link Foundation: Served on Selection Committees for Research and Program Development Grants in Simulation and Training, 2001-02; and Fellowships in Modeling, Simulation, and Training, 2001-present (URL: https://linksim.org/)

NSF BIOGRAPHICAL SKETCH

NAME: Guo, Feng

ORCID: 0000-0002-5054-1839

POSITION TITLE & INSTITUTION: Assistant Professor, University of Tennessee at Chattanooga

(a) PROFESSIONAL PREPARATION -(see PAPPG Chapter II.C.2.f.(a))

INSTITUTION	LOCATION	MAJOR / AREA OF STUDY	DEGREE (if applicable)	YEAR YYYY
Beijing Forestry University	Beijing, Beijing	Psychology	BS	2008
Middle Tennessee State University	Murfreesboro, TN	Quantitative Psychology	MA	2012
Bowling Green State University	Bowling Green, OH	Statistics	MS	2022
Bowling Green State University	Bowling Green, OH	Industrial and Organizational Psychology (PhD anticipated 2022)	PHD	2022

(b) APPOINTMENTS -(see PAPPG Chapter II.C.2.f.(b))

2022 - present Assistant Professor, University of Tennessee at Chattanooga

(c) PRODUCTS -(see PAPPG Chapter II.C.2.f.(c))

Products Most Closely Related to the Proposed Project

1. McAbee S, Casillas A, Way J, Guo F. The HEXACO Model in Education and Work. Zeitschrift für Psychologie. 2019 July; 227(3):174-185. Available from: https://econtent.hogrefe.com/doi/10.1027/2151-2604/a000376 DOI: 10.1027/2151-2604/a000376
2. Guo F, Min H, Jex S, Choi Y. Old Enough to Perceive Things Differently? Detecting Measurement Invariance Across Age Groups Using Item-Focused Tree. Work, Aging and Retirement. 2022 July 09; :-. Available from: https://academic.oup.com/workar/advance-article/doi/10.1093/workar/waac004/6634881 DOI: 10.1093/workar/waac004
3. Guo F, Gallagher C, Sun T, Tavoosi S, Min H. Smarter people analytics with organizational text data: Demonstrations using classic and advanced NLP models. Human Resource Management Journal. 2021 December 27; :-. Available from: https://onlinelibrary.wiley.com/doi/10.1111/1748-8583.12426 DOI: 10.1111/1748-8583.12426

Other Significant Products, Whether or Not Related to the Proposed Project

(d) SYNERGISTIC ACTIVITIES -(see PAPPG Chapter II.C.2.f.(d))

1. **Teaching and curriculum development**. I currently work in the Psychology department at University of Tennessee at Chattanooga (UTC), and have worked as the Instructor of Record at Bowling Green State University. The courses I have taught include: Introduction to Basic Statistics, Introduction to Advanced Statistics, and Introduction to Industrial Psychology.
2. **Experiences in big data**. I have years of experiences working as the data analyst and the business consultant role. My past job duties include detecting Medicaid/Medicare frauds using archive data, as well as providing consulting service to various financial institutions.

3. **Contributions to machine learning problem-solving**. I have developed novel machine learning algorithms to solve practical problems. E.g., I have won twice in the machine learning competitions within my field (i.e., The Society for Industrial and Organizational Psychology); and I have provided modern machine learning solutions to companies (e.g., Amazon) for employee selection challenges.

NSF BIOGRAPHICAL SKETCH

NAME: Kong, Lingju

ORCID: 0000-0002-1045-4941

POSITION TITLE & INSTITUTION: Professor, The University of Tennessee at Chattanooga

(a) PROFESSIONAL PREPARATION -(see PAPPG Chapter II.C.2.f.(a))

INSTITUTION	LOCATION	MAJOR / AREA OF STUDY	DEGREE (if applicable)	YEAR YYYY
Shandong Normal University	Jinan, Shandong	Mathematics Education	BS	1996
Ocean University of China	Qingdao, Shandong	Mathematics	MS	1999
Northern Illinois University	DeKalb, IL	Mathematics	PHD	2005

(b) APPOINTMENTS -(see PAPPG Chapter II.C.2.f.(b))

2014 - present Professor, The University of Tennessee at Chattanooga, Chattanooga, TN
2010 - 2014 Associate Professor, The University of Tennessee at Chattanooga, Chattanooga, TN
2005 - 2010 Assistant Professor, The University of Tennessee at Chattanooga,, Chattanooga, TN
2001 - 2005 Graduate Teaching Assistant, Northern Illinois University, DeKalb, IL
1999 - 2000 Instructor, Ocean University of China, Qingdao,

(c) PRODUCTS -(see PAPPG Chapter II.C.2.f.(c))

Products Most Closely Related to the Proposed Project

1. Kong L, Wang M. Deterministic and stochastic online social network models with varying population size. Differ. Equ. Appl.. 2022 May; 14(2):205--214. Available from: http://files.ele-math.com/articles/dea-14-13.pdf
2. Belinskiy BP., Graef JR., Kong L. Stefan-Boltzmann problem for heat transfer in a fin. Math. Methods Appl. Sci.. 2021; 44(6):4745--4755. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/mma.7066
3. Graef JR., Ledoan A, Kong L, Wang M. Stability analysis of a fractional online social network model. Math. Comput. Simulat.. 2020; 178:625--645. Available from: https://www.sciencedirect.com/science/article/pii/S0378475420302408?via%3Dihub
4. Graef JR., Kong L, Wang M. Stationary solution of a stochastic nosocomial epidemic model in hospital intensive care units. Stoch. Anal. Appl.. 2014; 32(5):840--850. Available from: https://www.tandfonline.com/doi/full/10.1080/07362994.2014.938861
5. Kong L, Wang M. Existence of positive solutions for a fractional compartment system. Electronic Journal of Qualitative Theory of Differential Equations. 2021; (60):1-9. Available from: http://www.math.u-szeged.hu/ejqtde/periodica.html?periodica=1&paramtipus_ertek=publication&param_ertek=9257 DOI: 10.14232/ejqtde.2021.1.60

Other Significant Products, Whether or Not Related to the Proposed Project

1. Kong L, Nichols R. On principal eigenvalues of biharmonic systems. Commun. Pure Appl. Anal.. 2021; 20(1):1--15. Available from:

https://www.aimsciences.org/article/doi/10.3934/cpaa.2020254

2. Kong L. A degenerate elliptic system with variable exponents. Sci. China Math.. 2019; 62(7):1373--1390. Available from: https://link.springer.com/article/10.1007/s11425-018-9409-5
3. Kong L. Homoclinic solutions for a higher order difference equation. Appl. Math. Lett.. 2018; 86:186--193. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0893965918302167?via%3Dihub
4. Kong L. Positive radial solutions for quasilinear biharmonic equations. Comput. Math. Appl.. 2016; 72(12):2878--2886. Available from: https://www.sciencedirect.com/science/article/pii/S0898122116305697?via%3Dihub
5. Kong L. Eigenvalues for a fourth order elliptic problem. Proc. Amer. Math. Soc.. 2015; 143(1):249--258. Available from: https://www.ams.org/journals/proc/2015-143-01/S0002-9939-2014-12213-1/home.html

(d) SYNERGISTIC ACTIVITIES -(see PAPPG Chapter II.C.2.f.(d))

1. Serving in the Editorial Board of Differential Equations & Applications.
2. Authored/co-authored more than 65 presentations at regional, national, and international conferences.
3. Have more than 30 co-authors on publications of which 9 were undergraduate students.
4. Hosted a number of mathematicians at UTC from China and the US who visited for the purpose of collaborating on joint research.
5. Co-designed the graduate courses Calculus of Variations, Real Analysis, Partial Differential Equations and Sobolev Spaces, and the Special Topics in Computational and Applied Mathematics offered in the Department of Mathematics at UTC.

Tian Li

Current Appointments

Assistant Professor of Physics (Aug 2022 – Present)
Chief Technology Officer of the UTC Quantum Center (Jan 2024 – Present)
Institution: University of Tennessee at Chattanooga
Email: tian-li@utc.edu

Education

Ph.D. in Physics, Aug 2012 – Dec 2017
Joint Quantum Institute, National Institute of Standards and Technology (NIST) and the University of Maryland, College Park, MD

M.S. in Physics, Aug 2009 – Jul 2012
University of Nevada, Reno, NV

B.S. in Physics, Sep 2005 – Jun 2009
Beijing Normal University, Beijing, China

Research Appointments

Associate Research Scientist — **Inst. for Quantum Science and Engineering**
Texas A&M University — **Jun 2021 – Aug 2022**

Postdoc Research Associate — **Inst. for Quantum Science and Engineering**
Texas A&M University — **Jun 2018 – Jun 2021**

Awarded Grants

NSF – Expanding Capacity in Quantum Information Science and Engineering (ExpandQISE)
"Demonstration of distributed quantum sensing with Heisenberg scaling by creating multipartite entanglement among eight nodes on a commercial quantum network"
PI, $792,705, 10/01/2024 - 09/30/2027

NIST – Congressionally Identified Scientific and Technical Research Services (STRS)
"UTC Quantum Center"
PI, $3.5M, 07/01/2024 - 06/30/2028

NSF – Experiential Learning for Emerging and Novel Technologies (NSF ExLENT)
"Beginnings: Creating and Sustaining a Diverse Community of Expertise in Quantum Information Science (EQUIS) Across the Southeastern United States"
Co-PI, $258,486, 10/01/2023 - 09/30/2026

UTC – Planning & Capacity Building for Collaborative Teams (PACCT)
"Enhancing the Capacity of Quantum Key Distribution Research and Education through an Integrated Approach"
Co-PI, $124,867, 01/01/2024 - 12/31/2025

UTC – Center of Excellence in Applied Computational Science & Engineering (CEACSE)
"Heisenberg-Limited Quantum Sensing Across Entanglement Distributed Quantum Networks"
PI, $100,000, 07/01/2023 - 06/30/2024

Awards and Honors

The Dean's List for UTC Quantum Initiative, 2024

UTAA Outstanding Teacher Award Nomination, 2024

Publications

Journal Articles

Harnessing quantum light for enhanced sensing of biokinetic processes
M. Kamble, J. E. Humberd, Tian Li*, G. S. Agarwal (*Corresponding author)
In submission, 2024

Continuous Automatic Polarization Channel Stabilization from Heterodyne Detection of Coexisting Dim Reference Signals
J. Chapman, M. Alshowkan, K. Reaz, Tian Li, M. Kiran
In review, 2024

Recovery of quantum correlations using machine learning
E. W. Steele, D. R. Reising, Tian Li* (*Corresponding author)
In review, available now on arXiv:2410.02818 (2024)

Harnessing quantum light for microscopic biomechanical imaging of cells and tissues
Tian Li, V. Cheburkanov, V. V. Yakovlev, G. S. Agarwal, M. O. Scully
In press in *PNAS*, available now on arXiv:2407.08160 (2024)

Mitigating scattering in a quantum system using only an integrating sphere
Z. Jiang, Tian Li*, M. L. Boone, A. V. Sokolov, G. S. Agarwal, M. O. Scully (*Corresponding author)
PRX Quantum, 5, 030351 (2024)

Probing ultra-fast dephasing via entangled photon pairs
X. Liu, Tian Li, J. Wang, M. R. Kamble, A. M. Zheltikov, G. S. Agarwal
Optics Express 30, 47463 (2022)

Quantum-enhanced stimulated Brillouin scattering spectroscopy and imaging
Tian Li*, F. Li, X. Liu, V. V. Yakovlev, G. S. Agarwal (*Corresponding author)
Optica 9, 959 (2022)

Experimental study of decoherence of the two-mode squeezed vacuum state via second harmonic generation
F. Li, Tian Li*, G. S. Agarwal (*Corresponding author and contributed equally with F.L.)
Physical Review Research 3, 033095 (2021)

Quantum advantage with squeezed light for absorption measurement
F. Li, Tian Li*, G. S. Agarwal (*Corresponding author and contributed equally with F.L.)
Physical Review Applied 15, 044030 (2021)

Temporal quantum noise reduction acquired by an electron-multiplying charge-coupled-device camera
F. Li, Tian Li*, G. S. Agarwal (*Corresponding author and contributed equally with F.L.)
Optics Express 28, 37538 (2020)

Squeezed light induced two-photon absorption fluorescence of fluorescein biomarkers
Tian Li*, F. Li, C. Altuzarra, A. Classen, G. S. Agarwal (*Corresponding author)
Applied Physics Letters 116, 254001 (2020)
Selected by AIP as a resource for the 2022 Nobel Prize in Physics

Signal advance and delay due to an optical phase-sensitive amplifier
N. R. Brewer, Tian Li, K. M. Jones, P. D. Lett
Optics Express 28, 14573 (2020)

Beyond sub-Rayleigh imaging via high order correlation of speckle illumination
F. Li, C. Altuzarra, Tian Li, M. O. Scully, G. S. Agarwal
Journal of Optics 21, 115604 (2019)

Improved measurement of two-mode quantum correlations using a phase-sensitive amplifier
Tian Li*, B. E. Anderson, T. Horrom, B. L. Schmittberger, K. M. Jones, P. D. Lett (*Corresponding author)
Optics Express 25, 21301 (2017)

Effect of input phase modulation to a phase-sensitive optical amplifier
Tian Li*, B. E. Anderson, T. Horrom, K. M. Jones, P. D. Lett (*Corresponding author)
Optics Express 24, 19871 (2016)

56

Quantum mutual information of an entangled state propagating through a fast-light medium
J. B. Clark, R. T. Glasser, U. Vogl, Q. Glorieux, Tian Li, K. M. Jones, P. D. Lett
Nature Photonics 8, 515 (2014)

Advanced quantum noise correlations
U. Vogl, R. T. Glasser, J. B. Clark, Q. Glorieux, Tian Li, N. V. Corzo, P. D. Lett
New Journal of Physics 16, 013011 (2014)

Method for traveling-wave deceleration of buffer-gas beams of CH
M. I. Fabrikant, Tian Li, N. J. Fitch, N. Farrow, J. D. Weinstein, H. J. Lewandoski
Physical Review A 90, 033418 (2014)

Degenerate four-wave mixing in atomic ytterbium
Tian Li, R. P. Baker, J. D. Weinstein
Journal of the Optical Society of America B 29, 2848 (2012)

Electromagnetically induced transparency in an open multilevel system
Tian Li, M.-J. Lu, J. D. Weinstein
Physical Review A 84, 023801 (2011)

Conference Articles

Mutual Information Propagation through an Optical Phase Sensitive Amplifier
N. R. Brewer, Tian Li, K. M. Jones, P. D. Lett
Rochester Conference on Coherence and Quantum Optics (CQO-11), OSA Technical Digest (Optical Society of America, 2019), paper W6A.12

Improving the Detection of Squeezed Light in the Presence of Loss
Tian Li, B. E. Anderson, T. Horrom, B. L. Schmittberger, K. M. Jones, P. D. Lett
Frontiers in Optics 2017, OSA Technical Digest (online) (Optical Society of America, 2017), paper JW3A.36

Measuring the propagation of entanglement and information in dispersive media
J. B. Clark, R. T. Glasser, Q. Glorieux, U. Vogl, Tian Li, K. M. Jones, P. D. Lett
Proceedings Volume 9378, Slow Light, Fast Light, and Opto-Atomic Precision Metrology VIII, 93780T (2015)

Sending Quantum Correlations through Dispersive Media
P. D. Lett, J. B. Clark, R. T. Glasser, Tian Li, Q. Glorieux, U. Vogl, K. M. Jones
Research In Optical Sciences, OSA Technical Digest (online) (Optical Society of America, 2014), paper QTu3A.1

Invited Talks

Quantum Sensing of Local & Nonlocal Quantities: from image contrast to global phase
Neuromorphic Computing Meets Quantum Mechanics (NCMQM) 2024, May 15-17, 2024, University of Georgia, Athens, Georgia

Quantum Bio-Sensing & Networked Sensing
Department of Physics & Astronomy Colloquium, February 15, 2024, University of Georgia, Athens, Georgia

Quantum Optical Bio-Sensing
4th International Conference on Optics, Photonics, and Lasers (OPL-2023), December 4-6, 2023, Hiroshima, Japan

Quantum Optical Sensing
Gig City Goes Quantum, April 19-21, 2023, Chattanooga, Tennessee

Mohammad J. Mahtabi

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615 McCallie Ave, Chattanooga, TN
37403

Education

Ph.D. in Mechanical Engineering 2017
Mississippi State University, MS, USA

M.Sc. in Structural Engineering 2008
Iran University of Science and Technology, Tehran, Iran

B.Sc. in Civil Engineering 2005
University of Tehran, Tehran, Iran

Professional Experience

Associate Professor of Mechanical Engineering: University of Tennessee at Chattanooga since Aug. 2024
Assistant Professor of Mechanical Engineering: University of Tennessee at Chattanooga Aug. 2018-Jul. 2024
Postdoctoral Research Associate: Dynamic and Smart Systems Lab, The University of Toledo, OH, PI: Dr. Mohammad Elahinia Sep. 2017-Aug. 2018
Graduate Research Assistant: The Center for Advanced Vehicular Systems (CAVS), Mississippi State University, MS Jan. 2014-Aug. 2017
Graduate Research Assistant: University of Toledo, OH, Jan. 2013-Dec. 2013
Structural Engineer: A & A Engineering Co., Toledo, Ohio, Jun. 2013-Sep. 2013
Structural Engineer: Aria Hangard Eng. Co., Tehran, Iran, Nov. 2010-Jan. 2013
Lecturer: Islamic Azad University, Eslamshahr branch, Tehran, Iran, Dec. 2009-Jun. 2010
Structural Engineer: Imen Sazeh Fadak Const. Eng. Tehran, Iran, Mar. 2007-Jun. 2009
Structural Engineer: MATN Const. Eng. Tehran, Iran, Apr. 2006-Feb. 2007
Civil Engineer: Omran-e Asr-e Sepid Const. Eng. Tehran, Iran, Apr. 2004-Apr. 2006

Publications

Italic: *Undergraduate* students co-authors; Underline: graduate students and postdoc co-authors.

Book Chapter

1. Nematollahi, M., Jahadakbar, A., **Mahtabi, M.J.**, Elahinia, M., 2019. "12 - Additive manufacturing (AM)", in: Niinomi, M. (Ed.), Metals for Biomedical Devices (Second Edition). Woodhead Publishing, pp. 331-353.
2. **Mahtabi, M.J.**, Shamsaei, N., Elahinia, M.H., 2015. "Fatigue of Shape Memory Alloys", Shape Memory Alloy Actuators. John Wiley & Sons, Ltd, pp. 155-190.

Journal Articles

1. **Mahtabi, M.J.**, Ghasemi, A., Ghasemi A., Newman III, J.C., 2023. "Polynomial Approximation over Arbitrary Shape Domains" Submitted to Mathematical and Computational Approaches in Applied Mechanics: A Themed Issue Dedicated to Professor J.N. Reddy.
2. Yadollahi, A. **Mahtabi, M.J.,** Doude, H., Rhee, H. and Newman, J.C., 2023. "Fatigue Life and Crack Growth Behavior of Ti-6Al-4V Fabricated via Laser Directed Energy Deposition", Materials Performance and Characterization, 13(2), https://doi.org/10.1520/MPC20230108.

3. Ataollahi, S. and **Mahtabi, M.J.**, 2023. "An investigation of the growth of fatigue cracks in single-crystal superelastic NiTi under high strain level using molecular dynamics simulations", Arabian Journal for Science and Engineering, https://doi.org/10.1007/s13369-023-08460-x.
4. Ataollahi, S. and **Mahtabi, M.J.**, 2023. "Atomistic simulation of the effect of H-phase precipitate on the transformation temperatures and the stress-induced phase transformation of Ni-rich NiTiHf" Shap. Mem. Superelasticity 10, 189–197 (2024). https://doi.org/10.1007/s40830-024-00478-w
5. Mahtabi, MB., Yadollahi, A., Ataollahi, S. and **Mahtabi, M.J.,** 2023. "Effect of build height on structural integrity of Ti-6Al-4V fabricated via laser powder bed fusion" Engineering Failure Analysis, 154, 107691. https://doi.org/10.1016/j.engfailanal.2023.107691
6. Ataollahi, S. and **Mahtabi, M.J.,** 2023. "An interatomic potential for ternary NiTiHf shape memory alloys based on modified embedded atom method." Computational Materials Science, 227, p.112278. https://doi.org/10.1016/j.commatsci.2023.112278
7. Ataollahi, S., Mahtabi, MB., Yadollahi, A., and **Mahtabi, M.J.**, 2023. "Computational modeling of the effects of process parameters on the grain morphology of additively manufactured stainless steel." The International Journal of Advanced Manufacturing Technology, 125, 3513–3526. https://doi.org/10.1007/s00170-023-10975-4
8. Bagheri, A., Yadollahi, A., **Mahtabi, M.J.**, Paudel, Y., Vance, E., Shamsaei, N. and Horstemeyer, M.F., 2022. "Microstructure-Based MultiStage Fatigue Modeling of NiTi Alloy Fabricated via Direct Energy Deposition (DED)." Journal of Materials Engineering and Performance, pp.1-15. https://doi.org/10.1007/s11665-022-06603-z
9. Saghaian, S.E., Nematollahi, M., Toker, G., Hinojos, A., Moghaddam, N.S., Saedi, S., Lu, C.Y., **Mahtabi, M.J.**, Mills, M.J., Elahinia, M. and Karaca, H.E., 2021. "Effect of hatch spacing and laser power on microstructure, texture, and thermomechanical properties of laser powder bed fusion (L-PBF) additively manufactured NiTi." Optics & Laser Technology, p.107680. DOI: 10.1016/j.optlastec.2021.107680.
10. Ataollahi, S. and **Mahtabi, M.J.**, 2021. "Effects of Precipitate on the Phase Transformation of Single-Crystal NiTi Alloy under Thermal and Mechanical Loads: A Molecular Dynamics Study." Materials Today Communications, p.102859. DOI: 10.1016/j.mtcomm.2021.102859.
11. Shayanfard, P., Alarcon, E., Barati, M., **Mahtabi, M.J.**, Kadkhodaei, M., Arbab Chirani, S. and Šandera, P., 2021. "Stress raisers and fracture in shape memory alloys: review and ongoing challenges." Critical Reviews in Solid State and Materials Sciences, pp.1-59. DOI: 10.1080/10408436.2021.1896475.
12. Jahadakbar, A., Bayati, P., Nematollahi, M., Safaei, K., Yadollahi, A., **Mahtabi, M.J.** and Elahinia, M., 2020. "Toward understanding the effect of remelting on the additively manufactured NiTi". The International Journal of Advanced Manufacturing Technology, 112(1), pp.347-360. DOI: 10.1007/s00170-020-06378-4.
13. Bayati, P., Jahadakbar, A., Barati, M., Nematollahi, M., Saint-Sulpice, L., Haghshenas, M., Chirani, S.A., **Mahtabi, M.J.** and Elahinia, M., 2020. "Toward low and high cycle fatigue behavior of SLM-fabricated NiTi: considering the effect of build orientation and employing a self-heating approach." International Journal of Mechanical Sciences, p.105878. DOI: 10.1016/j.ijmecsci.2020.105878.
14. Farjam, N., Nematollahi, M., Andani, M.T., **Mahtabi, M.J.**, Elahinia, M., 2020. "Effects of size and geometry on the thermomechanical properties of additively manufactured NiTi shape memory alloy". he International Journal of Advanced Manufacturing Technology, 107(7), pp.3145-3154. DOI: 10.1007/s00170-020-05071-w.
15. Nematollahi, M., Toker, G., Saghaian, S.E., Salazar, J., **Mahtabi, M.**, Benafan, O., Karaca, H., Elahinia, M., 2019. "Additive Manufacturing of Ni-Rich NiTiHf20: Manufacturability, Composition, Density, and Transformation Behavior". Shape Memory and Superelasticity 5, 113-124. DOI: 10.1007/s40830-019-00214-9.
16. Elahinia, M., Ibrahim, H., **Mahtabi, M.J.**, Mehrabi, R., 2019. "Engineering Bone-Implant Materials". Bioengineering 6 (2):5. DOI: 10.3390/bioengineering6020051.

17. Biffi, C.A., Bassani, P., Nematollahi, M., Shayesteh Moghaddam, N., Amerinatanzi, A., **Mahtabi, M.J.**, Elahinia, M., Tuissi, A., 2019. "Effect of Ultrasonic Nanocrystal Surface Modification on the Microstructure and Martensitic Transformation of Selective Laser Melted Nitinol". Materials 12.
18. Aboutaleb, A.M., **Mahtabi, M.J.**, Tschopp, M.A., Bian, L., 2019. "Multi-objective accelerated process optimization of mechanical properties in laser-based additive manufacturing: Case study on Selective Laser Melting (SLM) Ti-6Al-4V". Journal of Manufacturing Processes 38, 432-444.
19. Yadollahi, A., **Mahtabi, M.J.**, Khalili, A., Doude, H.R., Newman, J.C., 2018. "Fatigue life prediction of additively manufactured material: Effects of surface roughness, defect size, and shape". Fatigue & Fracture of Engineering Materials & Structures 41, 1602-1614.
20. **Mahtabi, M.J.**, Yadollahi, A., Rahmati, M., Stone, T.W., 2018. "Correlation Between Hardness and Loading Transformation Stress of Superelastic NiTi". Arabian Journal for Science and Engineering 43, 5029-5033.
21. **Mahtabi, M.J.**, Stone, T.W., Shamsaei, N., 2018. "Load sequence effects and variable amplitude fatigue of superelastic NiTi". International Journal of Mechanical Sciences 148, 307-315.
22. Bagheri, A., **Mahtabi, M.J.**, Shamsaei, N., 2018. "Fatigue behavior and cyclic deformation of additive manufactured NiTi". Journal of Materials Processing Technology 252, 440-453.
23. Shao, S., **Mahtabi, M.J.**, Shamsaei, N., Thompson, S.M., 2017. "Solubility of argon in laser additive manufactured α-titanium under hot isostatic pressing condition". Computational Materials Science 131, 209-219.
24. **Mahtabi, M.J.**, Shamsaei, N., 2017. "Fatigue modeling for superelastic NiTi considering cyclic deformation and load ratio effects". Shape Memory and Superelasticity 3, 250-263.
25. **Mahtabi, M.J.**, Shamsaei, N., 2016. "Multiaxial fatigue modeling for Nitinol shape memory alloys under in-phase loading". Journal of the Mechanical Behavior of Biomedical Materials 55, 236-249.
26. **Mahtabi, M.J.**, Shamsaei, N., 2016. "A modified energy-based approach for fatigue life prediction of superelastic NiTi in presence of tensile mean strain and stress". International Journal of Mechanical Sciences 117, 321-333.
27. **Mahtabi, M.J.**, Sanford, A., Shamsaei, N., Newman, J.C., 2016. "Transferability of the two-parameter fracture criterion for 2219 aluminium alloy cracked configurations". Fatigue & Fracture of Engineering Materials & Structures 39, 335-345.
28. **Mahtabi, M.J.**, Shamsaei, N., Rutherford, B., 2015. "Mean strain effects on the fatigue behavior of superelastic Nitinol alloys: an experimental investigation". Procedia Engineering 133, 646-654.
29. **Mahtabi, M.J.**, Shamsaei, N., Mitchell, M.R., 2015. "Fatigue of Nitinol: The state-of-the-art and ongoing challenges". Journal of the Mechanical Behavior of Biomedical Materials 50, 228-254.
30. Ghodrati Amiri, G., **Mahtabi, M.J.**, Razavian Amrei, S.A., 2012. "Seismic velocity and displacement hazard assessment for Tehran, including site effects". Asian Journal of Civil Engineering (Building and Housing) 13, 331-351.

Conference Papers and Presentations

1. Thompson, G. and **Mahtabi, M.J.**, 2021. "Advancing Manufacturing Efficiency: Electroplating Nickel onto 3D-Printed Polymer", Annual International Solid Freeform Fabrication Symposium (SFF Symp. 2024), Austin, TX, USA.
2. Ataollahi, S. and **Mahtabi, M.J.**, 2023. "Fatigue life prediction of critical metallic components based on strain energy density", UTC SPRING RESEARCH AND ARTS CONFERENCE PROCEEDINGS 2023, April 2023, University of Tennessee at Chattanooga, https://scholar.utc.edu/research-dialogues/2023/proceedings/9/
3. Ataollahi, S. and **Mahtabi, M.J.**, 2022. "A Study on Fatigue Crack Growth in Single-Crystal NiTi Using Molecular Dynamics" IMECE22- International Mechanical Engineering Congress & Exposition- Virtual Conference: October 30 – November 3, 2022.

4. Lado, L. and **Mahtabi, M.J.**, 2022. "Fatigue behavior of Ti-6Al-4V in the Multi-stage fatigue model fabricated by additive manufacturing: LENS, EBM, and SLM" ReSEARCH Dialogues Conference proceedings, April 2022, University of Tennessee at Chattanooga
5. Lado, L., Ataollahi, S., Yadollahi, A., and **Mahtabi, M.J.**, 2021. "Process-specific Microstructure-sensitive Modeling of Fatigue in Additively Manufactured Ti-6Al-4V Alloys", Annual International Solid Freeform Fabrication Symposium (SFF Symp. 2022), Austin, TX, USA.
6. Ataollahi, S. and **Mahtabi, M.J.**, 2021. "Effect of Different Process Parameters on the Grain Morphology of Additively Manufactured Materials Using Kinetic Monte Carlo Simulations", IMECE21- International Mechanical Engineering Congress & Exposition- Virtual Conference: November 1 – 5, 2021.
7. Ataollahi, S. and **Mahtabi, M.J.**, 2021. "A molecular dynamics study on the effect of precipitate on the phase transformation in NiTi." ReSEARCH Dialogues Conference proceedings, April 2021, University of Tennessee at Chattanooga, https://scholar.utc.edu/research-dialogues/2021/posters/2.
8. Bayati, P., Jahadakbar, A., Safaie, K., Nematollahi, M., Dabbaghi, H., Haghshenas, M., **Mahtabi, M.** and Elahinia, M., 2020, September. "Toward Structural Fatigue Analysis of Horizontally-Fabricated NiTi via Selective Laser Melting." In International Manufacturing Science and Engineering Conference (Vol. 84256, p. V001T01A044). American Society of Mechanical Engineers. DOI: 10.1115/MSEC2020-8473.
9. Bayati, P., Safaie Baghbadorani, K., Nematollahi, M., Jahadakbar, A., **Mahtabi, M.J.**, Elahinia, M., 2020. "Toward understanding the effect of selective laser re-melting on the mechanical properties of the SLM fabricated Nitinol", TMS2021, Virtual, March 15-18, 2021.
10. Bayati, P., Jahadakbar, A., Safaie Baghbadorani, K., Nematollahi, M., Dabbaghi, H., Haghshenas, M., **Mahtabi, M.J.**, Elahinia, M., 2020. "Toward Structural Fatigue Analysis of Horizontally-Fabricated Niti via Selected Laser Melting", MSEC 2020, University of Cincinati, Cincinati, OH, USA.
11. Chirani, S.A., Barati, M., Saint-Sulpice, L., Bayati, P., Nematollahi, M., **Mahtabi, M.**, Jahadakbar, A., Elahinia, M., 2019. "Self-heating and fatigue of additively manufactured NiTi", Congrès Français de Mécanique, Université de Bretagne Occidentale, Bretagne, France, pp. 11-13.
12. Bayati, P., Jahadakbar, A., Nematollahi, M., **Mahtabi, M.**, Elahinia, M., 2019. "Fatigue Life Analysis of the SLM Fabricated NiTi Samples With Different Build Directions", SMASIS 2019, Louisville, Louisville, KY.
13. Bayati, P., Jahadakbar, A., Nematollahi, M., **Mahtabi, M.**, Elahinia, M., 2019. "On the Effect of the Build Direction in Mechanical Fatigue Life of the SLM-Fabricated NiTi", MS&T19, Portland, Oregon, USA.
14. Jahadakbar, A., Dehghan, A., Nematollahi, M., Bayatimalayeri, P., **Mahtabi, M.**, Ibrahim, H., Elahinia, M., 2018. "The Effect of Re-melting on the Surface Condition of the Additively Manufactured NiTi Parts", MS&T18, Columbus, Ohio, USA.
15. Farjam, N., Nematollahi, M., **Mahtabi, M.**, Elahinia, M., 2018. "The Effects of Size and Geometry on the Microstructure and Transformation Temperatures of Additively Manufactured NiTi", MS&T18, Columbus, Ohio, USA.
16. Bayatimalayeri, P., Jahadakbar, A., **Mahtabi, M.**, Elahinia, M., 2018. "Effects of strained heat treatment on the transformation temperature of NiTi shape memory alloy wires", 18th International Conference on the Strength of Materials (ICSMA 18), The Ohio State University, Columbus, Ohio, USA.
17. Yadollahi, A., **Mahtabi, M.J.**, Doude, H., Newman, J.C., 2017. "Prediction of Fatigue Lives in Additively Manufactured Alloys based on the Crack-growth Concept", Annual International Solid Freeform Fabrication Symposium (SFF Symp. 2017), Austin, TX, USA.
18. Newman, J.C., **Mahtabi, M.J.**, 2017. "Improved Two-Parameter Fracture Criterion for various crack configurations under tension and bending loads", 17th International ASTM/ESIS Symposium on Fatigue and Fracture Mechanics (41st National Symposium on Fatigue and Fracture Mechanics). ASTM International.
19. Rutherford, B., **Mahtabi, M.J.**, Shamsaei, N., 2016. "Beneficial effects of tensile mean strain on the fatigue behavior of superelastic Nitinol", TMS 2016 145th Annual Meeting & Exhibition, Nashville, TN, USA.

20. **Mahtabi, M.J.**, 2016. "Fatigue modeling of superelastic NiTi alloys with various cyclic deformation responses and mean strain/stress effects", ASTM Committee E08 on Fatigue and Fracture Annual Meeting, Orlando, FL, USA.
21. Newman Jr., J.C., Warren, J.M., **Mahtabi, M.J.**, 2015. "Two-and Three-Dimensional Finite-Element Fracture Simulations on Metallic Materials Using the Critical CTOA Fracture Criterion", ASTM E08.07.07 CTOA and δ5 Task Group. ASTM International.
22. **Mahtabi, M.J.**, 2015. "Mean strain and stress effects on fatigue behavior of superelastic Nitinol alloys: analysis and modelling", ASTM Committee E08 on Fatigue and Fracture Annual Meeting, Tampa, FL, USA.
23. Parvin, A., Shrestha, U.S., **Mahtabi, M.J.**, 2014. "Evaluation of FRP-concrete bond interface", 2014, 7th International Conference on Fiber Reinforced Polymer (FRP) Composites in Civil Engineering", CICE 2014, University of British Columbia, Canada.
24. **Mahtabi, M.J.**, 2014. "Fatigue of Nitinol (NiTi) alloys under multiaxial loading", ASTM Workshop on Multiaxial Fatigue & Mixed Mode Fatigue Crack Growth, New Orleans, LA, USA.
25. **Mahtabi, M.J.**, 2014. "Fatigue of Nitinol (NiTi) alloys: current state and roadmap to multiaxial analysis", ASTM Committee E08 on Fatigue and Fracture Annual Meeting, New Orleans, LA, USA.
26. Ghodrati Amiri, G., **Mahtabi, M.J.**, Razavian Amrei, S.A., 2008. "Seismic displacement hazard assessment in Tehran", Asian Pacific Symposium on Structural Reliability and Its Applications (APSSRA'08), Hong Kong.

Invited Papers and Talks

1. **Mahtabi, M.J.,** May 19, 2022, "Experimental and Computational Modeling of Fatigue in Shape Memory Alloys", ONLINE Kolloquium über Werkstoffmodellierung (ONLINE Colloquium Materials Modelling), Institute for Materials Testing, Materials Science and Strength of Materials (IMWF), University of Stuttgart
2. Jahadakbar, A., Dehghan, A., Nematollahi, M., Bayatimalayeri, P., **Mahtabi, M.,** Ibrahim, H., Elahinia, M., 2018. "The Effect of Re-melting on the Surface Condition of the Additively Manufactured NiTi Parts", MS&T18, Columbus, Ohio, USA.
3. **Mahtabi, M.J.,** 2018. "Fatigue of Shape Memory Alloys under Variable Amplitude Loading", The University of Toledo, Toledo, OH, USA.
4. **Mahtabi, M.J.**, 2016. "Fatigue of NiTi Alloys: Current State of Research and Future Challenges", SAE International Fatigue Design & Evaluation Committee Meeting, Kansas State University, Manhattan, KS, USA.

Proposals and Funded Projects

1. Mahtabi, M.J. (PI), 2023, "CONTRACT: Commercializing Nickel Electroplated SLA Printed Die Plates for Injection Molding", State of Tennessee Appropriations, $105,000 – **Funded**.
2. Mahtabi, M.J. (PI), 2023, "ERI: Accelerated Fatigue-Life Prediction of Metallic Materials based on Strain-Energy Density", NSF-ERI program, $199,985.
3. Mahtabi, M.J. (PI), 2023, "Structural Integrity Assessment of Next-Generation Additively Manufactured Parts Using Seeded Defects", NSF MoMS, $192,150.
4. Mahtabi, M.J. (PI), "Toward High-Quality, Defect-Free 3D Printed Parts", Ruth S. Holmberg Grant for Faculty Excellence – $4,950-**Funded.**
5. Mahtabi, M.J. (PI, student: Ward Metcalfe), 2023, "Determination of the Representative Gage-Section Volume for Reliable Fatigue Testing of 3D-Printed Metallic Parts", UTC Office for Undergraduate Research and Creative Endeavor (URaCE), $1,000-**Funded**.
6. Mahtabi, M.J. (PI, student: Nate Moore), 2023, "Enhancing the Fatigue Life of Metallic Materials by Manipulating the Grain Structures", UTC Office for Undergraduate Research and Creative Endeavor (URaCE), $1,000-**Funded**.

7. Mahtabi, M.J., "Summer Research Collaboration with the University of Cadiz", UTC-Office of VCR-$11,120-Funded.
8. Mahtabi, M.J. (co-PI), Yang, S. (PI), 2023, "MRI: Acquisition of an Advanced Scanning Transmission Electron Microscopy for Multidisciplinary Research Activities", NSF - National Science Foundation, $999,908.
9. Mahtabi, M.J. (PI), 2022, "ERI: Rapid Fatigue-Life Prediction based on a New Strain-Energy Density Damage Parameter", NSF-ERI program, $197,646.
10. Mahtabi, M.J. (PI), 2022, "Actuation Fatigue and Crack Growth Behavior of Shape Memory Alloys", NSF TMR-MMN, $321,785.
11. Mahtabi, M.J. (PI), Ghasemi, A., 2022, "Design of new shape memory alloys using computational materials science and machine learning", Center of Excellence in Applied Computational Science and Engineering (CEACSE), $98,865.
12. Mahtabi, M.J. (co-PI), Ghasemi, A. (PI), 2022, "A Data-Driven Physic-Informed Shock Absorbing Device: Analysis and Design", Center of Excellence in Applied Computational Science and Engineering (CEACSE), $99,926.
13. Mahtabi, M.J. (PI, student: Ward Metcalfe), 2022, "A New Approach for High Throughput Fatigue Life Prediction of Critical Metallic Components Based on Strain Energy Density", UTC Office for Undergraduate Research and Creative Endeavor (URaCE), $1,000-**Funded**.
14. Mahtabi, M.J. (PI), 2022, "Materials Research for UTC Undergraduate Students", UT Alliance of Women Philanthropists, $9,360.
15. Mahtabi, M.J. (co-PI), Yang, S. (PI), 2022, "MRI: Acquisition of an Advanced Scanning Transmission Electron Microscopy for Multidisciplinary Research Activities", NSF - National Science Foundation, $999,908.
16. Mahtabi, M.J. (PI), Ibrahim, H., 2022, "Tailoring Location-Specific Mechanical Properties in Metal Additive Manufacturing via Simulations", Center of Excellence in Applied Computational Science and Engineering (CEACSE), $93,803.
17. Mahtabi, M.J. (co-PI), Ibrahim, H., 2022, "A physical approach to simulate the corrosion of biodegradable synthetic metallic heart valves", Center of Excellence in Applied Computational Science and Engineering (CEACSE), $96,842.
18. Mahtabi, M.J. (co-PI), Danquah, M., 2021- "Environmental Sustainability in industrial Manufacturing Practices (ENV-SMART)," National Science Foundation, $443,405.
19. Mahtabi, M.J. (PI), "Actuation Fatigue and Crack Growth Behavior of Shape Memory Alloys", White Paper - Office of Naval Research (ONR), $532,268.
20. Mahtabi, M.J. (PI), Ibrahim, H., 2021. "Development of Multi-Objectively Optimized Interatomic Potentials for Computational Design of High Temperature Actuator Materials", Center of Excellence in Applied Computational Science and Engineering (CEACSE), $90,000-**Funded**.
21. Mahtabi, M.J. (co-PI), Ibrahim, H., 2021. "Degradation modeling of coated magnesium towards patient-specific biomedical implants", Center of Excellence in Applied Computational Science and Engineering (CEACSE), $94,902-**Funded**.
22. Mahtabi, M.J. (PI), Ibrahim, H., 2020. "Computational Modeling of Thermal Residual Stress in Additive Manufactured Metallic Parts", Center of Excellence in Applied Computational Science and Engineering (CEACSE), $84,857.
23. Mahtabi, M.J. (co-PI), Ibrahim, H., 2021. "MRI: Acquisition of a Customized Metal Additive Manufacturing System for Multidisciplinary Research Activities", National Science Foundation (NSF), $261,500.
24. Mahtabi, M.J. (co-PI), Danquah, M., Onyango, N., Palchoudhury, S., Wu, D., 2020. "Experimental and computational characterization of nanoplastic-modified asphalt composites with self-repairing properties", DOT- FHWA - Federal Highway Administration, $569,094.
25. Mahtabi, M.J. (co-PI), Ibrahim, H., 2020. "MRI: Acquisition of a Customized Metal Additive Manufacturing System for Multidisciplinary Research Activities", National Science Foundation (NSF), $261,500.
26. Mahtabi, M.J. (PI), 2020. "Materials Characterization and Metallography Lab for Engineering Students and Researchers", UC Foundation, $145,000.

27. Mahtabi, M.J. (PI), 2020. "Effect of crack distribution on fatigue life of additively manufactured metallic parts", University of Tennessee Chattanooga, $2,453, **Funded**.
28. Mahtabi, M.J. (co-PI), Danquah, M., 2019. "REU Site: Bio Engineering for SustainabiliTy (BEST)", National Science Foundation (NSF), $457,276.
29. Mahtabi, M.J. (PI), Ibrahim, H., 2018. "Micromechanical Modeling of Polycrystalline Shape Memory Alloys", Center of Excellence in Applied Computational Science and Engineering (CEACSE), $88,900.
30. Mahtabi, M.J. (co-PI), Ibrahim, H., 2018. "Corrosion modeling of magnesium-based fixation hardware for mandibular reconstruction surgeries", Center of Excellence in Applied Computational Science and Engineering (CEACSE), $94,906, **Funded**.
31. Mahtabi, M.J. (co-PI), Elahinia, M., 2018. "Cyclic Deformation, Functional and Structural Fatigue of Additively Manufactured Superelastic Nickel-Titanium Alloys", National Science Foundation (NSF), $313,115.
32. Mahtabi, M.J. (co-PI), Elahinia, M., 2018. "Fatigue behavior of NiTi shape memory alloys: experimental and modeling aspects-Visiting Faculty Researcher Program", The University of Toledo, $5,000, Funded.

Recognition of My Works

- Most cited article of 2021 of Fatigue & Fracture of Engineering Materials & Structures journal, Yadollahi, A., **Mahtabi, M.J.**, Khalili, A., Doude, H.R., Newman, J.C., 2018. "Fatigue life prediction of additively manufactured material: Effects of surface roughness, defect size, and shape". Fatigue & Fracture of Engineering Materials & Structures 41, 1602-1614.
- Editor's choice for FFEMS journals virtual issue (VI), **Mahtabi, M.J.**, Sanford, A., Shamsaei, N., Newman, J.C., 2016. "Transferability of the two-parameter fracture criterion for 2219 aluminium alloy cracked configurations". Fatigue & Fracture of Engineering Materials & Structures 39, 335-345.

Research Interests

- Fatigue and Fracture Mechanics
- Additive Manufacturing
- Shape Memory Alloys
- Integrated Computational Materials Engineering (ICME): Atomistic Simulations and Phase-Field Modeling
- Multiscale Mechanics
- Variable Amplitude and Multiaxial Loading Effects

Teaching Experience

University of Tennessee at Chattanooga: since Aug. 2018

Undergraduate:
- Machine Design (9 semesters)
- Engineering Materials Science (5 semesters)

Graduate:
- Additive Manufacturing Technology (1 semester)
- Introduction to Molecular Dynamics Modeling of Materials (1 semester)
- Fatigue of Engineering Materials (1 semester)
- Mechanics and Materials Science of Shape Memory Alloys (1 semester)

Mississippi State University: Jan. 2014-Aug. 2016
- Machine Design (TA)

The University of Toledo: Jan. 2013-Dec. 2013
- Statics (TA)
- Design of Reinforced Concrete Structures (TA)

Islamic Azad University- Eslamshahr branch, Tehran, Iran: Dec. 2009-Jun. 2010

- Statics
- Structural Analysis I
- Retrofit and Maintenance of Structures

Professional Service

- NSF MoMS program Panelist, December 2022.

Editorial

- Editorial board member, ASTM International's *Journal of Testing and Evaluation*.
- Member of the Journal of Materials Engineering & Performance Committee
- Editorial board member, Frontiers in Metals and Alloys
- Guest associate editor: Frontiers In Metals and Alloys journal's Special Issue "New Trends in Additive Manufacturing for Biomedical Applications, Materials, Techniques, Case Studies", 2023-24.
- Guest editor: Journal of Manufacturing and Materials Processing's Special Issue "Fatigue and Fracture Mechanics in Additive Manufacturing", 2023.
- Guest editor: Bioengineering Journal's Special Issue "Engineering Bone-Implant Materials", 2019.

Conference Organization

- Technical Committee Member, 2022 International Conference on Mechanical, Automation and Electrical Engineering (CMAEE 2022), China. http://www.cmaee.net/Program%20Committee.html
- Technical Committee Member, SAMDE 2021, International Symposium on Automation, Mechanical and Design Engineering (SAMDE) 2019-2022. http://www.samde.org/com
- Session Chair: the first Southeastern Additive Manufacturing Symposium (SEAM 2021), The University of South Alabama, Mobile, AL- April 21, 2021
- Member of the Organization Committee, "Advanced Manufacturing, Processing, Characterization, and Modeling of Functional Materials", Materials Science & Technology 2020 (MS&T20), November 2-6, 2020, Virtual.
- Member of the Organization Committee, "Advanced Manufacturing, Processing, Characterization, and Modeling of Functional Materials", Materials Science & Technology 2019, September 29-October 3, 2019, Portland, Oregon, USA.
- Session Chair: 30th Annual International Solid Freeform Fabrication (SFF) Symposium - An Additive Manufacturing Conference – Austin, TX - August 12-14, 2019
- Member of the Organization Committee, "Advanced Manufacturing, Processing, Characterization, and Modeling of Functional Materials", Materials Science & Technology 2018, October 14 – 18, 2018, Columbus, Ohio, USA.
- Session Chair: "Advanced Manufacturing, Processing, Characterization, and Modeling of Functional Materials", Materials Science & Technology 2018, October 14 – 18, 2018, Columbus, Ohio, USA.

Peer-Review Activity

- Fatigue & Fracture of Engineering Materials & Structures; Materials; Materials & Design, Engineering Fracture Mechanics; International Journal of Fatigue; Aerospace; Journal of Vibration and Control; Journal of Intelligent Material Systems and Structures; Shape Memory and Superelasticity; International Journal of Mechanical Sciences; Bioengineering; Iranian Journal of Science and Technology, Transactions of Mechanical Engineering; Part C- Journal of Mechanical Engineering Science; Applied Sciences; Materials Letters; Steel and Composite Structures, An International Journal; Johnson Matthey Technology Review (formerly published as Platinum Metals Review); ASTM Journal of Testing and Evaluation; ASME 2016 PowerEnergy2016; ASME 2017 2017; Materialia; Journal of Materials: Design and Applications.

Advising and Committee Member

Advising

1. Saeed Ataollahi, PhD, University of Tennessee at Chattanooga, Dec. 2023
2. Stephan Rodemann, MSc, University of Tennessee at Chattanooga, May 2023
3. Lionardo Lado, BS (Honors Thesis), May 2022: "Multistage Fatigue Modeling of Additively Manufactured Metals Fabricated by Different Methods"
4. Maulik Amin, MS, University of Tennessee at Chattanooga, May 2021
5. Sergio Campo, MS, University of Tennessee at Chattanooga, Dec. 2019.
6. Daniel Landgraf, MS, University of Tennessee at Chattanooga, Dec. 2019.
7. Parisa Bayati, PhD, Dec. 2021 (co-Advised at The University of Toledo with Prof. Elahinia)
8. Javier Salazar, MS, May 2021 (co-Advised at The University of Toledo with Prof. Elahinia)
9. Peter Rocco, MS, 2019 (co-Advised at The University of Toledo with Prof. Elahinia)
10. Nazanin Farjam, MS, May 2018 (co-Advised at The University of Toledo with Prof. Elahinia)
11. More than ten undergraduate students at UTC on various research projects.

Committee Member

- Ahmadreza JahadAkbar, PhD, Dec. 2020, The University of Toledo (Advisor: Dr. Mohammad Elahinia)
- Austin Sims, MSc, Dec. 2021, University of Tennessee at Chattanooga (Advisor: Dr. Hamdy Ibrahim)
- Moataz Ataollah, MSc, Dec. 2021, University of Tennessee at Chattanooga (Advisor: Dr. Hamdy Ibrahim)
- Andy Turgeson, PhD, May. 2022, University of Tennessee at Chattanooga (Advisor: Dr. Bradley Harris)
- Godfred Sabbih, PhD, Mar. 2023, University of Tennessee at Chattanooga (Advisor: Dr. Michael Danquah)
- Nicolas Macallister, PhD, Jan. 2024, Stellenbosch University, South Africa (Advisor: Dr. Thorsten H. Becker)

Mentorship

- Three graduate and three undergraduate students at Mississippi State University to perform research on the mechanical behavior of materials.
- Three PhD and two MSc students at Dynamic and Smart Systems Lab at The University of Toledo.

Professional Memberships

- American Society of Mechanical Engineers (ASME)
- American Society for Testing and Materials (ASTM)
  - Committee E08 on Fatigue and Fracture
  - Committee F04 on Medical and Surgical Materials and Devices
  - Committee F42 on Additive Manufacturing Technologies
- ASM International (formerly the American Society for Metals)
  - ASM Sustainable Materials Engineering Committee Member

Awards and Honors

- **Outstanding Teaching Award**, Department of Mechanical Engineering, UTC, April 2023.
- Registration award - The 13th International Conference on the Technology of Plasticity (ICTP 2021) from July 25–30, 2021.
- Outstanding Graduate Student-Hall of Fame of Scholars, Bagley College of Engineering - Mississippi State University, spring 2017.
- Graduate Student Research Award sponsored by Offices of the Vice President for Research and Economic Development (ORED) - Mississippi State University, spring 2017.
- ASTM International Graduate Scholarship, 2016.
- SAE International Fatigue Design Committee - Henry O. Fuchs Student Award, 2016.
- Mississippi State University Bagley College of Engineering Travel Award, 2016.
- ASTM International E08 Committee on Fatigue and Fracture - Dr. M.R. Mitchell - Best Student Presentation Award, 2015.

- Mississippi State University Graduate Student Association Travel Award, 2015.
- Mississippi State University Bagley College of Engineering PhD Accelerator Scholarship, 2014 - 2015.
- Outstanding teaching assistant, the Department of Civil Engineering, University of Toledo, 2013.
- Masonry Institute of Michigan Scholarship, 2013.
- M.Sc. Full Scholarship, Iran University of Science and Technology, Iran, 2005 - 2007.
- B.Sc. Full Scholarship, University of Tehran, Iran, 2001 - 2005.

Special Works

- Design and fabrication of a machine for actuation fatigue testing of shape memory alloys, 2018.
- A computer code for Seismic Evaluation of Existing Building Program for steel structures (SEEB2007), 2007.
- The Iranian Design and Rehabilitation Code for Reinforced Concrete Structures, 2006.

Programming/Software Skills

- Finite Element Programs: ANSYS, ABAQUS, COMSOL, LS-DYNA, ZIP2D, ZIP3D, FASTRAN
- Molecular Dynamics and Electronic: VASP, Quantum Espresso, LAMMPS
- Programming: Python, C++, Visual C++, C#, Visual Basic, MATLAB, Fortran
- Structural Analysis and Design: SAP2000, ETABS, SAFE, STAAD Pro
- GIS and CAD Software: Arc GIS, Arc View, AutoCAD
- Microsoft Office Tools and Latex
- SAS statistical analysis software

ABDUL R. OFOLI, Ph.D., P.E.

U.C. Foundation Professor, Electrical Engineering, UTC (Tenured)
College of Engineering & Computer Science
735 Vine Street, Chattanooga, TN 37403
Dept. 2502, EMCS Bldg. 331B
Office: 423 425-5754; Abdul-Ofoli@utc.edu

RESEARCH INTEREST

- **Power & Energy**
  - Power Electronics & Drives; Power System; and Sustainable Energy.
- **Controls**
  - Motion Drives and Control; Robotics; Application of Intelligent Controls.
- **Automotive**
  - Diesel engine and after-treatment (emission) control development.
  - Virtual sensors development for engine and after-treatment systems.

EDUCATION

- **May 2006: Ph.D.** in Electrical Engineering; Howard University, Washington DC. Major in advanced/intelligent controls application.
- **May 2003: M.Eng.** degree in Electrical Engineering from Howard University, Washington DC. This degree was a major in power system application and controls.
- **July 1999: B.Sc. d**egree in Electrical & Electronic Engineering; Graduated with first-class honors from Kwame Nkrumah University of Science and Technology(KNUST), Kumasi, Ghana.

PROFESSIONAL REGISTRATION

- Registered Professional Engineer (**PE**) in the State of Tennessee, 2013.

PROFESSIONAL EXPERIENCE

ACADEMIC

Professor & Interim Dept Head — *July '23 – Present*
The University of Tennessee at Chattanooga, Tennessee USA

Associate Professor, Tenured — *Aug '15 – July '23*
The University of Tennessee at Chattanooga, Tennessee USA

Assistant Professor — *Aug '10 – July '15*
The University of Tennessee at Chattanooga, Tennessee USA

Research Assistant, — *Spr '03 – Spr '06*
Howard University, Washington DC
Developed and implemented real-time control algorithms for industrial applications using advanced digital control, adaptive control techniques, and intelligent control for alternative energy systems, drives, automation, and power networks. Hardware implementation of most of these control techniques was illustrated using industrial standard rapid prototyping tools like dSPACE systems.

Teaching Assistant, *Fall '04 – Spr '06*

Howard University, Washington DC

Developed and wrote experimental procedures and guidelines for the interdisciplinary undergraduate system dynamics and control laboratory to enhance the quality of instruction at the university. Taught the following lab sessions, *linear controls lab*, *energy conversion lab*, and *introduction to the electrical engineering lab*. Graded lab reports, and mid-term and final exam papers.

INDUSTRIAL

Senior Controls Engineer, *July '06 – June '10*

Cummins Inc., Columbus Indiana, USA

Some Responsibilities: (i) Develop and implement real-time control algorithms and strategies for diesel automotive applications to meet specific control objectives utilizing classical, advanced and intelligent control techniques. (ii)Implemented and validated real-time diagnostic and control algorithms on various diesel engine platforms using rapid controls prototyping systems. (iii) Developed electronic hardware and software controls for waste heat recovery systems and hybrid-diesel power systems.

Internship Experience, *Summer 1998*

Benso Oil Palm Plantation, Unilever, Ghana.

My major task included redesigning the one-line power diagram of the main factory while a minor assignment involved the design and implementation of control circuits for the protection of factory motors. A final project was to conduct and estimate the monthly power consumption for all small businesses around the factory housing units for billing purposes, which were then operating without any billing. The projected increase in profit averaged 10% annually if implemented. Attended a one-week workshop training on "***Improving Energy efficiency and minimizing energy wastage in industries***".

TEACHING SUMMARY

The following is a summary of the courses and labs taught since joining in the Fall of 2010.

Undergraduate Courses:

i. **Circuits I (ENEE 2700)**
   [SU2011, SU2014, SU2020, SU2021, SU2022]
ii. **Circuits II (ENEE 2720)**
   [SU2011, SU12, SU13, SU14, SU15, SU16, SU17, SU18, SU2019]
iii. **Analog Electronics (ENEE 3720)**
   [FA10, FA11, FA12, FA13, FA14, FA15, FA16, FA17, FA18, FA19, FA20, FA21, FA2022]
iv. **Analog Electronics Lab (ENEE 3720L)**
   [FA10, FA11, FA12, and FA2013]
v. **Power Electronics (ENEE 4600)**
   [SP11, SP12, SP13, SP14, SP15, SP16, and SP2017]
vi. **Power Electronics Lab (ENEE 4600L)**
   [SP2011 and SP2012]
vii. **Electronic Instrumentation (ENEE 4800)**
   [SP11, SP12, SP13, SP14, SP15, SP16, SP17, SP18, SP19, SP20, SP21, SP22]
viii. **Linear Controls and Drives Lab (ENEE 4790L)**
   [SP12, SP13, FA13, FA14, and FA2015]
ix. **Robotics and Controls Research I (ENEE 4350)**

[SP2014, FA2017, SP2018, FA2018, SP2019, SP2021]

x. **Fuzzy Logic and AI Controls Applications (ENEE 4330)**
[FA2015, FA2016, SU2018, FA2019, FA2020, FA2021, FA2022, FA2023]

xi. **Interdisciplinary Design I (ENEE 3850)**
[FA2017, FA2018, FA2019, FA2020, FA2021, FA2022, FA2023]

xii. **Interdisciplinary Design I (CPEN 3850)**
[FA2019, FA2020, and FA2021]

xiii. **Interdisciplinary Design II (ENEE 4850)**
[SP2018, SP2019, SP2020, SP2021, SP2022]

xiv. **Interdisciplinary Design II (CPEN 4850)**
[SP2020, SP2021, and SP2022]

xv. **Fundamentals of Engineering and Professionalism (ENEE 4900)**
[SP2014, SP2015, SP2016]

xvi. **Special Course on Robotic Control Applications (ENEE 4999R)**
[FA2022]

xvii. **Artificial Neural Networks (ENEE 4999)**
[FA2014]

Graduate Courses:

i. **Power Electronics and Drives (ENEE 5610)**
[SP11, SP12, SP13, SP14, SP15, SP16, and SP2017]

ii. **Artificial Neural Networks (ENEE 5910)**
[FA2014]

iii. **Advanced Fuzzy Logic Design and AI Applications (ENEE 5910R)**
[SP2016, FA2016, FA2019, SP2020]

iv. **Special Topics: Machine Vision Application with Python (ENEE 5910R)**
[FA2022]

Courses and Labs Developed

Developed new labs for power electronics, control & drives and upgraded the PLC lab.

i. **Power Electronics Lab (ENEE 4600L)**
[SP2011 and SP2012]

ii. **Linear Controls and Drives Lab (ENEE 4790L)**
[SP12, SP13, FA13, FA14, and FA2015]

iii. **Robotics and Controls Research I (ENEE 4350)**
[SP2014, FA2017, SP2018, FA2018, SP2019, SP2021, SP2022, SP2023]

iv. **Fuzzy Logic and AI Controls Applications (ENEE 4330)**
[FA2015, FA2016, SU2018, FA2019, FA2020, FA2021, FA2022, FA2022]

v. **Upgraded the PLC Lab** within the Instrumentation Course (ENEE 4800) and **created a new sensor board having NI myRIO** with different sensors for LabVIEW data acquisition and control.

Thesis & Dissertation Committees

- **Mohammed Khalifa**, Pursuing MS in Computer Sc., projected graduation in Summer 2024, UTC
  Title: AI application
  Role: Advisor

- **Garrick Muncie**, Currently pursuing MS in Eng, projected graduation in Spring 2024, UTC
  Title: (Tentative): AI Detection of damaged solar panels
  Role: Advisor

- **Nasir Abdulai Boakye-Boateng**, Ph.D. in Computational Engineering, March 6, 2020, UTC
  Title: Characterization of The Linear Variable Reluctance Motor Using Finite Element Analysis
  Role: Committee Member

- **Pablo Macedo**, MS in Engineering, May 2021, UTC
  Title: Improving Interarea Oscillations Damping of Power Systems Through Cooperative Active Power Control of Distributed Energy Resources
  Role: Committee Member

- **Shailesh Wasti**, MS in Engineering, December 2020, UTC
  Title: Distributed Online Algorithms for Energy Management In Smart Grids
  Role: Committee Member

- **Farog Ismail Fadlelmoula Mohamed**, MS in Engineering, Fall 2020, UTC
  Title: Modular Multilevel Converters for Solar Photovoltaic - Battery Energy Storage System Integration
  Role: Committee Member

- **Saroj Prasad Khanal**, MS in Engineering, August 2019, UTC
  Title: Optimal Modulation and Topology Design Of Modular Multilevel Converter For Grid Integration of Solar Photovoltaic Systems
  Role: Committee Member

- **Mitch Lautigar**, MS in Engineering, May 2019, UTC
  Title: The Square Mean Test Method; An RMS Alternative
  Role: Committee Member

- **Bharat Patel**, MS in Engineering, May 2019, UTC
  Title: Ionizing Radiation Effects Spectroscopy (IRES) for Analysis of Total Radiation Effects in Microelectronics
  Role: Committee Member

- **Matthew Joplin**, MS in Engineering, Summer 2018, UTC
  Title: A Method for Characterization Of Single-Event Latch-up In CMOS Technologies as A Function of Geometric Variation
  Role: Committee Member

- **Mohamed Fadul**, MS in Engineering, Summer 2018, UTC
  Title: The Impact of Rayleigh Fading Channel Effects on The Rf-DNA Fingerprinting Process
  Role: Committee Member

- **Simar Singh**, BS May 2018, Departmental Honors Thesis, UTC
  Title: Efficacy of Fuzzy Electronics for Space Applications
  Role: Committee member

- **Daniel Johnson**, BS, May 2016, Departmental Honors Thesis, UTC

Title: Wireless Voice Amplification Device for Weak Patients
Role: Advisor

- **David McPherson**, BS, May 2015, Departmental Honors Thesis, UTC
  Title: BasketBallBot: Education Level Development of a Fuzzy Controller for a Linear Motor under Saturation Limits
  Role: Advisor

- Mohammed Altimania, M.Sc. Graduate, Major Thesis Advisor, UTC, May 2014
- Boakye-Boateng, Nasir, M.Sc. Graduate, Major Thesis Advisor, UTC, May 2013
- Sarra Abd Elwahid, M.Sc. Graduate, Thesis Committee Member, 2013
- Cassandra H. Goff, M.Sc. Graduate, Thesis Committee Member, 2013
- Mark. Goff, M.Sc. Graduate, Thesis Committee Member, 2013
- Abdulelah Yousef Alharbi, M.Sc. Graduate, Thesis Committee Member, 2013
- Sharmila Kumari Bunga, M.Sc. Graduate, Thesis Committee Member, 2013
- David E Norwood, M.Sc. Graduate, Thesis Committee Member, 2011.

Advisement and Mentorship

- **Rowan Collazzo**, NSF Summer Research Experience for Undergraduates, 10 Wks, Summer 2022
  Title: Flight Demonstration of Crazyflie Drones for Communicative Swarm and Obstacle Avoidance Applications
  Role: Advisor

- **Jennifer Miles** and **David Paris**, NSF Summer Research Experience for Teachers (RET), June 7-July 16, 2021
  Title: COOPERATIVE TRANSPORT: Learning Python in High School with Flying Programmed Drones.
  Role: Advisor
- **David McIntosh**, NSF Summer Research Experience for Undergraduates, 10 Wks, Summer 2021
  Title: An Autonomous Cooperative Drone Indoor Testbed
  Role: Advisor

- **Michael Phares** and **Theodore Tolman**, Undergraduate Research, 2021 CECS Technology Symposium, UTC
  Title: Modification of Ride-On Toy for Special Needs Joystick Integration, Custom Motor Control, and Wireless Parental Override
  Role: Advisor

- **Jacob Pew** and **Robert Rhodes**, Undergraduate Research, 2021 CECS Technology Symposium, UTC
  Title: Design and Control of a UV Autonomous Disinfectant Robot
  Role: Advisor

- **Archer Thompson** and **Eric Johnson**, Undergraduate Research, 2021 CECS Technology Symposium, UTC
  Title: A Selective Compliance Articulated Robot Arm (SCARA) using ODrive Servo motors
  Role: Advisor

- **Nicolas Mateo** and **Jonathan Rinkel**, Undergraduate Research, 2018 UTC Research Dialogues
  Title: Automation of a BasketBallBot using LabVIEW and Arduino
  Role: Advisor

- **Braxton Towry** and **Simar Singh**, Undergraduate Research, 2018 UTC Research Dialogues
  Title: Feedback Control of a Haptic System using NI MyRIO Hardware
  Role: Advisor

- **Greg Draeger** and **Daniel Rhodes**, Undergraduate Research, 2018 UTC Research Dialogues
  Title: Power 'C' LED Sign
  Role: Advisor

HONORS AND AWARDS

- Recipient of the University-wide THINKACHIEVE BEYOND THE CLASSROOM Faculty Appreciation Award, May 2022
- Recipient of the EE Departmental Award for "***Outstanding Faculty Advising***", 2021-2022 Academic year.
- Recipient of the EE Departmental Award for "***Outstanding Faculty Teaching***", 2020-2021 Academic year.
- Recipient of the EE Departmental Award for "***Outstanding Faculty Advising***", 2020-2021 Academic year.
- Recipient of the **College-Level** Award for "***Outstanding Tenure/Tenure-Track Faculty Teaching***", 2019-2020 Academic year.
- Recipient of the 2013-2014 **campus-wide SGA** "***Outstanding Professor of the Year Award***" at the University of Tennessee at Chattanooga, April 2014.
- Recipient of the "***Teacher of the Year Award***" in the College of Engineering and Computer Science, April 2013.
- Recipient of the "***Outstanding Faculty Teacher of the Year Award***" in the EE Department in April 2011 and 2013.
- Recipient of the award: "***Keep the Stars Shining Performance Award***" UTC in 2012.
- Recipient of the "***Outstanding Faculty Researcher of the Year Award*** in the EE Department in April 2012.
- Four patents were received in the area of automotive engine controls for work at Cummins Inc.
- Recipient of the 2006 IEEE/IAS **Transaction Second Prize Paper Award**, September 2007.
- Founded the ***AnnoorBots*** First Lego League (FLL) robotics team in 2015 and has been coaching and managing it. In 2021, due to a large number of interest from students a second team was formed, the ***AnnoorMachines***. We have so far won the following awards with the team(s):
  - FLL Academic Year 2021/2022

    2022 Regional Championship
    - Best Robot Performance Award (*AnnoorMachines*)
    - Best Robot Design Award (*AnnoorMachines*)

    2021 Regional Qualifying Competition
    - Best Robot Performance Award (*AnnoorBots*)
    - Engineering Excellence Award (*AnnoorBots*)

- Best Robot Design Award (*AnnoorMachines*)

- FLL Academic Year 2019/2020

  2019/2020 Regional Championship at Eastbrook Middle School in Dalton

  - Programming Award
  - Best Robot Performance Award

  2019 Regional Qualifying Competition at Red Bank Middle School

  - Robot Design Award

- FLL Academic Year 2018/2019

  2018 Regional Qualifying Competition at Hixson Middle School

  - Overall, Champions Award

- FLL Academic Year 2017/2018

  2017/2018 Super-Regional Championship at Chatt State Comm College

  - Project Award

  2017 Reginal Qualifying at Red Bank Middle School

  - Robot Performance Award

- FLL Academic Year 2016/2017

  2016 Georgia State FLL Championship at Georgia Tech

  - Inspiration Award

  2016 Regional Qualifying at Red Bank Middle School

  - Project Award

- FLL Academic Year 2015/2016 (*Rookie Team*)

  2015 Super-Regional Qualifying at The University of Tennessee, UTC

  - Gracious Professionalism Award

  2015 Regional Qualifying at The University of Tennessee, UTC

  - Robot Performance Award

- Overall ***third place*** with the UTC IEEE robotics team as a faculty advisor at the 2019 IEEE Southeastern hardware competition.
- CECS Senior Capstone overall ***1st Place Award***: IEEE Robotics 2019 (Student(s)/Advisor: Anthony Maxwell, Artem Malashiy, Robert Rhodes, Shane Taylor / Dr. Abdul Ofoli)
- CECS Senior Capstone overall ***2nd Place Award***: LabVIEW Smart House (Student(s)/Advisor: Savannah Camp, Cody Davis, Otniel Gonzalez, Steven Stafford / Dr. Abdul Ofoli)
- CECS Senior Capstone overall ***Entrepreneurship Award*** – Sponsored by CO.LAB: Open Spots Parking Application (Student(s)/Advisor: Terrince Bramhall, Chase Futrell, Evan Lane / Abdul Ofoli)

SERVICE

University, College, and Department Service

- MS. Graduate Coordinator, Electrical Engineering Department [2022/2023 – Current]
- Member, University Undergraduate Petitions Committee [2022/2023 – Current]
- Member, University Undergraduate Admission Committee [2021/2022]
- Chair, College Teaching & Learning Strategic Plan Committee [2021/2022 - Current]
- Faculty advisor for the IEEE UTC Student branch chapter [2013/2014 – Current].
- Member, EE Dept. Reappointment, Promotion, and Tenure (RPT) Committee [Ongoing]
- Member, University Undergraduate Standard Committee [3yrs: 2018/2019 – 2020/2021].
- Coordinator, EE depart undergraduate curriculum program. Prepares and submits all curriculum proposals [9yrs: 2013/2014 – 2021/2022].
- Member, College Undergraduate Curriculum Committee [7yrs: 2015/16 – 2021/2022].
- University-wide Undergraduate Curriculum Committee [3yrs: 2015/2016 – 2017/2018].
- Member, CECS College Bylaws creation committee [2015/2016]
- University-wide Departmental Honors Committee [2yrs: 2013/2014-2014/2015].
- University-wide Classroom Technology Committee [2yrs: 2011/2012 – 2012/2013].
- Member, EE Dept. ABET Self-Study Report Committee. [2019/2020 – 2020/2021]
- Search Committees:
  - Member, EE Laboratory Tech Support, Spring 2022
  - Member, EE Department Head Search Committee, 2019/2020
  - Member, ME Faculty Search, FA2017/SP2018
  - Member, ME Faculty Search, Spring 2017
  - Member, EE Faculty Search, FA2016/SP2017
  - Member, EE Staff Search, FA2016
  - Member, CECS Dean Search, Fall 2015
  - Member, EE Faculty Searches 2013/2014

Professional Service

- ABET **Program Evaluator (PEV)**, conducted four visits since Fall 2021 [2021 - Current]
- **Member** of **IAS Executive Board** (Member-at-Large for North America), *2020 – Current*
- **Associate Editor** for Industrial Application Society (IAS) –IEEE, *2022 – Current.*
- **Reviewer** for IAS –IEEE Journals and conference proceedings, *2008 - Current.*
- Session chair at the 2022 IAS Annual Conference Meeting in Detroit, MI
- Session chair at the 2020 & 2021 Virtual IAS Annual Conference Meetings
- **Associate Editor** for Industrial Application Society (IAS) –IEEE, *2009 – 2017.*
- **Chair** for IAS Industrial Automation and Control Committee of IEEE. *Jan. 2013- Dec. 2015.*
- IEEE-IAS officer as **Technical Committee Paper Review Chair (TCPRC)** for Industrial Automation and Controls Committee (IACC), *Jan. '11 – Dec. '13.*
- **Vice-Chair** for Industrial Automation and Control Committee of IEEE-IAS, *Jan. '11 – Dec. '12.*

Community and Public Service

- Coach, First Lego League (FLL) robotics for elementary/middle school students. Teaches little kids (9 to 14 years) robotics and programming during the fall semester and up to six weeks in the spring semester. [2015/2016 – Current].
- Mentors the TVA/Chattanooga area high school robotic teams in LabVIEW programming and the use of electrical sensors in their robot; [2012/2013 – Current]
- Judge, First Robotic Competition (FRC) held at the Dalton Convention Center, Dalton, GA for high school teams. Spring 2022.
- Worked with the VEX Robotics Competition, a multi-state event with teams representing Tennessee and neighboring states by sending my UTC students to help as volunteers (Referee, Judge, scorekeeper, queuing table, inspection, etc.). March 13, 2021, at First Horizon Pavilion in Chattanooga.
- Worked with Rebecca Miller, a fourth-grade teacher at Michigan Avenue Elementary in Cleveland, TN who was hosting a STEAM class with an EV3 Mindstorms robot set for her program. Spring, 2021.
- Worked with the Chattanooga police department and Erlanger to troubleshoot their SWAT robot which was malfunctioning. Submitted a detailed summary and analysis of the cause of the problem and how to get it fixed. (Spring 2019)

BOOK CHAPTER:

- Lead Author of Chapter 36 – "Fuzzy Logic Applications in Electrical Drives and Power Electronics," THE POWER ELECTRONICS HANDBOOK, 4/e, Edited by M. H. Rashid, Elsevier Publications, 2017.

JOURNAL PUBLICATIONS:

*Key: **BOLD** indicates my name, Underline indicates student author*

1. Sowah, R. A., **Ofoli, A. R**., Mensah-Ananoo, E., Mills, G. A., Koumadi, K. M. (2021). "An Intelligent Instrument Reader-Using Computer Vision and Machine Learning To Automate Meter Reading", IEEE Industry Applications Magazine, July/August 2021.
2. Fadul, M., Reising, D. R., Loveless, T. D., **Ofoli, A. R**. "Nelder-Mead Simplex Channel Estimation for the RF-DNA Fingerprinting of OFDM Transmitters Under Rayleigh Fading Conditions". IEEE Transactions on Information Forensics and Security, Vol. 16, 2381-2396, 25 January 2021, DOI: 10.1109/TIFS.2021.3054524
3. Robert Sowah, Kwame O. Ampadu, **Abdul Ofoli**, Koudjo Koumadi, Godfrey A. Mills, Joseph Nortey, "Design and implementation of a fire detection and control system for automobiles using fuzzy logic", IEEE Industry Applications Magazine, Vol. 25, No. 2, March/April 2019.
4. R. Sowah, M. A. Acquah, **A. R. Ofoli**, G. A. Mills and K. M. Koumadi, "Rotational Energy Harvesting To Prolong Flight Duration Of Quadcopters", IEEE Transaction on Industry Applications. Volume: 53, Issue: 5, Pages: 4965 – 4972, Year: 2017.
5. Robert A. Sowah; **Abdul R. Ofoli**; Selase N. Krakani; Seth Yayra Fiawoo, "Hardware Design and Web-Based Communication Modules of a Real-Time Multisensor Fire Detection and Notification System Using Fuzzy Logic", IEEE Transaction on Industry Applications, vol. 53, Issue 1, pp. 559 - 566, Jan.-Feb., 2017.
6. **A. R. Ofoli** "Experimental Demonstration of ammonia storage and slip modeling with control for an SCR aftertreatment system," IEEE Transaction on Industry Applications, vol. 50, Issue 4, pp.

2342-2348, Jul.-Aug. 2014.

7. A. Rubaai, M. J. Castro-Sitiriche, and **A. R. Ofoli**, **"Design and Implementation of Parallel Fuzzy PID Controller for High-Performance Brushless Motor Drives: An Integrated Environment for Rapid Control Prototyping"**. IEEE Transaction on Industry Applications, vol. 44, Issue 4, pp. 1090-1098, Jul.-Aug. 2008.
8. A. Rubaai, **A. R. Ofoli**, and D. Cobbinah, **"DSP-Based Real-Time Implementation of a Hybrid H ∞ Adaptive Fuzzy Tracking Controller for Servo-Motor Drives".** IEEE Transaction on Industry Applications, vol. 43, Issue 2, pp. 476-484, March-April 2007.
9. **A. R. Ofoli** and A. Rubaai, **"Real-Time Implementation of a Fuzzy Logic Controller for Switch-Mode Power-Stage DC-DC Converters".** IEEE Transaction on Industry Applications, vol. 42, Issue 6, pp. 1367-1374, Nov.-Dec. 2006.
10. Ahmed Rubaai, **A. R. Ofoli**, L. Burge III and M. Garuba, **"Hardware implementation of an adaptive network-based fuzzy controller for DC-DC converters**". IEEE Transaction on Industry Applications, vol. 41, Issue 6, pp. 1557-1565, Nov.-Dec. 2005.
11. Ahmed Rubaai, and **A. R. Ofoli**, "Multi-Layer Fuzzy Controller for Control of Power Networks". IEEE Transaction on Industry Applications, vol. 40, Issue 6, pp. 1521-1528, Nov.-Dec. 2004.
12. A. Rubaai, and **A. R. Ofoli**, "Design and Analysis of Nonlinear Digital Controllers-Based Two-level Hierarchy for Electric Utility Industry," IEEE Transaction on Industry Applications, vol. 39, pp. 395-407, March/April 2003.

SELECTED CONFERENCE PUBLICATIONS:

*Key: **BOLD** indicates my name, Underline indicates student author*

1. R. Sowah, R. Friedman; **A. R. Ofoli**; B. Sarkodie-Mensah, "Think to Speak - A Piezoelectric-EEG system for Augmentative and Alternative Communication (AAC) using Recurrent Neural Networks", 2019 IEEE Industry Applications Society Annual Meeting, Baltimore, MD, USA, 29 Sept.-3 Oct. 2019, DOI: 10.1109/IAS.2019.8912419
2. Mohamed K. M. Fadul, Donald R. Reising, T. Daniel Loveless, **Abdul R. Ofoli**, "RF-DNA Fingerprint Classification of OFDM Signals Using a Rayleigh Fading Channel Model", 2019 IEEE Wireless Communications and Networking Conference (WCNC), 15-18 April 2019, DOI: 10.1109/WCNC.2019.8885421
3. Robert A. Sowah, **Abdul R. Ofoli**, Michael K. Tetteh, Richard A. Opoku, Stephen K. Armoo, "Demand Side Management of Smart Homes Using OpenHAB Framework for Interoperability of Devices", IEEE 7th International Conference on Adaptive Science & Technology (ICAST), DOI: 10.1109/ICASTECH.2018.8506917
4. Robert Sowah, **Abdul Ofoli**, Koudjo Koumadi, George Osae, Gilbert Nortey, Amewugah M. Bempong, Benedict Agyarkwa, Kwaku O. Apeadu, "Design and Implementation of a Fire Detection andControl System with Enhanced Security and Safety for Automobiles Using Neuro-Fuzzy Logic", 2018 IEEE 7th International Conference on Adaptive Science & Technology (ICAST), 22-24 August 2018, DOI: 10.1109/ICASTECH.2018.8507143
5. RA Sowah, **Abdul R Ofoli**, E Mensah-Ananoo, GA Mills, KM Koumadi, "Intelligent Instrument Reader Using Computer Vision and Machine Learning" 2018 IEEE Industry Applications Society Annual Meeting (IAS), Portland, OR, Sep 23-27 2018.
6. Robert A. Sowah, Nicholas A. Dzabeng, **Abdul R. Ofoli**, Amevi Acakpovi, Koudjo. M. Koumadi, Joshua Ocrah, Deborah Martin, "Design of Power Distribution Network Fault Data Collector for Fault Detection, Location and Classification using Machine Learning", 2018 IEEE 7th International

Conference on Adaptive Science & Technology (ICAST), 22-24 August 2018, 10.1109/ICASTECH.2018.8506774

7. **Abdul R. Ofoli**, Mohammed R. Altimania, "Real-time digital simulator testbed using eMEGASim® for wind power plants", 2017 IEEE Industry Applications Society Annual Meeting, 1-5 Oct. 2017, Cincinnati, OH, USA.
8. Robert Sowah, Kwame O. Ampadu, **Abdul R Ofoli**, Koudjo Koumadi, Godfrey A. Mills, Joseph Nortey, "Design and implementation of a fire detection and control system for automobiles using fuzzy logic", IEEE Industry Applications Conference Record, Portland, OR, USA, Oct. 2-6, 2016.
9. R. Sowah, M. A. Acquah, **A. R. Ofoli**, G. A. Mills and K. M. Koumadi, "Rotational Energy Harvesting To Prolong Flight Duration Of Quadcopters", IEEE Industry Applications Conference Record, Addison, TX, USA, Oct. 18-22, 2015.
10. D. McPherson, **A. Ofoli**, and T. D. Loveless, "BasketBallBot: Developing an Intelligent Controls Teaching Platform using LabView, MATLAB, and Arduino," Proceedings of the 2015 IEEE SoutheastCon, Ft. Lauderdale, FL, Apr. 2015.
11. R. Sowah, **A. R. Ofoli**, S. Krakani, and S. Fiawoo, "Hardware Module Design of a Real-time Multi-Sensor Fire Detection and Notification System using Fuzzy Logic", IEEE Industry Applications Conference Record, Vancouver, BC, Canada, Oct. 5-10, 2014.
12. R. Sowah, **A. R. Ofoli**, S. Krakani, and S. Fiawoo, "A Web-based Communication Module Design of a Real-time Multi-Sensor Fire Detection and Notification System", IEEE Industry Applications Conference Record, Vancouver, BC, Canada, Oct. 5-10, 2014.
13. N. Sisworahardjo, **A. R. Ofoli**, S. Craven, and A. Eltom, "State-of-the-Art Laboratories for Training the Modern Power Workforce", IEEE PES General Meeting, 21 - 25 July 2013, Vancouver, BC, Canada.
14. **A. R. Ofoli**, A. Khaled and B. Patel, "A Robust Adaptive-Fuzzy Controller for Different System Applications" IEEE Industry Applications Conference, Orlando, FL, Oct. 6-10, 2013.
15. N. Boakye-Boateng, **A. R. Ofoli**, "Real-Time Simulation of a Doubly-Fed Induction Generator Based Wind Power System on eMEGASim® Digital Simulator" IEEE Industry Applications Conference Record, Orlando, FL, Oct. 6-10, 2013.
16. A. Rubaai, **A. R. Ofoli**, "Teaching Power Electronics Converter Experiments That Integrates Fuzzy Logic Approach," ASEE Annual Conference, Vancouver, BC, Canada, June 26-29, 2011.

PATENTS

- "Combined engine out NO.sub.X management", Sujan; Vivek Anand (Columbus, IN), **Ofoli; Abdul R.** (Chattanooga, TN), Korthandaraman; Govindarajan (Columbus, IN). US Patent 8,869,512. October 28, 2014.
- "SCR catalyst ammonia surface coverage estimation and control", **Ofoli; Abdul R**. (Columbus, IN), Mohammed; Hasan (Eindhoven, NL). US Patent 8,733,083. May 27, 2014.
- "Methods, systems, and apparatuses of SCR diagnostics", Yezerets; Aleksey (Columbus, IN), Currier; Neal W. (Columbus, IN), Liu; Zheng (Knoxville, TN), Wills; Joan M. (Nashville, IN), **Ofoli; Abdul R.** (Columbus, IN), Haas; Michael R. (Columbus, IN), Osburn; Andrew W. (Nashville, IN). US Patent 8,590,290. November 26, 2013.

WORKSHOPS AND SEMINARS

- Continuing Education Program: "Cybersecurity 101 – Practical Survival Tips for Navigating the Cyber Threat Landscape - 12 PDHs." EPRI - The Center for Grid Engineering Education (GridEd) (March 7, 2022 - March 18, 2022).
- Continuing Education Program: "Machine Vision in the Electric Industry: a Hands-On Training for Practitioners – 20 PDHs." EPRI - The Center for Grid Engineering Education (GridEd) (October 25, 2021 - November 18, 2021).
- Workshop: "ABET Program Evaluator Candidate (PEVC) Training." ABET organization (April 9, 2021 - April 11, 2021).
- Grant Writers' Seminars and Workshops: "Write Winning NSF Grant Proposals", [January 28th to January 29th, 2021]
- Quality Matters (QM) Certification: Applying the QM Rubric (APPQMR) - March 29, 2019. Participants explore the challenges of online teaching and focus on using the QM Higher Education Rubric in reviewing the design of online and blended courses.
- Hands-On Introduction To Field Programmable Gate Arrays, April 11, 2019 (8 Professional Development Hours (PDH)), IEEE SoutheastCon 2019.
- Attended the 2015 SACSCOC Annual Meeting. (12/04/2015 - 12/08/2015). Participants get to learn the requirements/standards assessed by SACSCOC to determine if an institution meets or does not meet its accreditation.
- Attended the Workshop, *How to Organize and Manage Program Assessment*, SACSCOC Annual Meeting, December 2015.
- Attended the 2015 ABET Symposium (3/21/15 – 3/25/15), the premier event in quality assurance and innovations in technical education worldwide. Participants get to learn how their peers are using technology to enhance their assessment and accreditation processes.
- Seminar (8hrs), "Transformer Diagnostics", UTC, Oct 3rd, 2013.
- Seminar (1hr), "EPB's Demand Response", UTC, April 10, 2013.
- NSF/ONR/DOE Workshop on Electric Energy Systems Curriculum hosted at Napa, California from Feb. 07 - Feb. 10, 2013. (Presented two posters)
- DOE-Sponsored Nationwide Consortium of Universities to Revitalize Electric Power Engineering Education by State-of-the-Art Laboratories at UMN in August 2012.
- Two faculty development seminars by Dr. Rockquemore organized by the Office of Equity & Diversity on (September 29, 2011, at The University of Tennessee at Chattanooga (UTC)):

  (i) "*Tenure & Time Management: How to Manage Your Time so You Can Publish Prolifically AND Have a Life Beyond the Ivory Tower*" and

  (ii) "*Every Semester Needs a Plan: How to Create a Strategic Plan For Your Research and Writing & The Secret to Actually Doing It*!
- ONR-NSF sponsored Faculty Development Workshop in Electric Energy Systems for U.S. faculty interested in teaching Electric Energy Systems courses. June 6 – 12, 2010.
- Seminar (8hrs), "Smart Grid - IEC 61850", the University of Tennessee at Chattanooga (UTC), Nov. 2nd, 2010.

CONFERENCES ATTENDED

- Industry Application Society **(IAS) Annual Conference Meetings** ***with presentations of my peer-reviewed accepted conference papers***: 2019 (Baltimore, MD); 2018 (Portland, OR); 2017 (Cincinnati, OH); 2016 (Portland, OR); 2015 (Dallas, TX); 2014 (Vancouver, BC); 2013 (Orlando, FL); 2012 (Las Vegas); 2011 (Orlando, FL); 2010 (Houston, TX)
- **IEEE Region 3 Annual conference** (SoutheastCon 2013, 2017, 2018, and 2019)
- **ASEE Annual Conference**, Vancouver, BC, Canada. June 26-29, 2011.

FUNDED RESEARCH/GRANTS

1. **Sponsor: Center of Excellence in Applied Computational Science & Eng (CEACSE) FY24 Award**
   Title: Machine Vision & AI Application for Damaged Solar Panels Detection
   Budget: $97,983
   Role: Lead Principal Investigator
   Duration: July 01, 2023 - June 30, 2024

2. **Sponsor: UTC Fly for Researchers Pitch Competition - Second place Award**
   Title: SolarEagle - Drone-based AI system to detect and assess Damaged Solar Panels
   Award: $10,000.00.
   Role: Lead Principal Investigator
   Duration: June 2023 - July 2024

3. **Sponsor: Harris Chair Research Commercialization Mini-Grant**
   Title: SolarEagle Project
   Budget: $6,000.00.
   Role: Lead Principal Investigator
   Duration: June 2023

4. **Sponsor: Electric Power Research Institute (EPRI)**
   Title: Machine Vision Application for Damaged Solar Panels Detection
   Budget: $5,000
   Role: Lead Principal Investigator
   Duration: January 2022 - December 2022

5. **Sponsor: Florida Power & Light Company (FLP)**
   Title: Simulation and Analysis of Automatic Voltage Regulator (AVR) Modules for Unit 1 and Unit 2 Motor-Generator (MG) Sets
   Budget: $58,415.00
   Role: Lead Principal Investigator
   Duration: Jan 2020-Oct 2020

6. **Sponsor: Private Company by Robert Gonyea**
   Title: Initial Prototype of 200 Watts Wireless Power Transfer
   Budget: $16,394
   Role: Investigator
   Duration: January 1, 2020 - June 30, 2020

7. **Sponsor: Tennessee Board of Architectural and Engineering Examiners (TBAEE)**
   Title: TBAEE 2020 Electrical Engineering Interdisciplinary Design Project Proposal + FE Exam Fees
   Budget: $27,273.00.
   Role: Investigator
   Duration: January 1, 2020 - June 30, 2020

8. **Sponsor: Electric Power Research Institute (EPRI)**
   Title: Deep AI-Based Energy Management System
   Budget: $4,952.00
   Role: Principal Investigator
   Duration: October 1, 2019 - June 1, 2020

9. **Sponsor: UTC ThinkAchieve Grant**
   Title: ENGR 3280L and NI Academy Control Lab Project
   Budget: $1,500.00
   Role: Other Key Participant
   Duration: Aug. 2013 – Dec 2013

10. **Sponsor: Department of Energy (DOE)**
    Title: Workforce Training for the Electric Power Sector (TEPS)
    Budget: $2.4 Million
    Role: Co-Principal Investigator
    Duration: June 2010 - December 2014

11. **Sponsor: Tennessee Board of Architectural and Engineering Examiners (TBAEE)**
    Title: Equipment to upgrade Electrical Engineering Laboratories at UTC
    Budget: $20,120
    Role: Lead Principal Investigator
    Duration: January 1, 2011 - June 30, 2011

PROPOSALS NOT FUNDED

1. **Sponsor: US - NSF - National Science Foundation**
   Title: REU Site: UTChattSat2-A Research Program in Resilient Microelectronics for Critical Infrastructure and Space Systems
   Budget: $404,927
   Role: Investigator
   Duration: 03/01/23 - 02/28/26

2. **Sponsor: Tennessee Valley Authority (TVA)**
   Title: Power Shortage Risk Assessment with Increased Power Consumption from Electric Vehicle Boom and Other Future Risks
   Budget: $114,692
   Role: Principal Investigator
   Duration: January 01, 2023 - December 31, 2023

3. **Sponsor: DOE - EERE - The Office of Energy Efficiency and Renewable Energy**

Title: Machine Vision & AI Application for Damaged Solar Panels Detection
Budget: $377,549
Role: Lead Principal Investigator
Duration: July 01, 2022 - December 31, 2023

4. **Sponsor: DOE - EERE - The Office of Energy Efficiency and Renewable Energy**
   Title: Developing, Training, and Bridging the Skills Gap for the Solar Workforce
   Budget: $1,347,249
   Role: Lead Principal Investigator
   Duration: January 08, 2019 - November 01, 2021
   This proposal was highly encouraged by DOE with a very positive second round of reviews received in August 2018 but was not selected for funding.

5. **Sponsor: DOE - EERE - The Office of Energy Efficiency and Renewable Energy**
   Title: High-Efficiency, High-Reliability Grid Integration of Solar Photovoltaic Systems via Bidirectional Modular Multilevel Converters with Simultaneous Maximum Power Point Tracking and Power Flow Control Capabilities
   Budget: $2,269,043
   Role: Principal Investigator
   Duration: 07/01/18 - 06/30/21

6. **Sponsor: US - NSF - National Science Foundation**
   Title: RET Site in Computer Science and Engineering: Cybersecurity Education for All - Developing a Broad-based Cyber Defense Workforce for the 21st Century
   Budget: $595,267
   Role: Investigator
   Duration: 04/01/18 - 03/31/21

7. **Sponsor: US - NSF - National Science Foundation**
   Title: Using a Zero+ Energy Building as a Pathway to STEM Careers
   Budget: $1,142,807
   Role: Investigator
   Duration: 06/01/17 - 05/31/20

8. **Sponsor: Tennessee Department of Environment and Conservation**
   Title: Peak and Base Load Reduction Showcase at the UT Chattanooga (UTC) Center for Energy, Transportation and the Environment (CETE)
   Budget: $378,950
   Role: Principal Investigator
   Duration: 05/01/16 - 04/30/18

9. **Sponsor: US - NSF - National Science Foundation**
   Title: IRNC: ENgage - Research and Education Development of Open Virtual Laboratories, Networked for the Global Community (R&E DOVLab)
   Budget: $736,930
   Role: Principal Investigator
   Duration: 01/15/15 - 01/14/16

COMPUTER SKILLS:

- Skilled with Microsoft Office Applications, Windows, and UNIX Operating Systems.
- Skilled with Mathematical, Design, and Electronic Simulation Tools: P-Spice Schematics, NI Multisim, MATLAB, Simulink, LABVIEW, and Python.
- Skilled with Information Technology Applications: Web-Page Publishing, FrontPage, and HTML

PROFESSIONAL MEMBERSHIPS:

- The Institute of Electrical and Electronics Engineers (IEEE). ***Senior Member, Current***
- IEEE ***Industrial Application Society (IAS)***. (January 1, 2002 - ***Current***).
- American Society for Engineering Education (ASEE). (January 27, 2011 - ***Current***).
- IEEE ***Robotics and Automation (RA)*** Society. (January 1, 2017 - ***Current***).
- IEEE ***Education*** Society. (January 1, 2014 - ***Current***).
- IEEE ***Power & Energy Society (PES)***. (January 1, 2012 - ***Current***).

DONALD R. REISING, Ph.D.
Guerry and UC Foundation Associate Professor
Electrical Engineering Department
College of Engineering and Computer Science (CECS)
The University of Tennessee at Chattanooga (UTC)
735 Vine Street
Chattanooga, TN 37403
Phone: (423) 425-5843
Email: donald-reising@utc.edu

Education:

- Doctor of Philosophy, Air Force Institute of Technology, 2012.
  Major: Electrical Engineering
  Dissertation Title: Exploitation of RF-DNA for device classification and verification using GRLVQI processing.
- Master of Science in Electrical Engineering, Air Force Institute of Technology, 2009.
  Thesis Title: Classifying Emissions from Global System for Mobile (GSM) Communication Devices Using Radio Frequency (RF) Fingerprints.
- Bachelor of Science in Electrical Engineering, University of Cincinnati, 2006.
  Supporting Areas of Emphasis: Mathematics.

Teaching Experience:

- Alexander and Charlotte Guerry Associate Professor, University of Tennessee at Chattanooga, TN, 2023 -
- UC Foundation Associate Professor, University of Tennessee at Chattanooga, TN, 2022 -
- Associate Professor, University of Tennessee at Chattanooga, TN, 2020-2022
- Assistant Professor, University of Tennessee at Chattanooga, TN, 2014-2020
- Adjunct Professor, Sinclair Community College, OH, 2011-2013
- Adjunct Professor, Air Force Institute of Technology, OH, 2012-2014

Professional Experience:

- Electronics Engineer, U.S. Air Force Research Laboratory, Sensors Directorate, 2009-2014
- Communications Engineer, U.S. Air Force Aeronautical Systems Center, 2006-2009

Professional Memberships:

- Tau Beta Pi, 2011 - Present
- Eta Kappa Nu, 2007 - Present
- Senior Member, Institute of Electrical and Electronics Engineers, 2004 – Present
  - Societies: Communications; Computer; Power & Energy; Signal Processing

Awards and Honors:

- Alexander and Charlotte Guerry Professorship, University of Tennessee at Chattanooga, July 2023
- IEEE Power & Energy Society (PES) Chattanooga Chapter Outstanding Engineer Award, 2022

- University of Chattanooga (UC) Foundation Professorship, University of Tennessee at Chattanooga, July 2022
- Outstanding Service Award, University of Tennessee at Chattanooga, April 2018
- U.S. Air Force Dr. John L. McLucas Basic Research Award Nominee, 2014
- U.S. Air Force Research Laboratory Sensors Directorate Dr. Samuel M. Burka Award, 2013
- Tau Beta Pi – Engineering Honor Society, 2010
- Association of Old Crows Research Excellence Award, 2009
- Measurement and Signature Intelligence Committee Academic Excellence Award, 2009

Conference Proceedings (* - Denotes Student, ^ - Undergraduate):

- Rogers*, Fadul, Reising, "Deep Learning-driven Frequency Hopping for IEEE 802.11a Wi-Fi in the Presence of an Eavesdropper," *IEEE Consumer Communications & Networking Conference*, ***Accepted***, January 2025.
- Fadul, Reising, "Using Deep Learning to Combat Pilot Jamming in SISO OFDM-based Wireless Networks." *IEEE Military Communications Conference (MILCOM),* ***Accepted****,* 2024.
- Kim*, Loveless, Pew*, Young, Reising, Nour, Barnaby, "On-Chip Characterization of Random Telegraph Signal Noise in Bulk 90 nm CMOS." *IEEE International Reliability Physics Symposium (IRPS),* April 2024.
- Fadul, Reising, "Enhanced Communications Security via End-to-End Deep Adversarial Learning-driven Encoding." *IEEE International Mediterranean Conference on Communications and Networking (MeditCom),* July 2024.
- Steele*, Reising, Boyd, Murphy, "Deep Convolutional Neural Network for Multiple Smart Grid Event Classification through Sliding Windows." *International Conference on Smart Grid Synchronized Measurements & Analytics (SGSMA),* May 2024.
- Peyton*, Carpenter*, Reising, Loveless, "Classification of Microelectronics Radiation Effects Using Unsupervised Machine Learning." *IEEE Aerospace Conference*, March 2024.
- Tyler*, Reising, Fadul, Sartipi, "Assessing Time Offset and Classifier Impacts on Preamble-based Cross-Collection SEI," *IEEE Consumer Communications & Networking Conference*, January 2024.
- Mohammed* Taha*, Tyler*, Fadul, Reising, "CNN-based Emitter ID-Verification and Rogue Emitter Rejection for IoT Networks using Entropy-Informed RF-DNA Fingerprints," *IEEE Military Communications Conference (MILCOM),* December 2023.
- Peggs^, Jackson^, Tittlebaugh^, Olp^, Tyler*, Reising, Loveless, "Preamble-based RF-DNA Fingerprinting Under Varying Temperatures," *11th International Conference on Cyber-Physical Systems*, June 2023.
- Reising, Tyler*, Fadul, Hilling*, Loveless, "RF Fingerprint-based Identity Verification in the Presence of an SEI Mimicking Adversary," *19th International Conference on Wireless and Mobile Computing, Networking and Communications*, June 2023.
- Tyler*, Reising, Fadul, Sartipi, "Protecting Legitimate SEI Security Approaches From Phase-based Obfuscation Attacks," *IEEE International Conference on Communications (ICC),* May 2023.
- Taha*, Fadul, Tyler*, Reising, and Loveless, "An Assessment of Entropy-Based Data Reduction for SEI Within IoT Applications," *IEEE Military Communications Conference (MILCOM),* December 2022.

- Tyler*, Fadul, Reising, and Liang, "Assessing the Presence of Intentional Waveform Structure In Preamble-based SEI," *IEEE Global Communications Conference (GLOBECOM),* December 2022.
- Tyler*, Fadul*, Reising, and Kandah, "An Analysis of Signal Energy Impacts and Threats to Deep Learning Based SEI," *IEEE International Conference on Communications (ICC),* May 2022.
- Fadul, Willis^, Reising, and Loveless, "An Analysis of Process Parameters for the Optimization of Specific Emitter Identification Under Rayleigh Fading," *Springer Global IoT Summit,* June 2022.
- Fadul*, Reising, Arasu, and Clark, "Adversarial Machine Learning for Enhanced Spread Spectrum Communications," Military Communications Conference (MILCOM), Dec. 2021
- Tyler*, Fadul*, Reising, and Kaplanoglu, "Simplified Denoising for Robust Specific Emitter Identification of Preamble-based Waveforms," *IEEE Global Communications Conference (GLOBECOM),* December 2021.
- Mannon*^, Suggs*^, Reising, and Hay, "Automated Identification of Re-Closing Events in an Operational Smart Power Grid," *IEEE SoutheastCon,* March 2020.
- Wilson*, Reising, and Loveless, "Integration of Matched Filtering within the RF-DNA Fingerprinting Process," *IEEE Global Communications Conference (GLOBECOM),* December 2019.
- Kandah, Cancelleri*^, Reising, Altarawneh, and Skjellum, "A Hardware-Software Codesign Approach to Identity, Trust, and Resilience for IoT/CPS at Scale," *IEEE International Conference on Internet of Things (iThings),* July 2019.
- Fadul*, Reising, Loveless, and Ofoli, "RF-DNA Fingerprinting Classification of OFDM Signals Using a Rayleigh Fading Channel Model," *IEEE Wireless Communications and Networking Conference (WCNC),* April 2019.
- Wilson*, Reising, Hay, Johnson, "Automated Fuse Identification within An Operational Smart Power Grid," *IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC),* October 2018.
- Fadul*, Patel*, Reising, Loveless, Sartipi, "Estimating Energy Consumption Using Instantaneous Temperature," *American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Annual Conference,* June 2018.
- Wheeler*, and Reising, "Assessment of the Impact of CFO on RF-DNA Fingerprint Classification Performance," *IEEE International Conference on Computing, Networking and Communications (ICNC),* January 2017.
- Harmer, Reising, and Temple, "Classifier Performance Comparison Using 2D RF-DNA Features". *IEEE International Conference on Communications (ICC),* June 2013.
- Reising, and Temple, "WiMAX Mobile Subscriber Verification Using Gabor-Based RF-DNA Fingerprints," *IEEE International Conference on Communications (ICC),* June 2012.
- Reising, Temple, and Oxley, "Gabor-based RF-DNA Fingerprinting for Classifying 802.16e WiMAX Mobile Subscribers," *IEEE International Conference on Computing, Networking and Communications (ICNC),* January 2012.
- Reising, Prentice, and Temple, "An FPGA Implementation of Real-Time RF-DNA Fingerprinting for RFINT Applications." *IEEE Military Communications Conference (MILCOM),* October 2011.

- Williams, Temple, and Reising, "Augmenting Bit-Level Network Security Using Physical Layer RF-DNA Fingerprinting," *IEEE Global Communications Conference (GLOBECOM),* December 2010.
- Reising, Temple, and Mendenhall, "Improving Intra-Cellular Security Using Air Monitoring with RF Fingerprints," *IEEE Wireless Communication and Networking Conference (WCNC),* April 2010.
- Klein, Temple, Mendenhall, and Reising, "Sensitivity Analysis of Burst Detection and RF Fingerprinting Classification Performance," *IEEE International Conference on Communications (ICC),* June 2009.

Journal Articles (* - Denotes Student, ^ - Undergraduate):

- Steele*, Reising, Li, "Recovery of Quantum Correlations using Machine Learning." *PRX-Quantum, **Under Review**,* 2024.
- Tyler*, Reising, Cooke, Murphy, "Power Signal Histograms: A Method of Power Grid Data Compression on the Edge for Real-time Incipient Fault Forensics." *MDPI Applied Sciences Journal, **Under Review**,* 2024.
- Tyler*, Fadul, Hilling, Reising, Loveless, "Assessing Adversarial Replay and Deep Learning-Driven Attacks on Specific Emitter Identification-based Security Approaches." *Discover Internet of Things: Security, Privacy and Reliability of IoT Systems, **Under Review***, 2023.
- Taha*, Fadul, Reising, Loveless, Tyler*, "Enhanced Transportation Cyber-Physical Systems Security Through Entropy-Informed RF-DNA Fingerprint Learning from Gabor-based Images." *EURASIP Journal on Information Security Collection on Trends in Digital Identity: Security, Privacy, and Trust,* no. 27, 2024.
- Reising, Tyler*, Fadul, Hilling, Loveless, "Improved RF Fingerprint-based Identity Verification in the Presence of an SEI Mimicking Adversary." *(Invited) Journal of Cyber Security and Mobility,* vol. 13, no. 5, 2024.
- Khaleghian*, Harris, Fadul, Reising, Sartipi, "An SDR-based LTE for Infrastructure-based Vulnerable Road Users Safety: A Field Demonstration Transportation Research Record." *Transportation Research Record,* 2024
- Boyd*, Tyler*, Murphy, and Reising, "Learning from Power Signals: An Automated Approach to Electrical Disturbance Identification Within a Power Transmission System." *Sensors: Special Issue on Sensors Technology and Data Analytics Applied in Smart Grid,* 24(2), 2024.
- Boyd*, Reising, Murphy, Kuhlers, McAmis, Rossman, "Machine Learning Techniques to Predict Voltage Unbalance in a Power Transmission System," *IEEE Open Journal of Industry Applications,* vol. 5, 2024.
- Peyton^, Carpenter*, Camp*, Fadul, Dean*, Reising, Loveless, "Supervised Deep Learning and Classification of Single-Event Transients," *IEEE Transactions on Nuclear Science,* vol. 20, no. 8, 2023.
- Fadul, Reising, Weerasena, Loveless, and Sartipi, "Improving RF-DNA Fingerprinting Performance in An Indoor Multipath Environment Using Semi-Supervised Learning," *IEEE Transactions on Information Forensics and Security,* vol. 19, 2024.
- Fadul, Reising, and Weerasena, "An Investigation into the Impacts of Deep Learning-based Re-sampling on Specific Emitter Identification Performance," *IET Journal of Engineering,* Issue 11, 2023.

- Tyler*, Fadul, Reising, Considerations, Advances, and Challenges Associated with the Use of Specific Emitter Identification in the Security of Internet of Things Deployments: A Survey. *Information,* 14(9), 49, 2023.
- Carpenter*, Peyton^, Dean^, Lawrence*, Young*, Reising, and Loveless, "Detection of Single Event Transients in Arbitrary Waveforms using Statistical Window Analysis," *IEEE Transactions on Nuclear Science,* vol. 70, no. 4, 2023.
- Tyler*, Reising, Kandah, Kaplanoglu, and Fadul, "Physical Layer-based IoT Security: An Investigation into Improving Preamble-based SEI Performance When Using Multiple Waveform Collections," *IEEE Access,* vol. 10, Dec. 2022.
- Lawrence*, Smith^, Cannon^, Carpenter*, Reising and Loveless, "Effects of Total Ionizing Dose on SRAM Physical Unclonable Functions," *IEEE Transactions on Nuclear Science,* vol. 69, no. 3, Mar. 2022.
- Fadul*, Reising, and Sartipi, "Identification of OFDM-based Radios under Rayleigh Fading using RF-DNA and Deep Learning," *IEEE Access,* vol. 9, Jan. 2021.
- Cannon*^, Loveless, Estrada*^, Boggs*, Lawrence*, Santos*, McCurdy, Sternberg, Finzell, Cannon, and Reising, "Electrical Measurement of Cell-to-Cell Variation of Critical Charge in SRAM and Sensitivity to Single-Event Upsets by Low-Energy Protons," *IEEE Transactions on Nuclear Science,* vol. 68, no. 5, Feb. 2021.
- Loveless, Reising, Cancelleri*, Massengill, and McMorrow, "Analysis of Single Event Transients (SETs) using Machine Learning and Ionizing Radiation Effects Spectroscopy (IRES)," *IEEE Transactions on Nuclear Science,* vol. 68, no. 8, Jan. 2021.
- Fadul*, Reising, Loveless, and Ofoli, "Nelder-Mead Simplex Channel Estimation for the RF-DNA Fingerprinting of OFDM Transmitters Under Rayleigh Fading Conditions," *IEEE Transactions on Information Security and Forensics,* vol. 16, Jan. 2021.
- Reising, Cancelleri*, Loveless, Kandah, and Skjellum, "Pre-print: Radio Identity Verification-based IoT Security Using RF-DNA Fingerprints and SVM," *IEEE Internet of Things Journal,* vol. 8, no. 10, May 2021.
- Wilson*, Reising, Hay, Johnson, Karrar, and Loveless, "Automated Classification of Electrical Disturbance Waveforms within an Operational Smart Power Grid," *IEEE Transactions on Smart Grid,* vol. 11, no. 5, Sept. 2020.
- Loveless, Patel*, Reising, Roca*^, Allen*^, Massengill, and McMorrow, "Single Event Transient Spectroscopy," *IEEE Transactions on Nuclear Science,* vol. 67, no. 1, Jan. 2020.
- Patel*, Joplin*, Boggs*, Reising, McCurdy, Massengill, and Loveless, "Ionizing Radiation Effects Spectroscopy (IRES) for Analysis of Total-Ionizing Dose Degradation in Voltage-Controlled Oscillators," *IEEE Transactions on Nuclear Science,* vol. 66, no. 1, Oct. 2018.
- Reising, Temple, and Jackson, "Authorized and Rogue Device Discrimination Using Dimensionally Reduced RF-DNA Fingerprints," *IEEE Transactions on Information Forensics and Security,* vol. 10, no. 6, Jun. 2015.
- Reising, Temple, and Mendenhall, "Improved Wireless Security for GMSK-based Devices Using RF Fingerprinting," *International Journal Electronic Security and Digital Forensics,* vol. 3, no. 1, 2010.

Presentations and Invited Talks:

- Fadul, M. (Author), Reising D. (Author & Presenter) (July 2024). "Enhanced Communications Security via End-to-End Deep Adversarial Learning-driven Encoding." IEEE International Mediterranean Conference on Communications and Networking (MeditCom).

- Tittlebaugh, A. (Author & Presenter), Peggs, C. (Author), Jackson, T. (Author), Olp, T. (Author), Tyler, J. (Author), Reising, D. R. (Author), Loveless, T. D. (Author) (April 9, 2024). "Preamble-based RF-DNA Fingerprinting under Varying Temperatures." The National Conference on Undergraduate Research (NCUR).
- Reising, D. R. (Author & Presenter) (March 14, 2024). "Wireless Communications Security." Brigham Young University, *Invited*.
- Peyton, T. (Author & Presenter), Carpenter, J. (Author), Reising, D. R. (Author & Presenter), Loveless, T. D. (Author) (March 8, 2024). "Classification of Microelectronics Radiation Effects Using Unsupervised Machine Learning." Paper at IEEE Aerospace Conference, Big Sky, Montana, USA.
- Khaleghian, S., Harris, A. (Author), Tyler, J. H. (Author), Fadul, M. M. K. (Author), Reising, D. R. (Author & Presenter), Sartipi, M. (Author) (January 8, 2024). "LTE for Infrastructure-based Vulnerable Road Users Safety: A Field Demonstration." Paper at 2024 Transportation Research Board (TRB) Annual Meeting, Washington, DC.
- Tyler, J. H. (Author), Fadul, M. M. K. (Author), Reising, D. R. (Author & Presenter), Sartipi, M. (Author) (January 7, 2024). "Assessing Time Offset and Classifier Impacts on Preamble-based Cross-Collection SEI." IEEE 21st Consumer Communications & Networking Conference (CCNC).
- Mohammed, A., (Author) Taha, M. (Author), Tyler, J. (Author), Fadul, M. (Author), Reising, D. (Author & Presenter), and Loveless, T. (Author) (October 31, 2023). “An Assessment of Entropy-Based Data Reduction for SEI Within IoT Applications,” IEEE Military Communications Conference (MILCOM).
- Taha, M. (Author & Presenter), Fadul, M. (Author), Tyler, J. (Author), Reising, D. (Author), and Loveless, T. (Author) (November 30, 2022). “An Assessment of Entropy-Based Data Reduction for SEI Within IoT Applications,” IEEE Military Communications Conference (MILCOM).
- Reising, D. (Author & Presenter) (September 29, 2022). “Critical Infrastructure Protection: Device, Network, & System.” Mississippi State University Department of Computer Science and Engineering Seminar Series, https://www.cse.msstate.edu/event/speaker-seminar-series-donald-reising/.
- Carpenter, J. (Author & Presenter), Dean, B. (Author), Lawerance, S. (Author), Young, R. (Author), Reising, D. R. (Author), Loveless, T. D. (Author) (July 22, 2022). "Detection of Single Event Transients in Arbitrary Waveforms using Statistical Window Analysis." Symposium at Nuclear and Space Radiation Effects Conference (NSREC).
- Fadul, M. M. K. (Author), Willis, J. T. (Author), Reising, D. R. (Author & Presenter), Loveless, T. D. (Author) (June 21, 2022). "An Analysis of Process Parameters for the Optimization of Specific Emitter Identification Under Rayleigh Fading." Paper at Global IoT Summit, Dublin, Ireland.
- Lopez, J. (Moderator), Reising, D. R. (Panelist), Carnes, K. (Panelist), Huber, P. (Panelist) (June 9, 2022). "Modeling & Simulation in Industrial Cyber-Physical Systems." Panel at SIGSIM PADS 2022.

- Tyler, J. (Author), Fadul, M. (Author), Reising, D. (Author & Presenter), Kandah, F. (Author) (May 18, 2022). "An Analysis of Signal Energy Impacts and Threats to Deep Learning Based SEI." Paper at International Conference on Communications (ICC), Seoul, South Korea.
- Reising, D. (Author & Presenter) (May 12, 2022). "Protection of Critical Infrastructure." Invited talk at The Rotary Club of McMinnville, McMinnville, TN.
- Boyd, J. (Author & Presenter), Tyler, J. (Author), Murphy, A. (Author), Reising, D. (Author) (May 2, 2022). "Learning from Power Signals: An Automated Approach to Electrical Disturbance Identification." Paper at Fault and Disturbance Analysis Conference, Atlanta, Georgia, USA.
- Tittlebaugh, A. (Author & Presenter), Olp, T. (Author), Peggs, C. (Author), Reising, D. (Author), Loveless, T. (Author) (April 2022). "Extreme Environment Effects on Software Defined Radios (SDR) Radio Frequency Distinct Native Attributes (RF-DNA Fingerprints)." Symposium at National Conference on Undergraduate Research (NCUR) @ Home.
- Tyler, J. (Author), Fadul, M. (Author), Reising, D. (Author & Presenter), Kaplanoglu, E. (Author) (December 8, 2021). "Simplified Denoising for Robust Specific Emitter Identification of Preamble-based Waveforms." Paper at IEEE Global Communications (GLOBECOM) Conference, Madrid, Spain.
- Fadul, M. (Author), Reising, D. (Author & Presenter), Arasu, K. (Author), Clark, M. (Author) (December 1, 2021). "Adversarial Machine Learning for Enhanced Spread Spectrum Communications." Paper at Military Communications (MILCOM) Conference 2021, San Diego, CA.
- Dean, B. (Author & Presenter), Carpenter (Author), Reising, D. (Author), Loveless, T. (Author) (October 25, 2021). "Characterization of Single Event Transients (SETs) with Ionizing Radiation Effects Spectroscopy (IRES) & Machine Learning (ML)." Symposium at CUR Research Experiences for Undergraduates (REU) Symposium.
- Mitchell, W. (Author & Presenter), Hall, K. (Author), Ibrahim, A. (Author), Reising, D., Loveless, T. (Author) (March 2020). "Phase-Modulated Local Oscillator Effects on RF-DNA Fingerprints in IEEE 802.11a Wi-Fi Signals." Poster at American Physical Society March Meeting 2020.
- Mannon, T. (Author), Suggs, J. (Author), Reising, D. (Author & Presenter), Hay, R. (Author) (March 28, 2020). "Automated Identification of Re-Closing Events in an Operational Smart Power Grid." Paper at SoutheastCon 2020, Rayleigh, NC.
- Wilson, A. (Author), Reising, D. (Author & Presenter), Loveless, T. (Author) (December 2019). "Integration of Matched Filtering within the RF-DNA Fingerprinting Process." Paper at Global Communications Conference (GLOBECOM), Hawaii, USA.
- Cannon, J. (Author & Presenter), Estrada, R. (Author), Boggs, R. (Author), Reising, D. (Author), Loveless, T. (Author) (October 2019). "Electrical-Based Screening of Radiation Failure Modes in Transistor-Based Memory for Space Application." Poster at Research Experiences for Undergraduates Symposium, Alexandria, VA.
- Patel, B. (Author & Presenter), Reising, D. (Author), Massengill, L. (Author), Loveless, T. (July 12, 2019). "Single Event Transient Analysis with Ionizing Radiation Effects Spectroscopy (IRES)." Poster at Nuclear and Space Radiation Effects Conference, San Antonio, Texas.
- Patel, B. (Author & Presenter), Reising, D. (Author), Massengill, L. (Author), Loveless, T. (May 2019). "Single Event Transient Analysis with Ionizing Radiation Effects Spectroscopy (IRES)." Session at Single Event Effects (SEE) Symposium, San Diego, CA.

- Patel, B. (Author & Presenter), Joplin, M. (Author), Boggs, R. (Author), Reising, D. (Author), McCurdy, M. (Author), Massengill, L. (Author), Loveless, T. (Author) (July 2018). "Ionizing Radiation Effects Spectroscopy (IRES) for Analysis of Total Ionizing Dose Degradation in Voltage-Controlled Oscillators." Poster at Nuclear and Space Radiation Effects Conference (NSREC), Kona, HI.
- Fadul, M. (Author), Patel, A. (Author), Reising, D. (Author & Presenter), Loveless, T. (Author), Sartipi, M. (Author) (June 2018). "Estimating Energy Consumption Using Instantaneous Temperature." Paper at 2018 ASHRAE Annual Conference, Houston, Texas.
- Reising, D. (Presenter) (June 21, 2017). "Making the Smart Grid "Smarter" Through Real-Time Electrical Disturbance Identification." Session at EPRI Grid Analytics and Power Quality Conference and Exhibition, Sacramento, California.
- Wheeler, C. (Author), Reising, D. (Author & Presenter) (January 2017). "Assessment of the Impact of CFO on RF-DNA Fingerprint Classification Performance." Paper at International Conference on Computing, Networking, and Communications, Silicon Valley, California.

Invention Disclosures:

- Reising, D., Tyler, J., ``Audio Resampling," 2023.
- Carpenter, J., Loveless, D., Bharat, P., Peyton, T. Reising, D., ``Ionizing Radiation Effects Spectroscopy (IRES) Window Filter," 2022.
- Reising, D., Boyd, J., Coleman, A., Tyler, J., ``Learning from Power Signals," 2021.

Contracts, Grants, and Sponsored Research:

- Reising, D., et al. (five universities & 30+ investigators), "NSF Engineering Research Center (ERC) for Protecting Intelligent Energy Systems (PIES)," Sponsored by National Science Foundation (NSF), Federal, ***Preliminary Proposal***. *(Under Review).*
- Li, T., Reising, D., Lukens, J., "Collaborative Research: Demonstration of Sub-Shot-Noise Limited Distributed Quantum Sensing on a Commercial Metropolitan-Scale Quantum Network via Deep Learning Aided Noise Suppression," Sponsored by National Science Foundation, Federal, $549,909. *(Under Review).*
- Guo, N., MacKenzie, A., Reising, D., "Collaborative Research: NewSpectrum: Robust Spectrum Management Automation in A Zero-Trust Framework," Sponsored by National Science Foundation (NSF), Federal, $800,000.00. *(Under Review).*
- Kandah, F., Reising, D., "Collaborative Research: SaTC: CORE: Small: Symbiotic Trust and Identity For Resilient Systems and Data Integrity," Sponsored by National Science Foundation, Federal, $293,988. *(Under Review).*
- Sartipi, M., Harris, A., Zhang, T., Reising, D., Ward, C., "Interoperable V2X Solutions for Advancing Energy Efficiency in Diverse Traffic Environments," Sponsored by Department of Energy, Federal, $2,660,625. *(Under Review)*.
- Reising, D., "Collaborative AI/ML RF Agnostic Fingerprinting (CARAF)," Sponsored by U.S. Government, Federal, $637,771. *(Under Review)*.
- Mackenzie, A., Shannigrahi, S., Reising, D., Rogers, T., Wallin, J., Skjellum, A., "TREN: Building a Tennessee Research and Education Network," Sponsored by National Science Foundation, Federal, $260,000.00. *(Funded).*
- Skjellum, A., Li, T., Reising, D., Walker, D., "Collaborative Research: Beginnings: Creating and Sustaining a Diverse Community of Expertise in Quantum Information Science (EQUIS)

Across the South-Eastern United States," Sponsored by National Science Foundation, Federal, $258,486.00. *(Funded).*

- Reising, D., "WiSPrING for Optimal Privacy," Sponsored by Defense Advanced Research Project Agency (DARPA), Federal, $244,637. (May 1, 2023 – October 5, 2024).
- Reising, D., "Learning from Power System Signals: Integration and Deployment," Sponsored by Tennessee Valley Authority (TVA), Federal, $100,000. (October 1, 2022 – June 30, 2024).
- Loveless, T., Reising, D., Skjellum, A., "Heterogeneous computing system with dynamic fault tolerance to radiation harden commercial microelectronics (Hetero-Hard)," Sponsored by CFD Research Corporation (CFDRC), Federal, $650,000. *(Funded).*
- Loveless, T. D. (Principal), Reising, D. R. (Principal), "Efficient characterization and analysis of radiation hardness in System-on-a-Chip (SoC) and 3D Integrated Circuit (3D IC) using spectroscopy and machine learning," Sponsored by DOD - SEC - DTRA - Defense Threat Reduction Agency, Federal, $51,000.00. *(Funded).*
- Reising, D., "Scalable Asymmetric Lifecycle Engagement (SCALE) Radiation-Hard Microelectronics Workforce Development Consortium," Sponsored by Department of Defense, Federal, $429,300.00. (August 1, 2023 – October 20, 2024).
- Reising, D., "Foundry Assurance Modeling & Experiments for Radiation Hardened (FAME-RH) Applications," Sponsored by Nimbis Services, Inc., Federal, $108,000.00. (February 1, 2023 - July 31, 2024).
- Sartipi, M., Kandah, F., Osman, O., Reising, D., Wu, D., "CCRI: New: RUI: Testbed as-a-Service: A Sandbox for Fostering Smart and Connected City Research & Development," Sponsored by National Science Foundation, Federal, $1,374,885. (October 1, 2021 - September 30, 2024).
- Reising, D., Sartipi, M., Lopez, J., Awad, R., "A Defense-In-Depth Approach for Operable and Safe Connected Vehicles," Sponsored by The Oak Ridge Institute at University of Tennessee, State, $274,949. (August 2021 - May 2023).
- Reising, D., Karrar, A., "REVV! Safer Power Network," Sponsored by Oak Ridge National Laboratory, Federal, $100,000. (January 2021 - January 1, 2023).
- Reising, D., "Learning from Power Signals," Sponsored by Tennessee Valley Authority (TVA), Federal, $197,675. (February 23, 2021 - October 1, 2022).
- Loveless, T., Reising, D., "REU Site: An Interdisciplinary CubeSat Research and STEM Education Platform at University of Tennessee at Chattanooga (UTChattSat)," Sponsored by National Science Foundation, Federal, $359,783. (March 2018 – February 2023).
- Linga, K., Loveless, T., Reising, D., Skjellum, A., "Heterogeneous computing system with dynamic fault tolerance to radiation harden commercial microelectronics (Hetero-Hard)," Sponsored by Missile Defense Agency (MDA), Federal, $45,935. (December 6, 2021 - June 5, 2022).
- Reising, D., Loveless, T., "Title redacted per the funding agency," Sponsored by U.S. Government, Federal, $434,569. (June 1, 2021 - March 1, 2022).
- Reising, D., Loveless, T., Kandah, F., Skjellum, A., "REVV: Development of a sensor to detect and monitor potential health risks in the home," Sponsored by Oak Ridge National Laboratory, Federal, $250,000. (August 2020 - November 2021).
- Skjellum, A., Reising, D., Kandah, F., "RevV! Data Analytics to Fast-Forward Product Development and Job Creation In Tennessee," Sponsored by Oak Ridge National Laboratory, Federal, $250,000. (August 2019 - November 2020).

- Loveless, T., Reising, D., "Fault-Tolerant Design Through Ionizing Radiation Effects Spectroscopy and Intelligent Control," Sponsored by Office of Naval Research (ONR), Federal, $200,000. (August 2019 - March 2020).
- Reising, D., "Learning from Power Quality Waveforms," Sponsored by Electric Power Research Institute (EPRI), Other, $58,938. (August 1, 2017 - July 31, 2019).

Directed Student Learning:

- Dissertation Committee Chair, "TBD," August 2022 – Present, Candidate: Joshua Tyler.
- Dissertation Committee Chair, "TBD," January 2022 – Present, Candidate: Edward Steele.
- Dissertation Committee Chair, "TBD," January 2024 – Present, Candidate: Joshua Rogers.
- Master's Thesis Committee Chair, "TBD," January 2022 – Present, Candidate: Mohamedelfateh Mohamedkhir
- Honor's Thesis Committee Chair, "Investigation of PRA for Rapid Part Replacement," August 2023 – May 2024, Candidate: John Lazenby.
- Master's Thesis Committee Chair, " Investigations into the role of entropy-selected RF-DNA fingerprint features on ID-verification performance in the presence of rogue emitters," January 2022 – May 2024, Candidate: Awab Mohammed.
- Master's Thesis Committee Member, "Analysis of single event transients in arbitrary waveforms using statistical window analysis," August 2020 – May 2022, Candidate: James Carpenter.
- Master's Thesis Committee Chair, "Automated Detection and Prediction of Electrical Disturbances in a Power Transmission System," June 2021 – May 2023, Candidate: Jonathan Boyd.
- Master's Thesis Committee Chair, "Entropy Aided RF-DNA Fingerprint Learning from Gabor-based Images," June 2021 – May 2023, Candidate: Mohamed Taha.
- Master's Thesis Committee Member, "System-Level Radiation Effects Analysis Using Probabilistic Risk Assessment," August 2021 – May 2023, Candidate: Stephen Lawrence.
- Master's Thesis Committee Chair, "Addressing the challenges facing deep learning based Specific Emitter Identification via preamble-based waveforms," August 2020 – December 2022, Candidate: Joshua Tyler.
- Dissertation Committee Member, "Design, Modeling, and Simulation of Secure X.509 Certificate Revocation," January 2020 – December 2022, Candidate: Sai Medury.
- Master's Thesis Committee Member, "Deep learning-based anomaly detection for edge-layer devices," August 2020 – May 2022, Candidate: Jonathan Hunter.
- Honor's Thesis Committee Member, "Incorporating in situ measurements of energy into a designed method of detection of radiation induced degradation in embedded systems," August 2021 – May 2022, Candidate: Delwyn Sam.
- Dissertation Committee Chair, "Improving IoT security through the use of deep learning at the physical layer," January 2018 – May 2022, Candidate: Mohamed Fadul.
- Master's Thesis Committee Chair, "The manipulation of RF-DNA fingerprints through the use of a phase-modulated clock in IEEE802.11a Wi-Fi signals," August 2018 – May 2020. Candidate: Ahmed Ibrahim.
- Master's Thesis Committee Member, "Ionizing radiation effects spectroscopy," January 2018 – December 2019, Candidate: Bharat Patel.

- Master's Thesis Committee Member, "An electro-optical simulation methodology for the analysis of single-event radiation effects in photonic devices," August 2017 – August 2019, Candidate: Ryan Boggs.
- Master's Thesis Committee Chair, "A hierarchical approach to automated identification of anomalous electrical waveforms," August 2017 – May 2019, Candidate: Aaron Wilson.
- Master's Thesis Committee Chair, "The impact of Rayleigh fading channel effects on the RF-DNA fingerprinting process," August 2016 – August 2018, Candidate: Mohamed Fadul.
- Master's Thesis Committee Member, "Development of a remote IoT laboratory for cyber physical systems," August 2015 – August 2017, Candidate: Amee Patel.
- Honor's Thesis Committee Member, " Wireless voice amplification device for weak patients," August 2015 – May 2016, Candidate: Daniel Johnson.

NSF BIOGRAPHICAL SKETCH

NAME: Shi, Junrong

ORCID: 0000-0002-9330-6767

POSITION TITLE & INSTITUTION: Assistant Professor, The University of Tennessee at Chattanooga

(a) PROFESSIONAL PREPARATION -(see PAPPG Chapter II.C.2.f.(a))

INSTITUTION	LOCATION	MAJOR / AREA OF STUDY	DEGREE (if applicable)	YEAR YYYY
China Agricultural University	Beijing, Beijing	Management	BA	2003
University of Reading	Reading, England	Applied Development Studies	MS	2004
State University of New York at Albany	Albany, NY	Social work	MSW	2013
State University of New York at Albany	Albany, NY	Social Work	PHD	2018

(b) APPOINTMENTS -(see PAPPG Chapter II.C.2.f.(b))

2018 - present Assistant Professor, The University of Tennessee at Chattanooga, Chattanooga, TN
2017 - 2018 Data Analyst, Center for Excellence in Aging and Community Wellness , Albany, NY
2015 - 2015 Research Assistant, Center for Social and Demographic Analysis , Albany, NY
2012 - 2015 Research Assistant , New York State Office for Aging, Albany, NY
2009 - 2010 Training Consultant, Help Age International
2006 - 2008 Child Welfare and Protection Program Officer , Save the Children (UK)
2005 - 2006 Monitoring and Evaluation Coordinator , Plan International

(c) PRODUCTS -(see PAPPG Chapter II.C.2.f.(c))

Products Most Closely Related to the Proposed Project

1. Shi J, Ferretti L, McCallion P. Attending with family members, completion rate and benefits accrued from chronic disease self-management program. Chronic Illn. 2021 Jul 20; PubMed PMID: 34282954.
2. Shi J, Chan K, Ferretti L, McCallion P. Caregiving Load and Respite Service Use: A Comparison between Older Caregivers and Younger Caregivers. J Gerontol Soc Work. 2018 Jan;61(1):31-44. PubMed PMID: 29058525.
3. Shi J, McCallion P, Ferretti LA. Understanding differences between caregivers and non-caregivers in completer rates of Chronic Disease Self-Management Program. Public Health. 2017 Jun;147:128-135. PubMed PMID: 28404488.

Other Significant Products, Whether or Not Related to the Proposed Project

(d) SYNERGISTIC ACTIVITIES -(see PAPPG Chapter II.C.2.f.(d))

1. She investigated the impact of social factors (e.g., race/ethnicity, gender, socioeconomic status, disability status) on the career choices of college students as the PI (project funded by UTC).

2. She analyzed a large dataset for multiple programs including the chronic disease self-management program (CDSMP), and the National Diabetes Prevention Program (NDPP) while working with research centers.

NSF BIOGRAPHICAL SKETCH

NAME: Yuan, Yukun

ORCID: 0000-0003-2027-7085

POSITION TITLE & INSTITUTION: Assistant Professor, University of Tennessee at Chattanooga

(a) PROFESSIONAL PREPARATION -(see PAPPG Chapter II.C.2.f.(a))

INSTITUTION	LOCATION	MAJOR / AREA OF STUDY	DEGREE (if applicable)	YEAR YYYY
Shanghai Jiao Tong University	Shanghai, Shanghai	Computer Science	BENG	2015
Stony Brook University	Stony Brook, NY	Computer Engineering	PHD	2022

(b) APPOINTMENTS -(see PAPPG Chapter II.C.2.f.(b))

2022 - present Assistant Professor, University of Tennessee at Chattanooga, Chattanooga, TN

(c) PRODUCTS -(see PAPPG Chapter II.C.2.f.(c))

Products Most Closely Related to the Proposed Project

1. Yuan Y, Zhang D, Miao F, Stankovic J, He T, Pappas G, Lin S. eRoute: Mobility-Driven Integration of Heterogeneous Urban Cyber-Physical Systems under Disruptive Events. IEEE Transactions on Mobile Computing. 2021. issn: 1536-1233
2. Yuan Y, Ma M, Han S, Zhang D, Miao F, Stankovic J, Lin S. DeResolver: a decentralized negotiation and conflict resolution framework for smart city services. Proceedings of the ACM/IEEE 12th International Conference on Cyber-Physical Systems. 2021; :98-109.
3. Yuan Y, Zhang D, Miao F, Stankovic J, He T, Pappas G, Lin S. Dynamic integration of heterogeneous transportation modes under disruptive events. 2018 ACM/IEEE 9th International Conference on Cyber-Physical Systems (ICCPS). 2018; :65-76. isbn: 153865301X
4. Yuan Y, Zhang D, Miao F, Chen J, He T, Lin S. p^ 2Charging: proactive partial charging for electric taxi systems. 2019 IEEE 39th International Conference on Distributed Computing Systems (ICDCS). 2019; :688-699. isbn: 1728125197
5. Yuan Y, Zhao Y, Chen L, Lin S. Game Theoretic Analysis of Urban E-Taxi Systems: Equilibria and Efficiency. IEEE International Conference on Sensing, Communication, and Networking (SECON). 2022.

Other Significant Products, Whether or Not Related to the Proposed Project

(d) SYNERGISTIC ACTIVITIES -(see PAPPG Chapter II.C.2.f.(d))

1. **Teaching and curriculum development**. I currently work in the Computer Science and Engineering department at University of Tennessee at Chattanooga (UTC). My research can create the senior capstone project for the undergraduate students to train their ability of analyzing data, designing algorithms, and evaluating methods by coding.
2. **Collaboration with communities**. I have an on-going project with City of Newark, NJ. I actively investigate the methods of detecting illegal parking and enhancing the service quality for residents, such as more efficient electric scooter system management.

APPENDIX B
AWARDEE PROJECT REPORT
FY2024

Fiscal Year 2024 Annual Project Report

Tennessee Higher Education Commission: Center of Excellence in Applied Computation Science and Engineering Grant Competition

Dr. Meredith Barbee, Lead PI

Co-PI(s): N/A

Project Title: "Exploring entanglements in polymer network topologies with single-chain nanoparticles"

Date Submitted: 09/30/21

Award Start - End Date: July 1, 2022 - June 30, 2024

Non-Technical Summary:

The focus of our research was on two main goals: 1) understanding how entanglements in polymer network chains influence the mechanical properties of materials and 2) developing a synthetic design for polymer networks that include single-chain polymer nanoparticles. Through a combination of simulations and synthesis of polymer materials, we aimed to uncover fundamental relationships important in designing polymer networks. We are especially interested in applying this concept to hydrogels, which have many potential biomedical applications but are limited by their brittle nature.

During the first year of our grant, four undergraduate students were trained as researchers. We were able to obtain preliminary results from our efforts towards synthesizing the networks of single-chain nanoparticles and have developed a plan for future synthetic and computational work in the second year of the grant. During the second year of the grant, Professor Mohammed Mahtabi was added as a collaborator for his computational expertise. Three of the four students continued to work on the project, one additional undergraduate joined the project, and one student was hired into a post-baccalaureate research position and worked 25 hours per week for a semester. This student worked closely with both PIs on synthesis and computation. Our work has been presented at two ACS regional meetings (five student posters in total), one ACS national meeting (1 student poster), and one polymer chemistry conference (Tosoh Polymer conference faculty poster), with an additional two student posters, one faculty talk accepted for a regional meeting in Fall 2024. The PI has been invited to contribute a manuscript to a young investigator issue of the journal Polymer Chemistry and plans to submit this work for consideration in 2025 following some additional experiments.

PROJECT TITLE

"Exploring entanglements in polymer network topologies with single-chain nanoparticles"

TECHNICAL APPROACH

1. Modeling SCNP folding and unfolding processes
2. Developing a synthetic approach to SCNP hydrogels
    a. Synthesize and characterize precursor polymers

   b. Investigate single-chain folding through silyl ether cross-linking and dynamic Cross-linking
   c. Pursue development of SCNP networks through chain-end modification and side-chain modification
3. Simulation-guided material design and characterization of first-generation materials
4. Community and university outreach

OUTCOMES

1. Trained four students in synthetic chemistry
2. Obtained preliminary results
3. Developed plans for future synthetic and computational work
4. Work was presented at UTC and regional conferences
5. A new course, CHEM 4040- Polymer Chemistry, was added to the curriculum, which will include aspects of this research
6. A new outreach demonstration was developed
7. Established a new collaboration with Dr. Mohammed Mahtabi and developed the software methods to conduct simulations

RESULTS

1. A procedure for molecular dynamics simulations was developed for polymer chains of 200 monomers
2. Synthesis of precursor polymers by RAFT
3. Preliminary data from crosslinking reactions with silyl ethers suggests intrachain folding. This result has been demonstrated in several polymer backbones, and studies of the reversibility of this reaction are ongoing
4. Synthesis of 3 chain transfer agents for RAFT polymerization that allows for polymer chain-end modification or initiation of polymerization from polymer chain ends
5. Synthesis of polymers with acrylate side chains
6. Synthesis of hydrogel networks from SCNP precursor polymers

OTHER INFO

Budget and Schedule

Total Budget: $100,000

Actual Used: $

Balance: $

Total period of performance is 12 months.

Task 1: Months 1-4

Task 2: Months 1-6

Task 3: Months 10-12

Task 3: Months 1-3 and 11

PI was on maternity leave for months 6-10

Deliverables

- External and internal conference presentations by undergraduate students
- Technical reports written by undergraduate students at the end of month 6

Organization Information

Meredith Barbee
303 Grote Hall Dept 2252, 615 McCallie
Ave, Chattanooga, TN 37403
425-425-5364

ACCOMPLISHMENTS & OUTCOMES

Project Overview

In the computational components of this project, we are in the process of performing molecular dynamics simulations of the polymer chains made of random arrangements of two hundred monomers (referred to as 200mer). Our experimental design was based on work on single-chain nanoparticle folding in random copolymers and uses an atomistic approach with similar force fields that have been previously reported.1 The various monomers making up the first generation of our model are shown in Figure 1. Several 200mers of random arrangements of these monomers -- made up of 50% poly(ethylene glycol) methyl ether acrylate (PEGA), 40% acetoacetoxyethyl acrylate (AEAA), and 20% 2-hydroxyethyl acrylate (HEA) -- are generated. These are monomers that we are also working with synthetically. To conduct the simulations, we are using the General Amber Force Field (GAFF). For this reason, and to have correct dihedrals and atomic charges compatible with GAFF, the charges of the atoms will be calculated using AmberTools. Molecular Dynamics simulations will then be conducted in LAMMPS by converting the molecular structures to a LAMMPS-compatible format. Equilibration will be performed in LAMMPS with the objective of achieving a molecular weight matching the experimental results. Once successful, mechanical loading will be applied to these models to evaluate their mechanical behavior, e.g., mechanical strength and their variations for different arrangements of monomers. The results of these simulations will complement the experimental results for a journal publication.

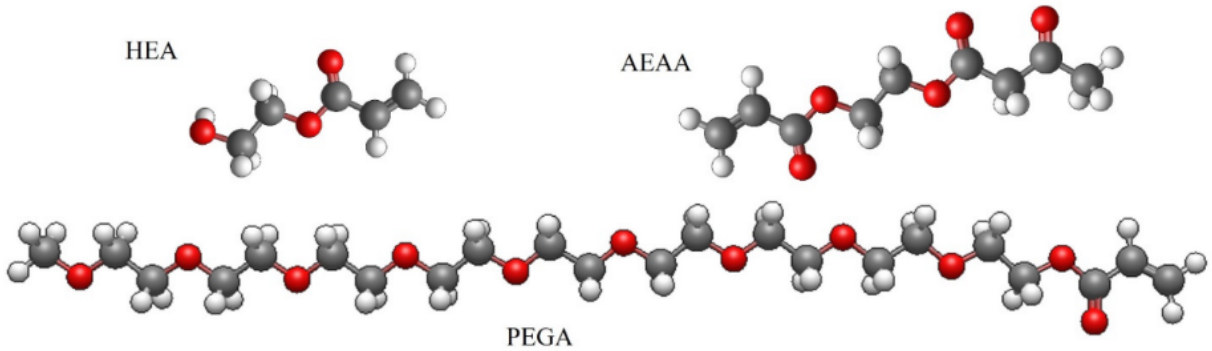

Figure 1: Various monomers that will make up the 200-mer in the MD simulations. In these molecules, gray atoms are carbon, red is oxygen, and white is hydrogen.

For the synthetic component of this project, we first focused on synthesizing precursor polymers, selecting “clip bonds” to form SCNPs, and performing intrachain cross-linking reactions. We

chose to initially focus on incorporating silyl ethers as “clip bonds” due to their wide use as protecting groups in organic synthesis and because of the relative ease of forming and breaking these bonds. To synthesize numerous precursor polymers, we used reversible activation fragmentation chain transfer (RAFT) polymerization. We identified poly(ethylene glycol) methyl ether acrylate or methyl acrylate as the monomers that comprise the majority of the polymer chains, but they are chemically inert. As a comonomer, we have investigated 2- hydroxyethyl acrylate, which contains a hydroxyl group that could react with a silane to form a silyl ether clip bond. We purified and characterized these polymers with nuclear magnetic resonance (NMR) and size exclusion chromatography (SEC) and determined that the precursor polymers had controlled chain lengths and low dispersity.

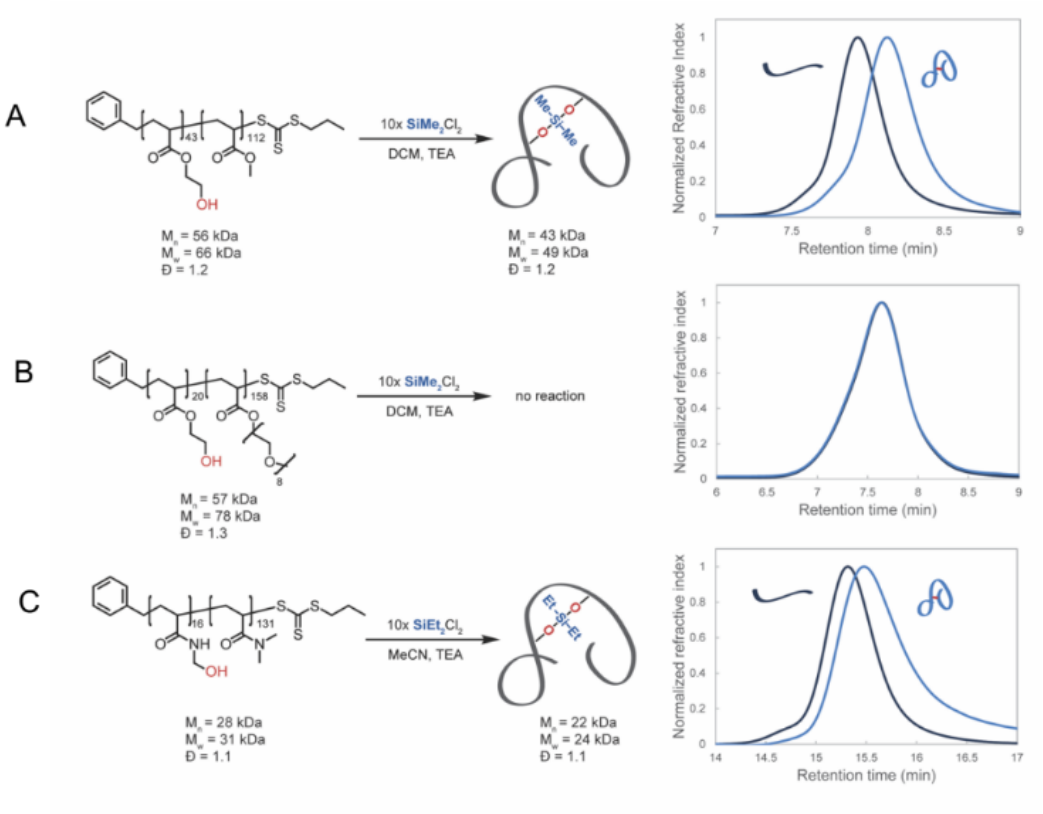

Figure 2: A: Single-chain collapse of a precursor polymer of poly(ethylene glycol) methyl ether acrylate and 2-hydroxyethyl acrylate. B: Single-chain collapse of a precursor polymer of poly(ethylene glycol) methyl ether acrylate and 2-hydroxyethyl acrylate. C: Single-chain collapse of a precursor polymer of N- hydroxymethylacrylamide and N, N-dimethylacrylamide. SEC traces for A and C have a longer retention time following the reaction, which is consistent with intra-chain folding. The apparent molecular weight decreases. The SEC trace for B shows no change.

Our initial efforts towards intrachain crosslinking of these precursor polymers with silanes have been promising. Inspired by the body of SCNP literature, we chose to add silane in a dropwise manner to a dilute solution of precursor polymer. For a copolymer of methyl acrylate and 2-hydroxyethyl acrylate, we observed longer retention times by SEC as expected for the formation of a single-chain nanoparticle (Figure 2A). One limitation of this polymer is that it is not water-soluble, which is necessary for future use in a hydrogel. As a result, a copolymer of poly(ethylene

glycol) methyl ether acrylate and 2-hydroxyethyl acrylate was prepared and was water-soluble, but we observed no change in size by SEC (Figure 2B). We hypothesized that the bulky poly (ethylene glycol) side chains may inhibit folding.

As a result, we chose to use monomers classified as acrylamides instead of acylates. The amide functionality increases the water solubility of the polymers due to increased hydrogen bonding, and a wide range of monomers are commercially available. A copolymer of N-hydroxymethylacrylamide and N,N-dimethylacrylamide was synthesized and crosslinked through a silyl ether, and SEC results indicated an apparent collapse in size (Figure 2C). We also developed a purification method for the SCNP. Precipitation was followed by dialysis and lyophilization to allow us to separate the SCNP from residual monomers and characterize it by NMR. The reverse reaction, where acid or a source of F- is added to break the silyl ether bond, is ongoing. We are also conducting kinetics experiments to determine whether the copolymers are statistical and studying the influence of the polymer size and density of hydroxyl groups on the reaction. We are preparing to submit this work for publication in 2025.

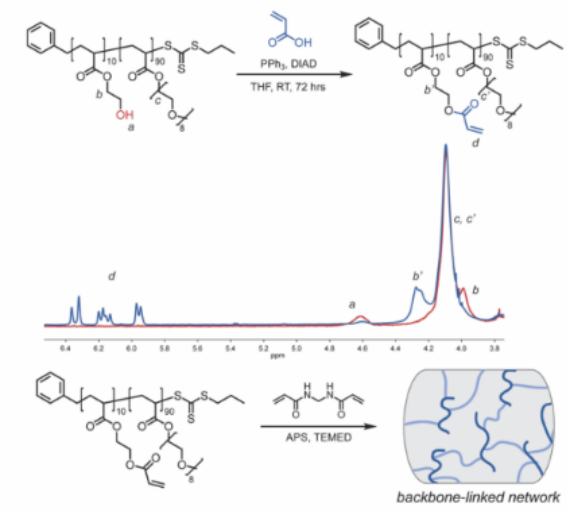

Figure 3: An SCNP network was created from a polymer with acrylate functionalized side chains. The reaction NMR spectra of the the initial polymer (red) contains peak "a", which is not present in the product polymer spectra (blue), while the product spectra has new peaks "d". This indicate that the hydroxyl group has reacted to form an acrylate side chain. This polymer was used to synthesize a backbone-linked hydrogel.

We have also focused on strategies for incorporating SCNPs into a polymer network. In our proposal, we developed a strategy to install reactive functionality onto each end of a polymer chain using a previously published bifunctional chain transfer agent with a protected thiol. We successfully synthesized this chain transfer agent in year 1 of the project. While working on the project, we became aware of a strategy from the literature that added acrylate functionalities onto the side chains of a protein to incorporate it into a polymer network. This strategy provides a network with back-bone-linked polymers. Inspired by their success and the ease of creating acrylate and acrylamide hydrogels, we successfully synthesized a polymer with acrylate side chains (Figure 3). This polymer was used to synthesize a hydrogel through a thermally initiated radical polymerization.

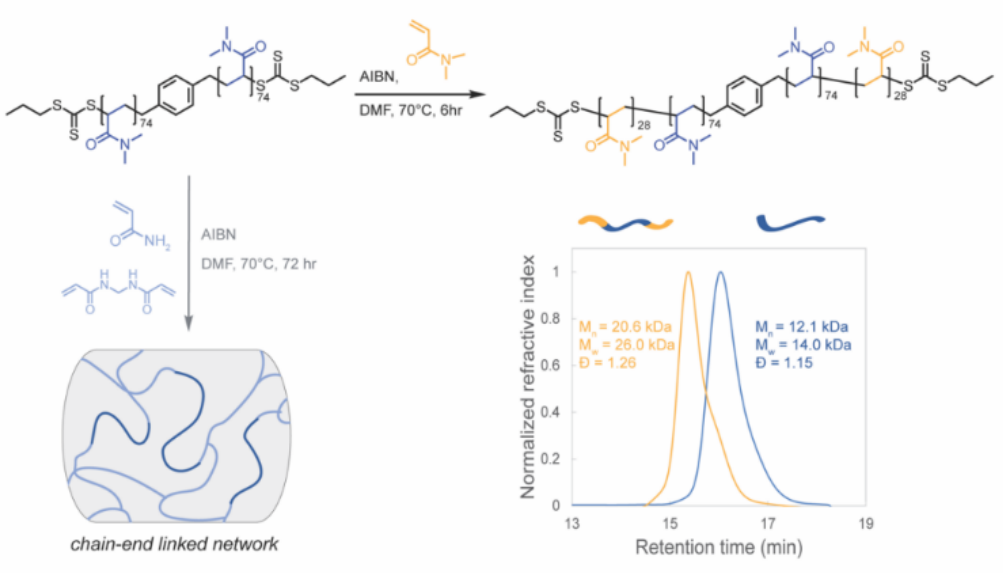

Figure 4: In the chain-end linked network, a bifunctional chain-transfer agent was used to synthesize the precursor polymer, which allows for additional monomer to be added at the end of the chains rather than from the backbone. SEC data indicates that re-initiation of the polymerization was successful, as the molecular weight increases following addition of more N,N-dimethylacrylamide monomer (yellow). These polymers have been used to synthesize chain-end linked networks.

We have also synthesized bifunctional chain transfer agents that allow for additional monomers to be added to each end of a polymer chain, called the chain-end linked network strategy. SCNP precursor polymers have been prepared from these chain transfer agents, and we have demonstrated the reinitiation of polymerization and extension of the polymer chain (Figure 4). We also prepared a hydrogel using this method by adding a cross-linking monomer. Following this successful polymerization, we are now optimizing reaction conditions prior to attempting to synthesize a network from our SCNPs.

In conclusion, we have developed a computational methodology to model the folding and unfolding process in these SCNPs. We have preliminary results that suggest our single-chain nanoparticle synthesis through silyl ether crosslinking has been successful. In the future, we will continue to characterize this reaction. We have also developed two potential methods to incorporate SCNPs into hydrogel networks (the backbone-linked and chain-end-linked approaches). In the future, we plan to validate these network synthetic strategies with SCNPs rather than linear precursor polymers and to use the results of our computational studies to guide the design of future SCNPs.

List of Objectives/ Aims/ Major Milestones Proposed	Cumulative Outcomes / Accomplishments
Submit proposals for external funding	• Planning an application to NSF CAREERin 2025 that continues the CEACSE project • Planning an application to the Cottrell Scholar Award that continues the CEACSE project • Awarded a proposal for ACS Petroleum Research Fellowship “Expanding covalent mechanochemistry to commonly used polymer materials”, which is not directly connected to this project, but the track record I have built through CEACSE contributed to the successful application.
Train students	• Five undergraduate students were trained, three of them for more than one year. • One post-baccalaureate student was trained for a semester at 25 hrs/week.
Develop outreach activities	• We developed and presented a new outreach demonstration on hydrogel materials and presented it at the Chattanooga Market. • The PI taught a new polymer chemistry class (CHEM 4040) at UTC and included material on single-chain nanoparticles and hydrogels in the lecture and lab.
Develop collaborations	The PI developed a collaboration with Dr. Eleni Panagiotou for this proposal. Dr. Panagiotou left UTC in month 1 of this project. We continued to collaborate in months 1-6 of the project. The PI developed a new collaboration with Dr. Mohammed Mahtabi in 2023. Dr. Mahtabi has been developing the experimental plan for the simulations, teaching the PI and students to work with software and written code, and conducting simulations on this system using LAMMPS.
Present at regional ACS meetings and at UTC	Students have presented their work at the annual chemistry department symposia, the Southeast Regional American Chemical Society Meeting (SERMACS), the URaCE annual spring meeting, and the ACS national meeting. The PI has presented at the Tosoh Polymer conference (June 2024) and will present at SERMACS (October 2024).

Challenges & Strategies Used to Address/Overcome:

There were several significant barriers to this work. First, the PI's initial research collaborator, Dr. Panagiotou, moved from UTC to Arizona State University at the start of the grant period. We were able to have several productive planning meetings about computational modeling and topological calculations, but our progress was limited by Dr. Panagioutou's overall workload in her transition to another university. Fortunately, Dr. Mahtabi joined as a collaborator in the second year of the grant and made significant strides toward the computational aims, but we probably could have been more efficient if we had been working together throughout both years of the grant. Secondly, the PI was on leave during the Spring 2023 semester due to childbirth and recovery, and has experienced ongoing challenges with accessing childcare in the Chattanooga area since that time. As all the researchers are undergraduate students who must be supervised in the lab for safety, no experimentation was conducted while the PI was on leave. As a result of these obstacles, a one-year extension on the CEACSE project was granted.

What didn't work? What did you disprove or learn from the part that didn't meet your initial concept in the proposal?

Our initial efforts to purify polymers with intrachain silyl ether crosslinks by the most common method, precipitation, were unsuccessful. We were able to solve this problem by adding a dialysis step to our purification method so that we could obtain pure SCNPs for characterization by NMR. We also anticipate that the dilution required for single-chain folding to occur instead of multichain crosslinking will make it challenging to synthesize large quantities of SCNPs, so we are adapting how we will make and test future SCNP hydrogel materials. We also shifted our strategy for incorporating SCNPs into networks based on additional reading in the literature. We have not made the aim 3 that we proposed, which involves using the computational results to inform the material's design, due to the initial collaborator leaving the project.

IMPACT & OUTCOMES

Impact on the Career(s) of the PI, the Co-PI(s), and Key Collaborators

This was the first grant the PI held as a new investigator at UTC, and it has been a valuable research and learning experience to establish a new lab. The opportunity to focus deeply on the research goals of this project has allowed me to recognize key challenges and make improvements to my plans and strategy. This work has led to important data and a manuscript is in progress with the goal of submitting it for consideration in a young investigator issue of the journal Polymer Chemistry in 2025 following some additional experiments. The PI was also awarded an external grant that began in August 2024, the ACS Petroleum Research Undergraduate New Investigator Fellowship titled "Expanding covalent mechanochemistry to commonly used polymer materials". While not directly following up on this grant's work, the process of writing the CEACSE proposal and managing the CEACSE grant has provided valuable experience that led to the success of this fellowship. We have obtained preliminary data that will help strengthen future external grant applications. In 2025, the PI plans to apply for Cottrell Research Scholars and NSF CAREER to continue the CEACSE project.

Students Impacted

Graham Ford worked full-time on this project in the summer of 2022 and in the fall of 2022. He started learning relevant lab skills when he was enrolled in CHEM 4997 (research) during the spring of 2022 and in the early summer of 2022 while funded by a research and creative activity grant. His project focused on the development of single-chain polymer nanoparticles with internal silyl ether cross-links (aim 2). He presented his work at the annual Undergraduate Research Program (URP) oral presentations in May and July 2022. He also presented a poster titled "Single-chain polymer nanoparticles with silyl ether crosslinks" at the Southeastern Regional American Chemical Society (SERMACS) meeting in San Juan, Puerto Rico, in October 2022. He earned his B.S. in Biology in December 2022 and is currently working as a paramedic and firefighter while applying to medical school. CEACSE was his only research experience at UTC and allowed him to build valuable critical thinking skills and independence that will help him accomplish his goal of becoming a doctor.

Kelly Hooper worked full-time on this project in Fall of 2022 and Summer of 2023, and continued to work on this grant through the academic year. Kelly began working with Dr. Barbee in Spring of 2022 on a different project, but she shifted her focus to CEACSE in 2022. Her project focuses on the development of a strategy for incorporating single-chain nanoparticles into polymer networks (aim 2). She presented her work at the annual Undergraduate Research Program (URP) oral presentations in May and July 2023. She will be presenting a poster titled "Synthetic Strategies for Single Chain Polymer Networks" at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023. She earned her B.S. in Chemistry in December 2023. Before Kelly began research on this project, she was considering going straight to the job market or pursuing a master's degree and focusing on forensics. CEACSE allowed her to realize how much she enjoys research. After graduation, Kelly worked on the grant as a post-baccalaureate student. This gave her the opportunity to devote a significant amount of time to the project, and she developed expertise in both computational simulations (aim 1) and wet-lab experiments. Kelly is currently pursuing a Ph.D. in chemistry at the University of North Carolina at Chapel Hill.

Samuel Robinson began working to develop a new intrachain crosslinking methodology for single-chain nanoparticles when he was enrolled in CHEM 4997 (research) during Spring of 2022 and in summer 2022 while funded by the Undergraduate Research Program (URP). He presented his work at the annual Undergraduate Research Program (URP) oral presentations in May and July 2022. In fall of 2022, he began focusing on work funded by the CEACSE grant. He presented a poster titled "Biomimetic Design of Single Chain Polymer Networks" at the Southeastern Regional American Chemical Society (SERMACS) meeting in San Juan, Puerto Rico, in October 2022. He also worked full-time on CEACSE during the summer of 2023 and presented his work at the annual Undergraduate Research Program (URP) oral presentations in May and July 2023. He will be presenting a poster titled "Biomimetic design of mechanochromic SCNP networks" at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023. He will earn his B.S. in Chemistry in May 2025 and is planning to pursue a PhD in chemistry after graduation. The CEACSE grant has allowed him to develop as a scientist and learn to take ownership of a project. The opportunity for him to work in Dr. Barbee's lab for an extended period of time has given him practical experience with

challenges that are faced in research and how to overcome them. He will be writing his honors thesis on his work in 2024-2025.

Dallas Donovan joined the team in May 2023. He worked part-time on CEACSE during the summer of 2023 and presented his work at the annual Undergraduate Research Program (URP) oral presentations in May and July 2023. He presented a poster titled “SCNP networks through reinitiating RAFT polymerization” at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023 and will also present this fall at SERMACS in Atlanta, GA. He will be writing his honors thesis on his work in 2024-2025. He will earn his B.S. in Chemistry in May 2025 and is planning to pursue a PhD in chemistry after graduation. Receiving funding from CEACSE allowed him to work fewer hours at an off-campus job and to be paid for research, which allowed him to build research experience.

Christine Rukeyser joined the team in August 2023. She synthesized an anthracene monomer for SCNP crosslinking (aim 2). She graduated from UTC in December 2023 with a B.S. in chemistry and worked at Oak Ridge National Lab in a research position until August 2024. She is currently pursuing a PhD in chemistry at Northwestern University and was awarded an NSF GRFP fellowship, which she wrote while Dr. Barbee was her mentor through CEACSE.

Community and Broader Impacts

We presented a new outreach demonstration with the local American Chemical Society’s “Smart is cool day” at the Chattanooga Market in fall 2023. This demonstration included two types of hydrogel materials and focused on an understanding of the molecular-to-macroscopic connection. This was the largest outreach event UTC Chemistry had been involved in (that we are aware of), and we presented for approximately six hours to countless people. The PI will continue presenting the demo in the future, including in October 2024. The PI taught a new polymer chemistry class (CHEM 4040) at UTC and included material on single-chain nanoparticles and hydrogels in the lecture and lab.

Scholarly Products

External Conferences:

- “Single-chain polymer nanoparticles with silyl ether crosslinks” presented by Graham Ford at the Southeastern Regional American Chemical Society (SERMACS) meeting in San Juan, Puerto Rico, in October 2022
- “Biomimetic Design of Single Chain Polymer Networks” presented by Sam Robinson at the Southeastern Regional American Chemical Society (SERMACS) meeting in San Juan, Puerto Rico, in October 2022
- “Biomimetic design of mechanochromic SCNP Networks” presented by Sam Robinson at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023.
- “Synthetic Strategies for Single Chain Polymer Networks” presented by Kelly Hooper at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham, NC, in October 2023.
- “Synthetic Strategies for Single Chain Polymer Networks” presented by Kelly Hooper at the Southeastern Regional American Chemical Society (SERMACS) meeting in Durham,

NC, in October 2023.

- "Synthesis and Computational Design of Single-chain Polymer Nanoparticle Networks", presented by Kelly Hooper at the ACS national meeting in New Orleans, LA, in April 2024
- "Designing Single-chain Nanoparticle Embedded Hydrogels", presented by Meredith Barbee at the Tosoh Polymer Conference in Raleigh, NC, in June 2024.

Presentations at UTC:

- "Single-chain polymer nanoparticles with silyl ether crosslinks" presented by Graham Ford at the URP symposium.
- "Biomimetic Design of Single Chain Polymer Networks" presented by Sam Robinson at the URP symposium.
- "Biomimetic Design of Single Chain Polymer Networks" presented by Sam Robinson at the URaCE conference, 2023.
- "Synthetic Strategies for Single Chain Polymer Networks" presented by Kelly Hooper at the URaCE conference, 2024.
- "SCNP networks through reinitiating RAFT polymerization" presented by Dallas Donovan at the URaCE conference, 2024

Inventions or Other Intellectual Property

N/A

Research Outreach & Collaboration

The PI collaborated with Eleni Panagiotou in months 1-6 to plan computational experiments. These meetings were held over Zoom. In year 2, we established a new collaboration with Dr. Mohammed Mahtabi. The PI and student Kelly Hooper met regularly with him in year 2 to plan the simulations. He taught us how to use modeling software such as LAMMPs and Moltemplate. He also conducted simulations of polymers for this project himself.

EXTERNAL FUNDING

Proposal Submissions

- ACS PRF proposal was awarded. It is not directly connected to this work, but the CEACSE project helped the PI develop the idea and the experience necessary. It will fund my work from 2024-2026.
- NSF CAREER and Cottrell Scholars applications will be submitted in 2025 using preliminary data from CEACSE.

Contracts/Awards Received

N/A

Sponsored Program Capacity Building Activities

- The PI met with Ashley Ledford (Research Development Specialist) at the start of the project to develop an individual strategic plan for upcoming external grant applications.
- Attended NSF Virtual Grants Conference for Spring 2023 to learn about opportunities to

submit external grants.

- The PI attended the Tosoh Polymer Conference in June 2024, where there was an opportunity for networking and feedback on the CEACSE project presentation from others in the field.

WHAT'S NEXT FOR THIS RESEARCH?

How will you follow up your CEACSE grant with work in the next 1,2,...5 years?

Over the next years, the PI plans to publish work that results from this project and will continue to pursue external funding. The PI is hiring two students in the summer of 2025, funded by the Department of Chemistry and Physics, who will continue to work on this project and collect more data. The PI plans to continue the computational collaboration with Professor Mahtabi.

What other related research will you pursue (and with whom) in light of the support you've received from CEACSE?

The findings from this work will allow us to thoroughly investigate a new polymer topology. We will continue to explore various intrachain crosslinking methodologies and the factors that influence the behavior of SCNP networks. We will also be working on our new ACS PRF grant, which focuses on a similar research area, covalent polymer mechanochemistry.

Tell us anything else we should know about this work not described above.

N/A

What barriers (if any) do you face to reach these next goals?

The PI will need to continue to win grants to continue to fund the work. The PI also needs to manage the time commitment of managing the new PRF grant and hiring students to work on that project while still having time to mentor students who work on the CEACSE project. There are several important experiments that need to be completed before publishing our silyl ether crosslinked SCNPs.

FINANCIAL ACCOUNTING

In year 1, we did not spend as much money as planned. Students did not work as much as expected due to the PI's parental leave. In the first year of the grant, the PI still had startup funding available, which expired at the end of FY24. When planning for the leave of absence and extension of the CEACSE grant, Dr. Skjellum suggested that the CEACSE funding could be primarily used in FY24. The PI had more students working on the project in year 2.

The PI worked with Anna Lane to revise the budget to account for the departure of Dr. Panagioutou and the new collaboration with Dr. Mahtabi. Dr. Mahtabi received a month of summer salary. Some of the student salaries were used to hire an undergraduate student, Kelly Hooper, as a post-baccalaureate researcher after her graduation in December 2023.

Fiscal Year 2024 Annual Project Report

Tennessee Higher Education Commission: Center of Excellence in Applied Computation Science and Engineering Grant Competition

Dr. Murat Barisik, Lead PI

Co-PI(s): N/A

Project Title: “Modeling heat generation and temperature variation in supercapacitors”

Date Submitted:

Award Start - End Date: July 1, 2023 - June 30, 2024

Non-Technical Summary:

Energy storage needs are expected to grow substantially in the coming years. Batteries are the most common solution, but they have multiple downsides, such as short lifetime, low performance at low temperatures, and high fire/explosion hazard risks. New-generation supercapacitors are promising candidates owing to their lightweight, fast charging, safe use, and non-toxic content. Supercapacitors are expected to satisfy high energy needs as well (to replace batteries), and their market size is expected to increase four times over the next six years. However, the thermal behavior of new-generation nanoporous supercapacitors designed to work at high potentials is not well understood, hindering their potential use. This project investigated the influence of temperature on supercapacitors to make them more reliable and support their transformation for future needs.

PROJECT TITLE

“Modeling heat generation and temperature variation in supercapacitors”

TECHNICAL APPROACH

Ionic layers near the electrode surface are known as electric double-layer (EDL). However, EDL formation through a nanoscale confined electrolyte is not well understood yet, as there is very limited information about the variation of solution temperature during working conditions and its influence on electric double-layer formation. Both ionic layering and heat transfer behavior of a supercapacitor show non-continuum behavior as the molecular level mechanisms become dominant at nano-levels. For such a case, this research project studied heat generation and nanoscale heat transfer through an electric double layer at the molecular level. The Molecular Dynamics (MD) simulations on high-performance computer clusters were employed, which naturally account for the molecular nature of both ionic transport and heat transfer. The thermal conductivity of nano-confined electrolytes and interfacial thermal resistance between electrode and electrolyte were determined.

ACCOMPLISHMENTS & OUTCOMES

Project Overview

List of Objectives/ Aims/ Major Milestones Proposed	Cumulative Outcomes / Accomplishments
Task 1. Molecular modeling of heat generation in EDL	Joule heating through an electrolyte is the function of polarization through the system. While the bulk region is at equal distribution, a strong concentration gradient develops in EDL such that heat generation is defined as a function of polarity at the local concentration. On the other hand, reversible heat generation develops mostly in the EDL region by ionic layering. Through this task, heat generation modeling at the molecular level was studied.
Task 2. Determination of nanoscale heat transfer in EDL	The non-continuum heat transfer behaviors include variations of electrolyte thermal conductivity and thermal resistance at the electro/electrolyte interface. Nanoscale effects show strong variation with changing electric potential. The PI validated the MD measurement of NaCl electrolyte conductivity at different concentrations and temperatures by comparing it with experiments. Later, the PI presented confinement and electric field effects compared to bulk electrolyte behavior. Next, the PI studied the thermal coupling between the electrolyte and the graphene surface. Through this task, the direct measurement of time-dependent temperature variation as a function of electric potential was obtained.
Task 3. Calculating EDL formation at different temperatures	Under the heat generation and nanoscale heat transfer effects, the solution temperature showed variation, which created changes inside the EDL. Changes in EDL also change the thermal behavior so that both ionic structure and solution temperature develop in a coupled behavior. During working conditions, the PI justified the influence of change in the ionic layer, which resulted in a change in nanoscale heat transfer on the temperature variation. This task will obtain electric double-layer variation as a function of temperature.
	(i) Molecular modeling of heat generation through electric double layer, (ii) Understanding of electrolyte's heat conduction behavior at the molecular level, (iii) Understanding of electrolyte/electrode interface thermal conductance, (iv) Understanding of ionic distribution at different temperatures.

Challenges & Strategies Used to Address/Overcome:

I had difficulties in hiring graduate students for this project due to competition with other universities and visa issues. Thankfully, I have a very qualified PhD candidate who has already shown great progress. We continue to use the remaining unused resources and complete our work for journal publications.

What didn't work? What did you disprove or learn from the part that didn't meet your initial concept in the proposal?

N/A

IMPACT & OUTCOMES

Impact on the Career(s) of the PI, the Co-PI(s), and Key Collaborators

This project made it possible for me to implement my experience from different engineering problems into an up-to-date nanoscale technology. I have been working on Molecular Dynamics modeling of nanoscale heat transfer and interfacial thermal resistance. This grant made it easier for me to start my research group and support graduate students. I had a chance to develop molecular dynamics and quantum chemistry abilities specific to nanomaterial/system modeling at UTC. With my new capabilities, I can move to more complex modeling to answer further problems of future designs of supercapacitors. This will feed future research projects and grant proposals to maintain my research activities and achieve my long-term plan of contributing to the future of battery technologies.

This project also accelerated my research more towards the application perspective so that I could connect with experimental researchers from national labs and companies for collaborations to develop strong proposals for external funding. Through this project, I developed close collaborations with Oak Ridge National Laboratory and applied multiple research calls related to energy technologies.

Through this project, I supported multiple graduate and undergraduate students. This grant helped them with their training in research and courses. My MS student showed great progress. He learned a lot about advanced modeling techniques and high-performance computing. He passed his "Computational Fluid Dynamics" course with an A grade. This MS student prepared and presented a literature summary about supercapacitors as a part of the course "Advance Thermodynamics." His review explained that supercapacitors are a critical component in energy storage and management, particularly in applications requiring rapid charge and discharge cycles. Their continued development and integration into various technologies are vital for advancements in fields ranging from transportation to renewable energy. He passed with a grade of A.

Students Impacted

In addition, two undergraduate students worked 20 hours a week on material modeling research by molecular dynamics. They learned about molecular dynamics and high-performance computing. To encourage them further, I connected with researchers from the "National Institute of Standards and Technology (NIST)." NIST has an ongoing project to develop open-source tools and algorithms for thermodynamic characterization of different materials

(https://www.nist.gov/programs-projects/nist-standard-reference-simulation-website). NIST happily accepted our possible contribution to the project. Our undergraduate students benefited from NIST resources and researchers and followed the systematics, including thermal characterizations and related algorithms. These students passed my “ENME3030 Thermodynamics” and “ENME3090 Heat Transfer” courses with a grade of "A". They simulated the thermodynamic behavior of argon and nitrogen. They presented their results in the “UTC Spring Research and Arts Conference” acknowledging the CEACSE support.

Community and Broader Impacts

As a part of this project, I performed multiple activities to improve STEM education and educator development in local “Title 1” schools. We visited the local “Orchard Knob Elementary” school for multiple STEM activities. OKE is a “Title 1” school with a large number of students from underrepresented minority groups (80% Black and 13% Hispanic) coming from low-income families (99% low-income). Underserved students at this school fall far behind other students in the state, and this school has large achievement gaps (1/10 in test scores and 2/10 in equity).

Following is the link to the article about one of our activities (https://blog.utc.edu/news/2024/03/utc-engineering-group-participates-in-read-across-america-week-event-at-orchard-knob-elementary/). As a part of “Read Across America Week,” we read “Horton Hears a Who!” and participated in interactive activities and demonstrations to explore size and scale with the K-5 students. Inspired by Horton’s adventures with things invisible to the naked eye, we introduced students to different length scales, nanotechnology, and its real-world applications. Exploring size and scale, students gained a deeper understanding of how small-scale science can have big impacts on society. On another visit, we had interactive activities to introduce chemistry. By leveraging the power of storytelling, we hope to ignite a passion for science and engineering in students at an early age and instill in them a sense of wonder and excitement about the possibilities of STEM.

Scholarly Products

Conferences, presentations, posters, and/or proceedings:

My MS student presented his results at UTC’s “Spring Research and Arts Conference” and “Technology Symposium.” His poster was selected as the best “Graduate Research” through the College of Engineering and Computer Science. He received the first place. My undergraduate student presented her results at UTC’s “Spring Research and Arts Conference.”

Inventions or Other Intellectual Property

N/A

Research Outreach & Collaboration

I initiated a collaboration with the “Ulsan University” in South Korea on the modeling of ionic systems and transport at the nanoscale. I supported their research on how to establish continuum-based boundary conditions inionic systems. We published two journal articles. Masuduzzaman M, Bakli C, Barisik M, Kim BH (2024) Applied Electric Field Effects on Diffusivity and Electrical Double-Layer Thickness, Small, 10.1002/smll.202404397 Karim KE, Barisik M, Bakli C, Kim B, (2024) Estimating water transport in carbon nanotubes: A critical review and inclusion of scale effects, Physical Chemistry Chemical Physics, 10.1039/D4CP01068J

EXTERNAL FUNDING

Proposal Submissions

- “Multiscale characterization of heat transfer in nanoporous materials assisted by machine learning” M Barisik (PI), NSF-CAREER $596,510
- “Multiscale characterization of heat transfer in nanoporous materials by machine learning” M Barisik (PI), DOE-ECRP $800,000
- “Molecular characterization of thermal effects on capacitance behavior of supercapacitors” M Barisik (PI), NSF-ERI $200,000
- “DMREF: Role of ordered interfacial water layers in condensation heat transfer” A. Kota (PI), M Barisik (co-PI), S. Bingham (co-PI), L. Velarde (co-PI), NSF $2,000,000
- “LEAPS-MPS: Molecular characterization of thermal effects on capacitance behavior of supercapacitors” M Barisik (PI), NSF-LEAPS-MPS $250,000

Contracts/Awards Received

The PI was happy to share that the NSF proposal he developed based on the experience and preliminary results of this CEACSE project has been awarded. He is thankful for the CEACSE support, which helped him develop a strong proposal for external funding.

- “Molecular characterization of thermal effects on capacitance behavior of supercapacitors” M Barisik (PI), NSF-ERI $200,000 (08/24-present).

Sponsored Program Capacity Building Activities

N/A

WHAT’S NEXT FOR THIS RESEARCH?

How will you follow up your CEACSE grant with work in the next 1,2,...5 years?

Currently, I started my NSF project and continue working on this research.

What other related research will you pursue (and with whom) in light of the support you’ve received from CEACSE?

The findings from this work will allow us to thoroughly investigate a new polymer topology. We will continue to explore various intrachain crosslinking methodologies and the factors that influence the behavior of SCNP networks. We will also be working on our new ACS PRF grant, which focuses on a similar research area, covalent polymer mechanochemistry.

Tell us anything else we should know about this work not described above.

N/A

What barriers (if any) do you face to reach these next goals?

N/A

FINANCIAL ACCOUNTING

I had difficulties in hiring graduate students.

Fiscal Year 2024 Annual Project Report

Tennessee Higher Education Commission: Center of Excellence in Applied Computation Science and Engineering Grant Competition

Dr. Lingju Kong, Lead PI

Co-PI(s): N/A

Project Title: “Dynamic Analysis of Online Social Network Models”

Date Submitted: 06/30/2024

Award Start - End Date: July 1, 2023 - June 30, 2024

Non-Technical Summary:

In this project, by developing the data-driven deterministic differential equation compartment models, the PI proposes to study the online social network (OSN) dynamics from two aspects: (a) User traffic dynamics of a single OSN and (b) Competition and coexistence principle of users among multiple OSNs. The proposed project consists of multiple research objectives. The first objective is the development of the user adoption and abandonment model for a single OSN. The model will contain a generalized nonlinear incidence, which is a function of the number of current OSN users. The second objective is to study the competitive exclusion and coexistence of users among multiple OSNs. Due to the physical meanings of the models, conditions for competitive exclusion and coexistence when one OSN is initially dominant will be the main research focus. Theoretic and numerical analysis will be conducted to understand the model dynamics. The phenomenon of various bifurcations (supercritical, subcritical, or Hopf et al.), as well as optimal control of the models, will also be studied in detail. Case studies combining the developed models and the real-world data will be carried out. These findings will be further applied to predict the evolution of OSN dynamics and derive actionable policies.

PROJECT TITLE

“Dynamic Analysis of Online Social Networks Models”

TECHNICAL APPROACH

The project’s technique approach involves careful analysis and extensive computations of the problems. Advanced theory from differential equations and linear algebra were extensively used in our work.

ACCOMPLISHMENTS & OUTCOMES

Project Overview

All the objectives specified in the Non-Technical Summary section were successfully achieved.

Challenges & Strategies Used to Address/Overcome:

Many challenges were encountered during the research. Almost every theorem proved in the project involves many hours of hard thinking and analysis. For instance, proving the existence of user-prevailing equilibrium is a nontrivial task, and one needs to think creatively to figure out an approach to prove the conclusion. Also, to prove the conclusion, the nonlinear term f(I; θ) was chosen as 1 + vI in the model for the first objective. The 'mutation' and 'superinfection' dynamics were not considered in the model for the second objective.

What didn't work? What did you disprove or learn from the part that didn't meet your initial concept in the proposal?

All the initial concepts worked.

IMPACT & OUTCOMES

This project will be closely integrated with education activities. Two graduate student researchers were involved in the project. Working on research projects helped the students gain valuable skills such as creative thinking, independent problem-solving, and self-confidence.

Part of the research findings was presented at the UTC Math Department Colloquium Series and the American Mathematical Society Regional meeting, as well as the annual UTC Spring Research and Arts Conference.

Impact on the Career(s) of the PI, the Co-PI(s), and Key Collaborators

Students Impacted

Michael Downs and Uyen Nguyen.

Community and Broader Impacts

Scholarly Products

Conferences, presentations, posters, and/or proceedings:

- "Modeling user adoption and abandonment dynamics of a product". Invited Talk in the Special Session on Mathematical Models for Population and Methods for Parameter Estimation in Epidemiology, American Mathematical Society 2024 Spring Southeastern Sectional Meeting, Florida State University, Tallahassee, FL, March 23–24, 2024.
- "Modeling the dynamics of product adoption and abandonment" UTC Spring Research and Arts Conference, April 10, 2024.
- "Modelling the Dynamics of Product Adoption and Abandonment", January 26, 2024. Colloquium talk given in the Mathematics Department at UTC

Papers:

- **L. Kong**, Modeling the dynamics of product adoption and abandonment, Proc. R. Soc. A 480 (2024), 20240034, 25 pp.

- R. Chen, **L. Kong**, and M. Wang, Modeling the dynamics of adoption and abandonment of multiple products, submitted for publication.

Inventions or Other Intellectual Property

N/A

Research Outreach & Collaboration

N/A

EXTERNAL FUNDING

No funding has been secured at this time. Planning to submit an external proposal in the future.

Proposal Submissions

N/A

Contracts/Awards Received

N/A

Sponsored Program Capacity Building Activities

N/A

WHAT'S NEXT FOR THIS RESEARCH?

How will you follow up your CEACSE grant with work in the next 1,2,...5 years?

As stated above, an external proposal is planned to be submitted in the future.

What other related research will you pursue (and with whom) in light of the support you've received from CEACSE?

There are several other interesting research problems related to the project, I am planning to keep working on this subject in the future.

Tell us anything else we should know about this work not described above.

N/A

What barriers (if any) do you face to reach these next goals?

N/A

FINANCIAL ACCOUNTING

Leftover amount: $2000.19. Final total amount of budget expended: $94,939.81.

Fiscal Year 2024 Annual Project Report

Tennessee Higher Education Commission: Center of Excellence in Applied Computation Science and Engineering Grant Competition

Dr. Tian Li, Lead PI

Co-PI(s): Dr. Donald Reising

Project Title: "Recovery of Quantum Correlations Using Machine Learning"

Date Submitted:

Award Start - End Date: July 1, 2023 - June 30, 2024

Non-Technical Summary:

Quantum information science and engineering (QISE) leverages the core principles of quantum mechanics to handle and process information in ways that outperform classical techniques, paving the way for significant advancements in quantum computing, communication, and sensing. Central to these breakthroughs are quantum correlations, which provide the non-classical resources essential for QISE. However, these correlations are intrinsically fragile and highly sensitive to environmental disturbances. Disruptive processes, namely decoherence and loss, can severely degrade these correlations, resulting in the loss of the unique quantum behaviors that distinguish QISE systems from their classical counterparts. As a result, addressing these processes' adverse effects is paramount for practically realizing QISE protocols. Strategies to protect quantum correlations from disruptive environments are crucial for deploying robust quantum systems in real-world applications. Thus, successfully mitigating decoherence and loss will enhance the stability of quantum systems and expedite the deployment of QISE protocols in real-world settings.

Among the most extensively studied quantum systems, squeezed states of light have consistently demonstrated their utility as reliable quantum resources for numerous QISE protocols, especially in the continuous variable (CV) regime. Complementary to PI Li's recent work [PRX Quantum 5 (3), 030351 (2024)], where he demonstrated the mitigation of scattering effects using a simple hardware solution—an integrating sphere (IS)—we now turn our attention to a software-based approach to mitigate the adverse effects caused by scattering. This is particularly crucial for QISE as scattering contributes to both decoherence and loss, the two key challenges in maintaining quantum coherence and correlations. This study uses a two-mode squeezed state of light produced through the four-wave mixing (FWM) process in warm rubidium vapor as the quantum source to explore how machine learning (ML) algorithms can mitigate the disruptive effects on quantum correlations.

In this project, we introduce a scatterer—a ground glass diffuser—to one of the two modes of the squeezed state to simulate a realistic disruptive environment. In contrast to the hardware-based approach detailed in [PRX Quantum 5 (3), 030351 (2024)], this work achieves mitigation using Long Short-Term Memory (LSTM), a recurrent neural network (RNN) architecture in ML. Using the time sequence difference between the two quantum-correlated modes before the scatterer was introduced and the time sequence of the undisrupted mode, the LSTM model is employed to reconstruct the disrupted mode, effectively restoring the quantum correlations.

PROJECT TITLE

“Recovery of Quantum Correlations Using Machine Learning”

TECHNICAL APPROACH

In this project, we present a method that leverages Long Short-Term Memory (LSTM), a machine learning technique known for its effectiveness in time-series prediction, to mitigate the detrimental impact of scattering in quantum systems. Our setup involves generating two-mode squeezed light via four-wave mixing in warm rubidium vapor, with one mode subjected to a scatterer to disrupt quantum correlations. Mutual information between the two modes is used as the metric for quantum correlations. We demonstrate a 74.7% recovery of mutual information and 87.7% recovery of two-mode squeezing despite significant photon loss that would otherwise eliminate quantum correlations. This approach marks a significant step toward recovering quantum correlations from random disruptions without the need for hardware modifications, paving the way for practical applications of quantum protocols.

ACCOMPLISHMENTS & OUTCOMES

Project Overview

List of Objectives/ Aims/ Major Milestones Proposed	**Cumulative Outcomes / Accomplishments**
Task 1. Generating continuous-variable entanglement from the four-wave mixing process in hot rubidium atomic vapor	Successfully completed
Task 2. Establishing a quantum network with distributed entanglement based on a two-mode squeezed state	Successfully completed
Task 3. Developing ML-aided phase sensing algorithms across the quantum network with Heisenberg-limited sensitivity	Task 3 remains partially accomplished, as we did not fully explore the quantum sensing capabilities of our machine learning architecture. The investigation into this aspect would need to occur after the recovery of quantum correlations, particularly following the propagation of entanglement through disruptive channels. This recovery process has emerged as the primary focus and final deliverable of this project. Further efforts are needed to assess the quantum sensing potential of our machine learning architecture, which can only be pursued once the foundational recovery of quantum correlations is fully achieved.

Challenges & Strategies Used to Address/Overcome:

We encountered two significant challenges:

1. How can we verify that our ML architecture is sufficiently effective at restoring quantum correlations?

In this project, we used mutual information (MI) as a metric to assess the performance of our ML architecture. By comparing the recovered MI with the original, undisrupted MI, we observed that it is consistently lower, as expected. However, the key question is determining the upper limit of MI that our ML architecture can achieve. We explored various figures of merit to quantify the behavior of the LSTM algorithm and ultimately settled on a method that tests the architecture using undisrupted quantum-correlated beams. By comparing the predicted joint probability distribution with the original, undisrupted distribution, we found that the connected patterns between the two were essentially identical, confirming the robust performance of our LSTM architecture.

2. The ML-recovered quantum correlations are even better than the original undisrupted ones.

In principle, the quantum correlations recovered by the LSTM architecture should never exceed the original, undisrupted quantum correlations. However, early observations showed the opposite. Initially, we focused on revising the LSTM architecture itself but were unable to resolve the discrepancy. Eventually, we identified the issue: the size of the recovered time traces was consistently smaller than the original, suggesting that the virtual optical power associated with the recovered traces was lower than the actual power. We addressed this by rescaling the recovered time traces relative to the real ones using a universal prefactor, which effectively resolved the problem.

What didn't work? What did you disprove or learn from the part that didn't meet your initial concept in the proposal?

The second challenge mentioned above can be categorized as an observation that did not align with our initial concept in the proposal. This discrepancy prompted us to reflect on our original hyperparameters and reassess our LSTM architecture. For a detailed account of how we learned from this issue and ultimately arrived at a solution, please refer to the above section.

IMPACT & OUTCOMES

Impact on the Career(s) of the PI, the Co-PI(s), and Key Collaborators

This interdisciplinary project has greatly expanded the research portfolios of both the PI and Co-PI, blending their expertise in Quantum Information Science and Engineering (QISE) and Machine Learning (ML). Through the convergence of these fields, the PI has gained deeper insights into the innovative applications of ML, while the Co-PI has broadened its work in advanced quantum technologies. This collaboration has not only strengthened each researcher's expertise but also opened up new opportunities for cross-disciplinary exploration, positioning them at the forefront of utilizing machine learning to address complex challenges in QISE.

Students Impacted

Graduate Student: Edward W. Steele (Computational Science Ph.D. program)

Undergraduate Student: Landon Boone (Physics major)

Community and Broader Impacts

The PI plans to extend this effort to address inevitable disruptive processes on the EPB Bohr-IV Quantum Network testbed in downtown Chattanooga. The LSTM architecture will be integrated into the entire network through the UTC Quantum Node Lab, leveraging its software-reconfigurable access to the deployed fiber-optic infrastructure. Conducting this research project within a metro-scale fiber-optic network infrastructure will provide critical validation for the scalability and practicality of advanced QISE technologies. Furthermore, it positions the technology for direct implementation across various industrial sectors, potentially setting new standards in quantum technologies.

Scholarly Products

The outcomes of this project have been showcased in two conference presentations and have led to the publication of one paper:

- "Recovery of quantum correlations using machine learning," E. W. Steele, D. R. Reising, Tian Li, In review, available now on arXiv:2410.02818 (2024)
- "Quantum Sensing and Quantum Control on a Deployed Metro-Scale Quantum Network," Southeast Quantum Workshop 2024, November 15-17, 2024, University of Tennessee, Knoxville, Tennessee
- "Quantum Sensing of Local & Nonlocal Quantities: from image contrast to global phase," Neuromorphic Computing Meets Quantum Mechanics (NCMQM) 2024, May 15-17, 2024, University of Georgia, Athens, Georgia

Inventions or Other Intellectual Property

N/A

EXTERNAL FUNDING

Proposal Submissions

- 2023: NSF ExpandQISE: Track 1: *Deep Learning Aided Distributed Quantum Phase Sensing with Squeezed States*
- 2024: NSF ENG-QUANT: CCSS: *Demonstration of Sub-Shot-Noise Limited Distributed Quantum Sensing on a Commercial Metropolitan-Scale Quantum Network via Deep Learning Aided Noise Suppression*

Contracts/Awards Received

None to date. However, the NSF ENG-QUANT: CCSS proposal was recommended for funding by the review panel but was ultimately declined by the Program Manager due to the late submission of NSF budget cuts.

Sponsored Program Capacity Building Activities

N/A

WHAT'S NEXT FOR THIS RESEARCH?

How will you follow up your CEACSE grant with work in the next 1,2,...5 years?

The primary objective is to implement the LSTM architecture in real-world scenarios, bridging the gap between proof-of-concept demonstrations and practical applications of quantum protocols. The PI aims to expand this work by addressing inevitable disruptive processes on the EPB Bohr-IV Quantum Network testbed in downtown Chattanooga. The LSTM architecture will be deployed across the entire network through the UTC Quantum Node Lab, which offers software-reconfigurable access to the fiber-optic infrastructure. Conducting this research within a metro-scale network will provide essential validation for the scalability and feasibility of advanced QISE technologies. Moreover, it positions the solution for direct application in various industries, potentially setting new benchmarks in quantum technologies.

What other related research will you pursue (and with whom) in light of the support you've received from CEACSE?

The relevant research is part of PI Li's funded NSF ExpandQISE grant, titled "*ExpandQISE: Track 1: Demonstration of Distributed Quantum Sensing with Heisenberg Scaling by Creating Multipartite Entanglement on a Metropolitan-Scale Quantum Network*." The grant totals $792,705, with a project period from 10/01/2024 to 09/30/2025.

Tell us anything else we should know about this work not described above.

We will be re-submitting the NSF ENG-QUANT: CCSS proposal by October 16th, 2024, with the goal of securing funding for FY 2024-2025.

What barriers (if any) do you face to reach these next goals?

N/A

FINANCIAL ACCOUNTING

The remaining balance is $3,000, as we were unable to compensate an undergraduate student due to his prior work commitments on campus.

Fiscal Year 2024 Annual Project Report

Tennessee Higher Education Commission: Center of Excellence in Applied Computation Science and Engineering Grant Competition

Dr. Abdul R. Ofoli, Lead PI

Co-PI(s): Dr. Vahid Disfani

Project Title: "Machine Vision & AI Application for Damaged Solar Panels Detection"

Date Submitted: 7/31/2024

Award Start - End Date: July 1st, 2022 - June 30th, 2023

Non-Technical Summary:

In this project, machine vision and artificial intelligence solutions were developed to detect damaged solar panels in huge solar farms to increase the reliability of power cultivated from these solar farms and help significantly reduce the farms' maintenance costs. An intake and staging platform was developed, which was robust using extensive data. The data used came from different stakeholders' websites, including national labs, the government, manufacturers, distributors, developers, system owners, and recyclers.

This was followed by a data storage & processing platform developed due to the volume of data that needs to be stored and then processed. The data processing included sizing, formatting, and labeling for object detection. A working Artificial Intelligence (AI) model was then built to detect damaged sections of a solar panel from images presented at an accuracy rate of more than 95%. Leveraging convolutional neural networks (CNNs), the model is trained on a diverse dataset, capturing various environmental conditions and solar panel configurations.

After the AI model had been developed and tested, it was converted into a TensorFlow Lite model, which is optimized for deploying models on mobile devices, microcontrollers, and other edge devices. The code was then transitioned to a Raspberry Pi 4 and Nvidia Jetson Nano for further testing and implementation in a lab environment. This resulted in a trained model running smoothly on prototype hardware for damaged PV detection.

Two graduate students and three undergraduate students were impacted directly through this project. One of the graduate students completed his program in the spring of 2024, doing his thesis work on part of this research. The second one is working to complete his program in the fall semester. The three undergraduate students worked on various aspects of the research, such as using ROS to control multiple drones, setting up X8 drones with cameras, sensors, and microcontrollers, debugging and retrieving data from cameras, etc.

PROJECT TITLE

“Machine Vision & AI Application for Damaged Solar Panels Detection”

TECHNICAL APPROACH

The following are the breakdown tasks for the project:

Software: Develop a drone-based AI software system to detect and assess damaged solar panels.

Drones: Getting the X8 drone working with Pixhawk and Mission Planner control software.

Cameras: Setting up the FLIR and GoPro cameras; tagging both images with GPS data using Pixhawk; transmitting camera images wirelessly using Wi-Fi or Bluetooth.

Drone and Camera Integration: Integrate and mount FLIR and GoPro cameras on the X8 drone; Integrate Raspberry Pi 4 hardware on the X8 drone with appropriate power supply; Test instrumentation to verify all individual hardware components work with Pixhawk on the X8 drone.

OUTCOMES

Some of the outcomes of this project are:

- A working Artificial Intelligence (AI) model was then built to detect damaged sections of a solar panel from images presented at an accuracy rate of more than 95%.
- One master's student Thesis publication titled "Solar Panel Damage Identification using TensorFlow Lite."
- A Working hardware (Raspberry Pi 4 and Nvidia Jetson Nano) with AI detection software using TensorFlow Lite.
- Conference paper publication (In progress for resubmission after initial review comments)
- X8 drones with mounted cameras, sensors, and Raspberry Pi 4 hardware (Needs more instrumentation to complete setup before flying in the field)

RESULTS

After setting up, training, and testing different models using both Keras and PyTorch, the resnet18 model resulted in the best performance.

A working Artificial Intelligence (AI) model using the resnet18 model was then built to detect damaged sections of a solar panel from images presented to it at an accuracy rate of more than 95%.

Result on Testing dataset:

	Final Model	Best Model
Overall Accuracy	97.84%	97.12%
Class Good Accuracy	100.00%	96.88%
Class Dirty Accuracy	96.67%	100.00%
Class Hot Accuracy	95.83%	93.75%
Class Broken Accuracy	100.00%	100.00%
Epoch	50	22

OTHER INFO

Budget and Schedule

Total Budget: $97,983.00

Actual Used: $88,183.71

Balance: $9,799.29

Total period of performance is 12 months.

Task 1: Months 1-4

Task 2: Months 3-6

Task 3: Months 4-12

Task 4: Months 8-12

DELIVERABLES

- Quarterly report that focused on past quarter accomplishments, plans for next quarter, challenges and plans to overcome, impacts, and quarterly financial report summary.
- Final report detailing results, financials, and future work
- Publication (thesis work)
- Internal presentation

ACCOMPLISHMENTS & OUTCOMES

Project Overview

List of Objectives/ Aims/ Major Milestones Proposed	**Cumulative Outcomes / Accomplishments**
Milestone #1: Develop an Intake and Staging Platform	A working Artificial Intelligence (AI) model was then built to detect damaged sections of a solar panel from images presented to it at an accuracy rate of more than 95%.
Milestone #2: Develop a Data Storage and Processing Platform	One master's student thesis publication was titled "Solar Panel Damage Identification using TensorFlow Lite."
Milestone #3: Model Development	Working hardware (Raspberry Pi 4 and Nvidia Jetson Nano) with AI detection software using TensorFlow Lite.
Milestone #4: Trained Model on prototype hardware and validation in Lab Environment	X8 drones with mounted cameras, sensors, and Raspberry Pi 4 hardware (Needs more instrumentation to complete setup before flying in the field)

Challenges & Strategies Used to Address/Overcome:

Although most of this project's milestones were achieved, we were pushing the limit to test a working complete system in the field. This has not yet been done, and most of the issues stem from hardware installation issues. One of the issues was camera setup and tagging of images and video using Pixhawk. Currently, the team can tag images from the FLIR camera but not streaming video. The GoPro camera with added accessories can tag its own images, but using the Pixhawk to tag is still unresolved. Other issues involved mounting hardware, using appropriate cabling and instrumentation to supply power, and communicating with Pixhawk on the x8 drone for the necessary hardware.

During the summer, one of my undergraduate student researchers, who was working on the hardware integration, could not stay, and this became a big challenge for the graduate students, dramatically reducing the work's pace.

What didn't work? What did you disprove or learn from the part that didn't meet your initial concept in the proposal?

The initial AI model using Keras with TensorFlow had an accuracy of around 86%, which was not satisfactory for our system. Due to the time constraints, we used it to create the TensorFlow Lite model and get it working with the Raspberry Pi 4 and the Jetson Nano hardware. A second graduate student started testing other models until we got the resnet18 model with an accuracy above 95%. During this period, one PyTorch model was created but later rejected, showing signs of overfitting after the 25th epoch with an accuracy of around 75%.

IMPACT & OUTCOMES

Impact on the Career(s) of the PI, the Co-PI(s), and Key Collaborators

The impact of this proposal on the PI was tremendous. Aside from obtaining an internal grant of this magnitude, prestige for the EE department, and the college at large, the PI worked with two graduate students; one graduated in spring 2024 with a thesis, and the second student is to graduate in December 2024. This award also helps the PI expand his lab research activities by hiring three undergraduate students, which is one of the department and college-level metrics.

Students Impacted

Two graduate students and three undergraduate students were impacted directly through this project. One of the graduate students completed his program in the spring of 2024, doing his thesis work on part of this research. The second one is working to complete his program in the fall semester. The three undergraduate students worked on various aspects of the research, such as using ROS to control multiple drones, setting up X8 drones with cameras, sensors, and microcontrollers, debugging and retrieving data from cameras, etc.

Community and Broader Impacts

The proposed research has a transformative potential to overcome the challenges of integrating machine vision and AI solutions with real-world hardware devices beyond the scope of this proposal in power and energy systems, transportation systems, etc. (ii) The solutions are planned to be tested on real solar projects, which will lead to close collaboration with industry and academic partners.

Scholarly Products

Publications

- Conference paper publication (In progress for resubmission after initial review comments)

Presentations at UTC

- Thesis presentation to the broader UTC community titled "Solar Panel Damage Identification using TensorFlow Lite."

Inventions or Other Intellectual Property

We have an Invention Disclosure with a UTRF Number 23049-02 titled "Machine Vision Application for Damaged Solar Panels Detection."

Research Outreach & Collaboration

We are working with EPB to use their shared solar farm for testing and data collection. We have been given approval anytime we are ready with our drone and accessories and a licensed pilot. The EPB contact person is Jim Glass, Manager of Smart Grid Development at EPB Chattanooga.

EXTERNAL FUNDING

Proposal Submissions

I submitted a DOE proposal in 2022 under the solicitation DE-FOA-0002606 titled "Machine Vision & AI Application for Damaged Solar Panels Detection" but was unsuccessful due to a lack of preliminary data. This was under the topic area: Small Innovative Projects in Solar (SIPS): PHOTOVOLTAICS. A new proposal will be submitted when the hardware setup with the drone is completed and tested on a solar farm by the end of the year.

Contracts/Awards Received

N/A

Sponsored Program Capacity Building Activities

An on-campus workshop/meeting of EE faculty with Mr. Corbid Cawood from MDRB will cover an overview and some depth of the computational resources available through the UTC Research Institute.

WHAT'S NEXT FOR THIS RESEARCH?

How will you follow up your CEACSE grant with work in the next 1,2,...5 years?

The final integration of the software with the X3 drone, the FLIR and GoPro cameras, and the Raspberry Pi4 or Jetson Nano will be completed in the coming months. Internal funding will be sought to support undergraduate students in working on this project and getting it to fruitful completion. The results will then be used to seek extramural funding to expand this project to using multiple coordinated drones and optimization for very large-scale applications.

What other related research will you pursue (and with whom) in light of the support you've received from CEACSE?

I am working with Dr. Disfani (Main PI) and other co-PIs on the UTC Research Institute Call for Concept Paper. Our topic is focused on Sustainable and Smart Energy Systems Through Grid Integration of Distributed Energy Resources.

Tell us anything else we should know about this work not described above.

N/A

What barriers (if any) do you face to reach these next goals?

Securing student(s) funding for the project's next phase to complete and test it on a real solar farm and publish the results in a conference/journal.

FINANCIAL ACCOUNTING

My graduate student could not work full-time this summer for family reasons (here and abroad), although funding was made available to him. Hence, most of the hardware integration was not completed, and we lost the funds.

Also, although we had money in our budget, we were told the CEACSE rules did not allow us to pay the full summer tuition for my graduate thesis work; hence, I had to use my F&A, which I had none, so I had to borrow to pay for half of his summer tuition (~$1,900).

Fiscal Year 2024 Annual Project Report

Tennessee Higher Education Commission: Center of Excellence in Applied Computation Science and Engineering Grant Competition

Dr. Yukun Yuan, Lead PI

Co-PI(s): Dr. Joseph Dumas, Dr. Feng Guo, Dr. Junrong Shi

Project Title: “Creating a Socially Aware, Efficient, Transparent, and Equitable 311 System for Smart Cities”

Date Submitted: 7/31/2024

Award Start - End Date: July 1st, 2023 - June 30th, 2024

Non-Technical Summary:

Urban 311 services have already been widely used by residents to report non-emergency service requests, e.g., graffiti removal. Researchers have accumulated extensive knowledge on the bias of submitting service requests resulting from persistent spatial, racial, and economic inequalities in cities. However, for residents with diverse social backgrounds, studies on the service quality provided by city departments are lacking. This project develops a data-driven approach to promote efficient, transparent, and equitable 311 services for diverse communities in a city by leveraging multi-source data from public socioeconomic and demographic data, city infrastructure, historical service requests, and self-reported survey findings. There are four tasks of this project: i) modeling residents' behavior profiles, ii) analyzing community-level social disparity, iii) predicting response time of addressing issues, and iv) designing a socially aware learning-based resource scheduling algorithm. Our project has a broader impact on both training students and enhancing service quality for residents in real cities.

PROJECT TITLE

“Creating a Socially Aware, Efficient, Transparent, and Equitable 311 System for Smart Cities”

TECHNICAL APPROACH

- Latent profile analysis
- Monte Carlo simulation
- Regression model
- Machine learning-based prediction
- Reinforcement learning

OUTCOMES

- Submitted U.S. Environmental Protection Agency proposal, $1.25M under the collaboration with Alabama A&M University, Florida State University, and University of Texas at Arlington
- Three papers published under the support of this grant
- One paper in progress (~70%), a peer-reviewed publication on resident behavior modeling and social disparity analysis
- Oral presentation at the American Control Conference (2024).

ACCOMPLISHMENTS & OUTCOMES

Project Overview

List of Objectives/ Aims/ Major Milestones Proposed	**Cumulative Outcomes / Accomplishments**
Resident behavior profile modeling	Completed
Community-level social disparity analysis	Completed
Response time prediction	In progress (We tested several existing machine learning models to predict the response time of service requests, and we are now designing a new model to enhance the prediction accuracy.)
Socially aware city resource scheduling	In progress

Challenges & Strategies Used to Address/Overcome:

- Developing collaboration with community partners: Developing collaboration with community partners often presents challenges such as differing organizational goals, communication barriers, and limited resources. Misaligned priorities or expectations can lead to tension and hinder progress. Additionally, logistical difficulties, such as coordinating schedules and navigating bureaucratic processes, may slow down the partnership's effectiveness.

  To address these challenges, it is essential to establish clear communication from the start, ensuring all parties have a shared understanding of the goals and expectations. Building trust through regular meetings and transparent discussions can foster a more cohesive relationship. Additionally, focusing on mutual benefits, developing flexible plans that accommodate changes, and seeking feedback can help maintain the partnership's momentum.

- Limited research resources: Limited research resources pose significant challenges, such as constrained funding, insufficient access to advanced tools or technology, and a lack of specialized personnel. These limitations can hinder the depth and scope of research, delay progress, and reduce the overall impact of findings.

  To address these challenges, researchers can seek external funding opportunities through grants, collaborate with other institutions to share resources, and explore innovative, cost-effective methods for conducting experiments or data analysis. Prioritizing key research areas and leveraging existing resources efficiently, such as utilizing open-access data or software, can also help mitigate the impact of limited resources. Additionally, engaging with the broader academic and industry communities may open doors to new partnerships and shared facilities.

What didn't work? What did you disprove or learn from the part that didn't meet your initial concept in the proposal?

The PI has realized that the proposed research cannot be fully completed within the one-year timeframe due to the scope and complexity of the project. However, despite these constraints, sufficient preliminary results have been generated to form the foundation for an external grant proposal. These preliminary findings will provide the necessary groundwork to demonstrate the project's potential impact, address key research questions, and justify the need for additional funding and resources in subsequent phases of the research.

IMPACT & OUTCOMES

Impact on the Career(s) of the PI, the Co-PI(s), and Key Collaborators

This grant can have a transformative impact on the career of PI by providing the initial funding necessary to explore innovative research ideas and generate preliminary data. This early-stage support enables the PI to establish a strong foundation for future grant applications, such as a submission to the U.S. Environmental Protection Agency and a planning grant to the NSF. By demonstrating the feasibility and potential impact of their research, the PI can build credibility in their field, enhance their professional reputation, and open doors for collaboration with other researchers or industry partners. For example, the submitted proposal involves collaborators from Alabama A&M University, Florida State University, and the University of Texas at Arlington. Additionally, success with a seed grant can lead to increased visibility, leadership opportunities within academic and research communities, and long-term career advancement through publications and subsequent funding.

Students Impacted

N/A

Community and Broader Impacts

Under the support of this funding, the PI plans to collaborate with the City of Chattanooga to incorporate the designed algorithm with the implemented Chattanooga 311 systems, which can help to increase the transparency and fairness of city service.

Scholarly Products

Publications

- Resident Perceptions, Experiences, and Utilization of City Services: A Latent Profile Analysis (In progress)
- Human Preference-aware Rebalancing and Charging for Shared Electric Micromobility Vehicles (In ICRA 2024)
- Fairness-aware Electric Taxi Fleet Coordination under Short-term Power System Failures (In ACC 2024)
- Joint Rebalancing and Charging for Shared Electric Micromobility Vehicles with Energy-defined Demand (In CIKM 2024)

External Presentations

- Oral presentation at the American Control Conference, 2024

Presentations at UTC

- UTC Spring Research and Arts Conference 2024

Inventions or Other Intellectual Property

N/A

Research Outreach & Collaboration

The PI collaborates with Dr. Guo in the Psychology Department, Dr. Shi in the Social Work Department, Dr. Bathi in the Civil Engineering, Cindy Hornsby in the UTC Education Department, Dr. Ford in the Hamilton County Health Department, Dr. Preetha in Alabama A&M University, Dr. Shang in the University of Texas at Arlington, and Dr. Zhang in Florida State University.

EXTERNAL FUNDING

Proposal Submissions

The proposals submitted during the reporting period related to this award are listed as follows:

Agency	Role	Amount requested	Cayuse #
NSF	Solo PI	$174,969.00	24-0532
EPA	Leading PI	$1,249,915.00	24-4796

Contracts/Awards Received

N/A

Sponsored Program Capacity Building Activities

N/A

WHAT'S NEXT FOR THIS RESEARCH?

How will you follow up your CEACSE grant with work in the next 1,2,...5 years?

The PI plans to target the 3-year NSF grant and 5-year NSF CAREER grant.

What other related research will you pursue (and with whom) in light of the support you've received from CEACSE?

The PI plans to explore the research in the field of collaborative autonomous vehicles with the collaborator from the University of Texas at Arlington.

Tell us anything else we should know about this work not described above.

N/A

What barriers (if any) do you face to reach these next goals?

The biggest challenge is to hire qualified Ph.D. students to help the PI conduct the preliminary research for academic papers and proposals and build research reputation.

FINANCIAL ACCOUNTING

$31,159.12 is leftover. Around $4800 is for the travel. This is because the grant only covers the travel expense during the one-year project period. Dr. Dumas did not receive summer compensation, as he served as the Associate Dean with administrative responsibilities during that period and did not claim any contributions to this project for the summer months. Nearly $ 5,300 was not spent since the PI did not find a qualified undergraduate student for the research.