ANNUAL REPORT
FY 2018—2019

Center for Manufacturing Research

College of Engineering

Tennessee Tech University

CMR
Center for Manufacturing Research
Moving Technology Forward

College of Engineering
TENNESSEE TECH

About the Cover

The CMR's Industrial Assessment Center students Jacob Bilbrey, William Alston, Raman Senthil Kumar, and Kade Howard conduct an energy efficiency assessment at a manufacturing plant. Tennessee Tech's IAC was awarded 2018 Center of the Year from among 28 eligible Centers by the U.S. Department of Energy.

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Tennessee Technological University
Center for Manufacturing Research
Annual Report – FY 2018 – 2019

Mission Statement
(Unchanged since 2001)

"To advance and support scientific and engineering knowledge in areas related to manufacturing through fundamental research and technology transfer activities, and to impact the instructional program in those areas."

The Center for Manufacturing Research (CMR) at TTU is a THEC Established Center of Excellence and has been since 1990.

Director

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CMR Faculty and Staff

Dr. Robert Qiu, Professor, ECE
Dr. Cynthia Rice, Assoc. Prof., ChE
Dr. Kwun-Lon Ting, Professor, ME

Brian Bates, R&D Engineer I
Michelle Davis, Outreach Coordinator
Dr. Nan (Terry) Guo, R&D Engineer III
E. Wayne Hawkins, Material Science Lab Manager
Suzanne Henry, Center Manager
Tammy Martin, Administrative Associate III (part-time, temporary)
Robert Matthews, R&D Engineer I (part-time, temporary)
Anysa Milum, Financial Associate VI
Rob Reab, IT Systems Administrator (part-time, temporary)
Phyllis Stallion, Administrative Associate V
Darlene Wiegand, Financial Analyst (part-time, temporary)

CMR Faculty Associates

Dr. Ali Alouani, Professor, ECE
Dr. Adam Anderson, Joint Faculty with ORNL
Dr. Stephen Anton, Asst. Professor, ME
Dr. Pedro E. Arce, Chair, Professor, ChE

Dr. Curtis P. Armstrong, Chair, Professor, Decision Sciences & Mgt.
Dr. Indranil Bhattacharya, Associate Professor, ECE
Dr. Joseph J. Biernacki, Professor, ChE
Dr. Stephen Canfield, Professor, ME
Dr. Pingen Chen, Asst. Professor, ME
Dr. George Chitiyo, Professor, Curriculum & Instruction
Dr. Glenn Cunningham, Assoc. Professor, ME
Dr. William Eberle, Professor, CS
Dr. Ahmed ElSawy, Chair, Professor, MET
Dr. Ismail Fidan, Professor, MET
Dr. Melissa J. Geist, Assoc. Professor, Nursing
Dr. Sheikh Ghafoor, Professor, CS
Dr. Syed Rafay Hasan, Asst. Professor, ECE
Dr. Ada Haynes, Professor, Sociology & Political Science
Dr. Stephen A. Idem, Professor, ME
Dr. Wayne Johnson, Retired Chair and Part-time Faculty Member, ECE
Dr. DuckBong Kim, Asst. Professor, MET
Dr. Ethan Languri, Asst. Professor, ME
Dr. Satish Mahajan, Professor, ECE/Director, CESR
Dr. Mohamed Mahmoud, Assoc. Professor, ECE
Dr. Vahid Motevalli, Assoc. Dean of Research and Innovation, College of Engineering; Professor, ME
Dr. Joseph Ojo, Professor, ECE
Dr. Andy Pardue, Lecturer, ME
Dr. Sally Pardue, Assoc. Professor, ME
Dr. Mohammad Rahman, Asst. Professor, CS
Dr. Mohan Rao, Chair, Professor, ME
Dr. Jonathan (Robby) Sanders, Asst. Professor, ChE
Dr. Ambareen Siraj, Professor, CS
Dr. Holly Stretz, Assoc. Professor, ChE
Dr. Meenakshi Sundaram, Professor, ME
Dr. Doug Talbert, Assoc. Professor, CS
Dr. Chris Wilson, Assoc. Professor, ME
Dr. Dale Wilson, Professor, ME
Dr. Liqun "Laura" Zhang, Asst. Professor, ChE
Dr. Yunbo (Will) Zhang, Asst. Professor, ME
Dr. John Zhu, Professor, ME

EXECUTIVE SUMMARY

In 2018, a strategic plan was developed by the NSTC (National Science and Technology Council) *Subcommittee on Advanced Manufacturing*, based on a vision for American leadership in advanced manufacturing across industrial sectors to ensure national security and economic prosperity.[1] Developing and transitioning new manufacturing technologies to market and educating/training the manufacturing workforce are among the key goals identified by the *Subcommittee*. The mission of the CMR, "to advance and support scientific and engineering knowledge in areas related to manufacturing through fundamental research and technology transfer activities, and to impact the instructional program in those areas", aligns perfectly with this vision. The efforts made by CMR Faculty Associates over the past year have centered on achieving these key goals.

In FY18-19, the Center secured competitive grants totaling $3,627,332, a 21.7% increase from FY17-18. Thirty-one research projects were funded by various funding agencies, including National Science Foundation, National Institute of Health, Air Force Office of Scientific Research, Department of Energy, Oak Ridge National Laboratory, etc. The CMR's external research funding in FY18-19 reached the second highest level since the Center's inception in 1984.

The Center's effort in educating/training the manufacturing workforce is reflected by the number of graduate students supported. In FY18-19, the CMR supported a total of 33 graduate students, 15 Ph.D. and 18 M.S. students. This accomplishment was made possible with the revenues provided from the State appropriations and externally funded grants that were designated for graduate student support. Among the graduate students funded by the CMR, five Ph.D. and two M.S. students were from underrepresented minority groups. During this past year, degrees were awarded to six Ph.D. students and five M.S. students supported by the CMR.

As a state-funded Center of Excellence, the CMR continues to support and enhance Tennessee's manufacturing industries. The *Industrial Assessment Center* (IAC) led by Dr. Glenn Cunningham and Dr. Ethan Languri greatly impacted small- and medium-sized manufacturers across the State of Tennessee through providing solutions and assistance in energy saving and waste reduction.

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[1] "Strategy for American Leadership in Advanced Manufacturing," a report by the SUBCOMMITTEE ON ADVANCED MANUFACTURING COMMITTEE ON TECHNOLOGY of the NATIONAL SCIENCE & TECHNOLOGY COUNCIL, October 2018.

Center Research Areas

The CMR focuses on several research, education and outreach areas:

Advanced Manufacturing focuses on improving manufacturing processes and methodology through the innovative application of technologies to product design and production.

Materials for Energy Storage and Conversion addresses the need to develop the material for next generation of energy storage/conversion devices and energy efficiency technologies.

Networking and Algorithms for Big Data offers changing opportunities to assist advanced manufacturing in use of sensors and automation in large networks and Big Data in manufacturing processes.

Industry Support provides Tennessee manufacturers with technical expertise in problem-solving challenges faced in materials, design, testing, and processes.

Education and Outreach efforts enhance the Tennessee workforce development and outreach in the CMR's research areas in addition to such other activities as energy efficiency, waste reduction, and productivity improvements.

Selected Highlights from FY 2018 – 2019

External Funding Highlights

Thirty-one different research projects were funded for a total of $3,627,332 from various funding agencies (i.e., National Science Foundation, National Institute of Health, Air Force Office of Scientific Research, Department of Energy, and Oak Ridge National Laboratory). This is the second highest year of external funding since the Center's inception in 1984.

CMR's new matching funds for the past FY were $3,111,002. This amount excludes $526,095 of indirect costs associated with this year's funded projects.

Thirty-three research proposals were submitted by CMR faculty and faculty associates.

CMR supported 33 graduate students during the past FY. Eighteen M.S. students and 15 Ph.D. students were funded from both State appropriations and grants received by faculty. Specifically, external grants funded 13 of the M.S. students and five of the Ph.D. students. Thus, 53% of CMR graduate students supported was from external funding. Among the graduate students funded by CMR, two M.S. and five Ph.D. students were from underrepresented minorities.

CMR supported a total of 46 undergraduate students during this past fiscal year from both State Appropriations and externally funded projects.

Table 2. Summary of CMR Accomplishments

	FY 14-15	FY 15-16	FY 16-17	FY 17-18	FY 18-19
Value of Proposals Submitted	$12,179,250	$21,117,542	$16,175,678	$12,788,866	$9,754,283
Number of Proposals Submitted	51	59	58	47	33
Total External Activations	$2,403,677	$2,896,320	$3,782,809	$2,981,089	$3,627,332
Number of Graduate Students Supported	32	55	55	46	33
Number of Undergraduate Students Supported	54	67	69	53	46

The percentage of graduate research assistant funding from external sponsors was 53% as shown in Table 3 below. Table 3 provides a summary of various sources of external revenues for the past five years that were used to "release" or "free up" State appropriations for other strategic investment areas. It is the CMR's goal to continue to increase the amount of income (resources), both internally and externally, that can be used to expand research in the Center's research focus areas as described on page 4.

Table 3. Salary and Supplies Released by External Funding

Performance Metric	FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
CMR faculty and staff release time	$99,224	$128,231	$142,801	$101,464	$86,717
Graduate student stipend and fees from external sponsors	$325,719	$282,994	$481,254	$428,579	$287,144
Percentage of GRA support funding from external sponsors	65%	45%	60%	74%	53%
Total of income resources (F&A return, testing income, GRA support, equipment usage, and release time)	$558,390	$552,393	$796,950	$614,388	$412,454

Personnel Highlights

Dr. Ying Zhang was selected as CMR Director and officially started in this position beginning July 1, 2018. Dr. Zhang joined TTU in 2001 and is a professor in the Department of Mechanical Engineering. Prior to that, she was a coating R&D engineer at Walbar Metals (Peabody, Massachusetts). Dr. Zhang holds a Ph.D. in Materials Science and Engineering from the University of Tennessee, Knoxville. Her research focuses on novel manufacturing processes for high-temperature materials and coatings. Dr. Zhang has 70 journal and conference publications, and has received over $2.8M external funding as PI from NSF, DOE, ONR, NASA, etc. Dr. Zhang is the recipient of the 2014 Caplenor Faculty Research Award and has received the Kinslow Engineering Research Award twice.

Research Highlights

CMR Faculty Associate Dr. Ambareen Siraj continues to serve as PI for the Tennessee CyberCorps: Scholarship for Service Program with **Dr. Douglas Talbert** serving as Co-PI. NSF provided additional funding of this Cybersecurity Program by awarding two separate supplemental components: 1) Bootcamp Funding Supplement for $45,015 and 2) Community College Inclusion for $106,714. Dr. Siraj was also awarded third-year funding from the National Security Agency for $134,925 for GenCyber Camp and funding from the Department of Defense for Cybersecurity scholarships. This combined funding for Cybersecurity research continues to make Tennessee Tech one of the highly visible cyber defense education programs in the country as well as designation by both NSA and the Department of Homeland Security (DHS) as a National Center of Academic Excellence in Cyber Defense Education (CAE-CD) through AY 2021. Dr. Siraj led the sixth annual Women in Cybersecurity Conference in Pittsburgh, PA in March 2019.

Dr. Ismail Fidan, CMR Faculty Associate, was awarded $278,234 for the third year of a three year NSF grant entitled "AM-WATCH: Additive Manufacturing – Workforce Advancement Training Coalition and Hub". The primary goal of AM-WATCH is to bridge the gap between industry needs and future workforce skills via the enhancement of high school and community college curriculum with Additive Manufacturing Practices. This is accomplished through the development of curriculum and the delivery of professional development.

Dr. Jiahong Zhu, CMR Faculty Associate, was awarded $181,348 for Year 2 of the DOE grant entitled "Development and Validation of Low-Cost, Highly-Durable, Spinel-Based Contact Materials for SOFC Cathode-Side Contact Application". As a collaborative research effort between Tennessee Tech (the leading research institution) and FuelCell Energy (FCE, the subawardee), this project focuses on developing and validating the low-cost, highly-durable, spinel-based material for SOFC cathode-side contact application utilizing a unique environmentally-assisted reactive sintering process to lower the sintering temperature.

CMR Faculty Associate Steven Anton was awarded $135,561 for the third year of a three-year grant entitled "Self-Powered in Vivo Force and Implant Wear Sensing in Knee Arthroplasty" from the National Institute of Health. This research will help to determine if sensors can be used to record force and wear data, which in turn could develop better surgical procedures and implant designs in order to improve surgical outcomes and ultimately better public health.
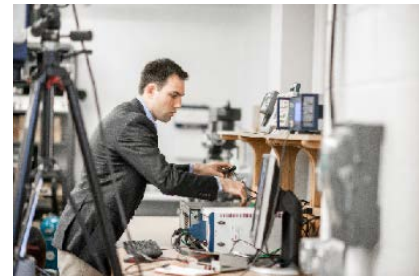
Dr. Steven Anton also received $120,000 for Year 3 of the Young Investigator Research Program (YIP) award from the Air Force Office of Scientific Research (AFOSR) for his work entitled "Continuous Real-Time State Monitoring in Highly Dynamic Environments." This research focuses on developing novel sensing systems for structures experiencing rapid changes by extending conventional electromechanical impedance-based structural health monitoring (SHM) concepts to structural systems experiencing rapid changes in state (e.g., boundary conditions, interfaces, structural damage, etc.) in order to identify those changes on the microsecond to millisecond time frame.

The National Science Foundation awarded CMR Faculty Associates, Dr. Mohamed Mahmoud and Dr. Syed Hasan $119.424 for Year 1 of a three year program to host a Research Experiences for Undergraduates (REU) Site - Secure and Privacy Preserving Cyber Physical Systems at Tennessee Tech for a ten-week period in Summer 2019. This REU Program focused on research related to security and privacy preservation in Smart Cities infrastructures, including smart power grid and smart traffic management, and will provide undergraduate research experiences for a total of ten interns from eight different universities.

Dr. Stephen Canfield, CMR Faculty Associate, continued to lead the Innovation Corps Sites Training Grant at Tennessee Tech during the third year. Funding of $99,956 was awarded for Year 3 to support this research effort.

CMR Faculty Associates and R&D engineers have published 46 journal papers, 59 conference papers, and four book chapters during the past year.

The CMR recruited two new Visiting International Researchers to Tennessee Tech during 2018-19. Dr. Yuliang Zhang joined the Center's Wireless Communications/Networking Systems Research Group. Also, Professor Yongtang Li visited Tennessee Tech to discuss potential research collaboration in the area of casting-rolling compound forming of metallic rings.

A CAPSTONE grant funded for $15,000 was awarded from UT/CIS again in 2018-2019. This grant will allow students the opportunity to correlate their innovative ideas with various industries in a classroom environment.

Center Activities

Tennessee Three-Star Industrial Assessment Center

The Tennessee 3-Star Industrial Assessment Center (IAC) received an award of $346,687 from the U.S. Department of Energy (DOE) to continue the IAC that was established in the CMR in 2006. The mission of the IAC is two-fold: 1) Assist small to medium sized manufacturers to become more energy efficient, and 2) Instruct engineering students in best practices of industrial energy efficiency to prepare them for the workforce. In twelve years, 229 assessments have been performed by the students and faculty for companies of all sizes and industries in and around Tennessee, with total implemented savings of $8.5 million. One hundred and eighty-one students have participated in the IAC with 58 receiving DOE certification in the program. The IAC also offers additional services such as water and wastewater assessments, consulting in Smart Manufacturing, ISO 50001 energy management systems, and cybersecurity assessments in collaboration with the Cybersecurity Education, Research, and Outreach Center (CEROC) at Tennessee Tech.

The IAC was honored by the DOE with the 2018 Center of Excellence Award, naming TTU's IAC as the center of the year from among 28 centers.

The IAC contracted with the Tennessee Valley Authority (TVA) to provide assistance to them in achieving certification to the ISO 50001 Energy Management Standard for their Magnolia Combined Cycle Power Plant in Mississippi. This will be the first power plant in the country certified to this rigorous standard.

CMR Distinguished Speaker Series

Dr. Michael McCarthy (ASME Fellow and Professor in Mechanical & Aerospace Engineering, University of California, Irvine) was invited by the CMR to give a presentation titled "Computer Aided Invention of a Linkage System to Draw a Given Curve". The seminar was well received by faculty and students in the College of Engineering.

Seminar Presentations

Golden Eagle Additively Innovative Virtual Lecture Series

Fall 2018

Integrating Additive Manufacturing into CAD Courses, Tom Singer, Sinclair Community College, Ohio

Where's My Spare Part? Changing Maintenance, Repair and Overhaul through Additive Manufacturing, Brett P. Conner, Youngstown State University, Ohio

Design for Additive Manufacturing: The Key to the Industrial Adoption of Additive Manufacturing, Olaf Diegel, Lund University, Sweden

Functionality Graded Additive Manufacturing, Eujin Pei, Brunel University, United Kingdom

How to Integrate Additive Manufacturing in Your Production, Benjamin Denayer, The Collective Center for the Belgian Technology Industry, Belgium

Spring 2019

The Phantom Hole Technique, Improving Structural Performance in FFF/FDM 3D Printed Products, Eric Wooldridge, Somerset Community College, Kentucky

Understanding Powder Bed Additive Manufacturing, Josh Dennis, South Central Region EOS NA, Texas

Preparing Your Model for 3D Printing, Adam Wills, Tennessee College of Applied Technology, Tennessee

Project iGen: Using Additive Manufacturing for Service Learning, Amy Fricks, DeKalb County High School, Tennessee

CMR Student Lightning Round Seminar Series

Fall 2018

Molecular-scale Interactions between Gel-forming Polymers and Cement for 3D Printing Applications, Hajar Taheri Afarani, ChE

Microscopy Analysis and Inspection for Damage after Thermal Cycling of Sn-Pb Solder, Daniel Gothard, ME

Coefficient of Thermal Expansion Characterization of Printed Circuit Board Components at Cryogenic Temperatures, Daniel Hott, ME

Topology Optimization of the Fiber Reinforced Additive Manufactured Objects, Astrit Imeri, ME

Configuration and Control Design for a Passive SCR System with NOx Storage Capability, Qinghua Lin, ME

Spring 2019

Fabrication and Heat Treatment of Bimetallic Additively Manufactured Structures (BAMS), Runman Ahsan, ME

Thermo-Mechanical Characterization of 3D-Printed Hybrid Short Fiber Reinforced Polymer Matrix Composites, Ankit Gupta, ME

Multiscale Modeling of Fusion Deposition Modeling Made Parts, Aslan Nasirov, ME

Electro-Mechanical Impedance Based Structural Health Monitoring During a Dynamic Event, Eric Nolan, ME

Characterization of Water in Gel-Forming Polymers for Cement-Based 3D Printing Applications, Hajar Taheri Afarani, ChE

Wire+Arc Additive Manufacturing (WAAM) of High Performance Alloys, Ali Tanvir, ME

Faculty, Staff and Student Accomplishments and Awards

CMR Faculty Associate, **Dr. Stephen Canfield** (Mechanical Engineering), was awarded the Brown-Henderson Outstanding Engineering Faculty Award which rewards accomplishments that most closely reflect the mission of the College of Engineering – preparing graduates through a blend of education, research, and service.

Dr. Stephen Canfield was also awarded the 2019 Kinslow Engineering Research Award which is given for the best paper written by a TTU engineering faculty member and published in a refereed professional journal. The paper is entitled "Controllability Ellipsoid to Evaluate the Performance of Mobile Manipulators for Manufacturing Tasks", published in the ASME Journal of Mechanisms and Robotics, October 12, 2017.

Dr. Dale Wilson (Mechanical Engineering), CMR Faculty Associate, was awarded the 2019 Leighton E. Sissom Innovation and Creativity Award. This award was established to recognize innovation and creativity in scholarship, methodology, invention, technique, processes, or other unique contributions demonstrating innovation and creativity.

CMR-supported Manufacturing and Engineering Technology (MET) graduate students **Aslan Nasirov and Shane Terry** tied for the MET Graduate (Masters) section of the Tennessee Tech Research and Creative Inquiry Day. Mr. Nasirov's paper was entitled "Prediction of Mechanical Properties of Fused Deposition Modeling-Made Parts using Computational Models" and Mr. Terry's was entitled "Innovating the FDM Process – Metal Powder PLA Printing."

CMR-supported MET student, **Mahdi Mohammadizadeh** won the MET Graduate (Ph.D.) section of the Tennessee Tech Research and Creative Inquiry Day with his paper entitled "Thermomechanical Investigation of Continuous Fiber Reinforced Additively Manufactured Components".

In the Mechanical Engineering section of the Tennessee Tech Research and Creative Inquiry Day, CMR-supported student **Nathan Ghattas** won the Undergraduate section with his paper "Investigation of Mechanical Boundary Conditions on Impedance-Based Structural Health Monitoring in a Biomedical Environment."

In the Graduate (Masters) Mechanical Engineering section of the Tennessee Tech Research and Creative Inquiry Day, CMR-supported student **Farzin Mashali** won with his paper entitled "A Particular Nanodiamond Suspension for Thermal Management."

CMR-supported student **Mohsen Safaei** won the Mechanical Engineering Graduate (Ph.D.) section of the Tennessee Tech Research and Creative Inquiry Day with his paper, "Finite Element Simulation of High Frequency Electromechanical Impedance Measurements for Structural Health Monitoring."

2018-19 CMR Alumni Employed in Tennessee

William Alston, M.S, Mechanical Engineering, 2019
Project Engineer
Lockheed Martin
Nashville, Tennessee

Michael Renfro, Ph.D., Mechanical Engineering, 2018
High Performance Computing Systems Administrator
Tennessee Tech University
Cookeville, Tennessee

Nicholas Russell, M.S., Mechanical Engineering, 2019
Post-Graduate Researcher
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Mohammad Arman Ullah, M.S., Computer Science, 2018
.NET Developer
Wipro Limited
Franklin, Tennessee

Jason Witman, Ph.D., Mechanical Engineering, 2018
Materials Lab Engineer
National Aerospace Solutions, LLC
Arnold AFB, TN

Publications of CMR Faculty Associates & Staff

Journal Publications

1. Adenson, Michael O., Jessica D. Murillo, Matthew Kelley, **Joseph J. Biernacki**, and Clyde P. Bagley. "Slow Pyrolysis Kinetics of Two Herbaceous Feedstock: Effect of Milling, Source, and Heating Rate." Industrial & Engineering Chemistry Research 57, no. 11 (2018): 3821-3832.

2. Adenson, Michael O., Matthew D. Kelley, Osama O. Elkelany, **Joseph J. Biernacki**, and Yung-Way Liu. "Kinetics of Cellulose Pyrolysis: Ensuring Optimal Outcomes." The Canadian Journal of Chemical Engineering 96, no. 4 (2018): 926-935.

3. Ahmed, Asad, Osman Hasan, Falah Awwad, Nabil Bastaki, and **Syed Rafay Hasan**. "Formal Asymptotic Analysis of Online Scheduling Algorithms for Plug-In Electric Vehicles' Charging." Energies 12, no. 1 (2018): 1-20.

4. Ahsan, Md RU, **Taehoon Kim**, Changwook Ji, and Yeong-Do Park. "A Study on the Effect of Wire Composition on Welding with Gap and Offset in Cold Metal Transfer (CMT) GMAW." Journal of Welding and Joining 36, no. 5 (2018): 12-18.

5. Alsharif, Ahmad, Mahmoud Nabil, Samet Tonyali, Hawzhin Mohammed, **Mohamed Mahmoud**, and Kemal Akkaya. "EPIC: Efficient Privacy-Preserving Scheme With EtoE Data Integrity and Authenticity for AMI Networks." IEEE Internet of Things Journal 6, no. 2 (2018): 3309-3321.

6. Bahraseman, Hamidreza Ghasemi, and **Ehsan Mohseni Languri**. "Enhanced Evaporation in a Multilayer Porous Media Under Heat Localization: A Numerical Study." Heat Transfer Engineering 39, no. 15 (2018): 1355-1363.

7. Darbar, Devendrasinh, M. R. Anilkumar, Vijayaraghavan Rajagopalan, **Indranil Bhattacharya**, Hendry Izaac Elim, T. Ramakrishnappa, F. I. Ezema, Rajan Jose, and M. V. Reddy. "Studies on Spinel Cobaltites, MCo_2O_4 (M= Mn, Zn, Fe, Ni and Co) and Their Functional Properties." Ceramics International 44, no. 5 (2018): 4630-4639.

8. Esfahani, Milad Rabbani, Mahesh R. Nunna, **Ethan Mohseni Languri**, Kashif Nawaz, and **Glenn Cunningham**. "Experimental Study on Heat Transfer and Pressure Drop of In-House Synthesized Graphene Oxide Nanofluids." Heat Transfer Engineering (2018): 1-14.

9. Esfahani, Milad Rabbani, Vasanta L. Pallem, **Holly A. Stretz**, and Martha JM Wells. "Core-Size Regulated Aggregation/Disaggregation of Citrate-Coated Gold Nanoparticles (5–50 nm) and Dissolved Organic Matter: Extinction, Emission, and Scattering Evidence." Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 189 (2018): 415-426.

10. Hailesellasie, Muluken Tadesse, and **Syed Rafay Hasan**. "MulNet: A Flexible CNN Processor With Higher Resource Utilization Efficiency for Constrained Devices." IEEE Access 7 (2019): 47509-47524.

11. Hailesellasie, Muluken, and **Syed Rafay Hasan**. "Intrusion Detection in PLC-based Industrial Control Systems Using Formal Verification Approach in Conjunction with Graphs." Journal of Hardware and Systems Security 2, no. 1 (2018): 1-14.

12. He, Xing, Lei Chu, **Robert Caiming Qiu**, Qian Ai, and Zenan Ling. "A Novel Data-Driven Situation Awareness Approach for Future Grids—Using Large Random Matrices for Big Data Modeling." IEEE Access 6 (2018): 13855-13865.

13. **Fidan, Ismail**, "Creating An Engaged and Sustainable SME," Manufacturing Engineering 160, no. 2 (2018): 17-18

14. Imeri, A., **I. Fidan**, M. Allen, **D. A. Wilson**, and **S. Canfield**. "Fatigue Analysis of the Fiber Reinforced Additively Manufactured Objects." The International Journal of Advanced Manufacturing Technology 98, no. 9-12 (2018): 2717-2724.

15. **Languri, Ehsan M.**, and Houman B. Rokni. "Flow of Microencapsulated Phase Change Material Slurry through Planar Spiral Coil." Heat Transfer Engineering 39, no. 11 (2018): 977-984.

16. **Languri, Ehsan M.**, Houman B. Rokni, Jorge Alvarado, Behrouz Takabi, and Minsuk Kong. "Heat Transfer Analysis of Microencapsulated Phase Change Material Slurry Flow in Heated Helical Coils: A Numerical and Analytical Study." International Journal of Heat and Mass Transfer 118 (2018): 872-878.

17. Li, Yelong, Jianli Song, **Jiahong Zhu**, Yongtang Li, and Wen Yang. "(Co, Mn) 3O4 Spinel Coating for Protecting Metallic Interconnects Thermally Converted from an Electro-Codeposited Co-Mn3O4 Composite Coating." Advances in Materials Science and Engineering 2018 (2018).

18. Lin, Qinghua, and **Pingen Chen**. "An NOx Sensor-based Direct Algebraic Approach-Newton Observer for Urea Selective Catalytic Reduction System State Estimations." Journal of Dynamic Systems, Measurement, and Control 140, no. 11 (2018): 111004.

19. Marshall, Ryan, **Sheikh Ghafoor**, Mike Rogers, Alfred Kalyanapu and Tigstu Dullo, "Performance Enhancement of a Flood Simulator for Heterogeneous HPC Environments," International Journal of Network and Communication 9, no. 2 (2018): 387-407.

20. Mativo, Thomas, Colleen Fritz, and **Ismail Fidan**. "Cyber Acoustic Analysis of Additively Manufactured Objects." The International Journal of Advanced Manufacturing Technology 96, no. 1-4 (2018): 581-586.

21. Mirshekari, G. R., and **C. A. Rice**. "Effects of Support Particle Size and Pt Content on Catalytic Activity and Durability of Pt/TiO$_2$ Catalyst for Oxygen Reduction Reaction in Proton Exchange Membrane Fuel Cells Environment." Journal of Power Sources 396 (2018): 606-614.

22. Mohammad, Abdul Salam, **Joseph J. Biernacki**, Scott Northrup, and Michael Adenson. "Diffusion of CO_2 and Fractional Free Volume in Crystalline and Amorphous Cellulose." Journal of analytical and applied pyrolysis 134 (2018): 43-51.

23. Mohammadizadeh, M., **I. Fidan**, M. Allen, and A. Imeri. "Creep Behavior Analysis of Additively Manufactured Fiber-Reinforced Components." The International Journal of Advanced Manufacturing Technology 99, no. 5-8 (2018): 1225-1234.

24. Mookiah, Lenin, **William Eberle**, and Maitrayi Mondal. "Personalized News Recommendation Using Graph-based Approach." Intelligent Data Analysis 22, no. 4 (2018): 881-909.

25. Powelson, Matthew W., and **Stephen L. Canfield**. "Experimental Investigation on Attachment Properties of Dry Adhesives Used in Climbing Robots." International Journal of Mechanisms and Robotic Systems (in press) (2018).

26. Prabhu, Vinit Vinayak, and **Ehsan Mohseni Languri**. "Shelter Energy Use Reduction through Buoyancy-Driven Air Flow Manipulation: A Numerical and Experimental Study." Sustainable Energy Technologies and Assessments 26 (2018): 37-46.

27. **Qiu, Robert**, Lei Chu, Xing He, Zenan Ling, and Haichun Liu. "Spatiotemporal Big Data Analysis for Smart Grids Based on Random Matrix Theory." Transportation and Power Grid in Smart Cities: Communication Networks and Services (2018): 591-633.

28. Rashidi, Saman, Omid Mahian, and **Ehsan Mohseni Languri**. "Applications of Nanofluids in Condensing and Evaporating Systems." Journal of Thermal Analysis and Calorimetry 131, no. 3 (2018): 2027-2039.

29. Rentschler, Micah, and **Indranil Bhattacharya**. "Decoupled Control of Wireless Power Transfer: Eliminating the Interdependence of Load Resistance and Coupling to Achieve a Simple Control Framework with Fast Response Times." International Journal of Electrical Power & Energy Systems 99 (2018): 156-163.

30. Safaei, Mohsen, R. Michael Meneghini, and **Steven R. Anton**. "Energy Harvesting and Sensing with Embedded Piezoelectric Ceramics in Knee Implants." IEEE/ASME Transactions on Mechatronics 23, no. 2 (2018): 864-874.

31. Safaei, Mohsen, R. Michael Meneghini, and **Steven R. Anton**. "Force Detection, Center of Pressure Tracking, and Energy Harvesting from a Piezoelectric Knee Implant." Smart Materials and Structures 27, no. 11 (2018): 114007.

32. Taherian, Hessam, Jorge L. Alvarado, and **Ehsan M. Languri**. "Enhanced Thermophysical Properties of Multiwalled Carbon Nanotubes Based Nanofluids. Part 1: Critical Review." Renewable and Sustainable Energy Reviews 82 (2018): 4326-4336.

33. Taherian, Hessam, Jorge L. Alvarado, and **Ehsan M. Languri**. "Enhanced Thermophysical Properties of Multiwalled Carbon Nanotubes Based Nanofluids. Part 2: Experimental Verification." Renewable and Sustainable Energy Reviews 82 (2018): 4337-4344.

34. Tiwari, Bibek, and **Indranil Bhattacharya**. "Layered P2-Type Novel $Na_{0.7}Ni_{0.3}Mn_{0.59}Co_{0.1}Cu_{0.01}O_2$ Cathode Material for High-Capacity & Stable Rechargeable Sodium Ion Battery." Electrochimica Acta 270 (2018): 363-368.

35. Velraj, S., A. K. Estes, B. L. Bates, and **J. H. Zhu**. "Effects of Testing Conditions on the Performance of Carbon-Supported Bifunctional Electrodes." Electrochimica Acta 292 (2018): 446-457.

36. Walker, Donald M., Christopher M. Murray, **Doug Talbert**, Paul Tinker, Sean P. Graham, and Thomas W. Crowther. "A Salamander's Top Down Effect on Fungal Communities in a Detritivore Ecosystem." FEMS microbiology ecology 94, no. 12 (2018): fiy168.

37. Wang, Chao, Biming Mo, Zhenfeng He, Xiaofeng Xie, Cindy Xinxin Zhao, **Liqun Zhang**, Qian Shao, Xingkui Guo, Evan K. Wujcik, and Zhanhu Guo. "Hydroxide Ions Transportation in Polynorbornene Anion Exchange Membrane." Polymer 138 (2018): 363-368.

38. Wen, Fei, Lei Chu, Peilin Liu, and **Robert C. Qiu**. "A Survey on Nonconvex Regularization-Based Sparse and Low-Rank Recovery in Signal Processing, Statistics, and Machine Learning." IEEE Access 6 (2018): 69883-69906.

39. Wen, Fei, Peilin Liu, Haichao Wei, Yi Zhang, and **Robert C. Qiu**. "Joint Azimuth, Elevation, and Delay Estimation for 3-D Indoor Localization." IEEE Transactions on Vehicular Technology 67, no. 5 (2018): 4248-4261.

40. Yeasmin, Rabeta, Matthias Buck, Aaron Weinberg, and **Liqun Zhang**. "Translocation of Human β Defensin Type 3 through a Neutrally Charged Lipid Membrane: A Free Energy Study." The Journal of Physical Chemistry B 122, no. 50 (2018): 11883-11894.

41. Yu, Y. T., and **J. H. Zhu**. "Communication—Reactive Sintering of a $CoFe_2O_4$ Coating on Ferritic Stainless Steels for SOFC Interconnect Application." Journal of The Electrochemical Society 165, no. 5 (2018): F297-F299.

42. Yu, Y. T., **J. H. Zhu**, and B. L. Bates. "Effect of Precursor Materials on the Performance of the $NiFe_2O_4$-based Spinel Layer for SOFC Cathode-Side Contact Application." Solid State Ionics 324 (2018): 40-48.

43. Zhang, Dongxia, and **Robert Caiming Qiu**. "Research on Big Data Applications in Global Energy Interconnection." Global Energy Interconnection 1, no. 3 (2018): 352-357.

44. **Zhang, Liqun**. "Investigation on Two Human Defensin Dimers: Structure Prediction and Refinement Using a Combined Simulation Strategy." Molecular Simulation 44, no. 9 (2018): 757-768.

45. **Zhang, Ying** and Jason Witman, "Electro-codeposition of MCrAlY Coatings for Advanced Gas Turbine Applications," Products Finishing 82, no.12 (2018): 39-45.

46. Zolghadr, Ali, **Joseph J. Biernacki**, and Ronald J. Moore. "Biomass Fast Pyrolysis Using a Novel Microparticle Microreactor Approach: Effect of Particles Size, Biomass Type, and Temperature." Energy & fuels 33, no. 2 (2018): 1146-1156.

Conference Publications

1. Alsharif, A., Nabil, M., **Mahmoud, M.**, and Abdallah, M., "Privacy-preserving collection of power consumption data for enhanced AMI networks," In 2018 25th International Conference on Telecommunications (ICT), pp. 196-201. IEEE, 2018.

2. Bonning, B., Blackburn, J., **Stretz, H. A.**, and **Wilson, C.**, "Thermomechanical behavior of polymer films at cryogenic temperatures," AICHE National Conference Annual Proceedings, 2018.

3. Brown, D.W., **Ghafoor, S.K.**, and **Canfield, S.**, "Instruction of introductory programming course using multiple contexts." In Proceedings of the 23rd Annual ACM Conference on Innovation and Technology in Computer Science Education, pp. 147-152. ACM, 2018.

4. Carlson, J., Tiberi, Z., Safaei, M., Ponder, R.I., and **Anton, S.R.**, "Parametric testing of surrogate knee replacement bearings with embedded piezoelectric transducers," in ASME 2018 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, pp. V002T06A004-V002T06A004.

5. Chandramouli, R., Jin, G., **Fidan, I.**, and Cossette, M., "Virtual Reality Education Modules for Digital Manufacturing Instruction," Proceedings of the 2018 ASEE Annual Conference, 2018.

6. **Chen, P.** and Lin, Q., "Simultaneous Optimization of Configuration and Control for a Passive SCR System," in ASME 2018 Dynamic Systems and Control Conference, 2018, pp. V002T26A006-V002T26A006.

7. **Chen, P.**, Lin, Q., Prikhodko, V., and Parks, J., "Non-Uniform Cylinder-to-Cylinder Combustion for Ammonia Generation in a New Passive SCR System," American Control Conference (ACC) 2018, pp. 19-24, 2018.

8. Childress, B. and **Chen, P.**, "A Decomposition Algorithm for a Class of Nonlinear Dynamic Systems with Cross-sensitive Output Measurement," in 57th IEEE Conference on Decision and Control, pp. 662-667, 2018.

9. Childress, B. and **Chen, P.**, "State and Output Estimations for a Class of Nonlinear Dynamic Systems With Highly Cross-Sensitive Output Measurements," in ASME 2018 Dynamic Systems and Control Conference, 2018, pp. V002T21A003-V002T21A003.

10. Ehite, E.H. and **Anton, S.R.**, "A low-cost modular impact-based experimental setup for evaluation of EMI based structural health monitoring at high rates," In Sensors and Instrumentation, Aircraft/Aerospace and Energy Harvesting, Volume 8: Proceedings of the 36th IMAC, A Conference and Exposition on Structural Dynamics 2018, p. 93. Springer, 2018.

11. **Fidan, I.**, "Innovations in additive manufacturing workforce development," Proceedings of 2018 RAPID + TCT Conference. Fort Worth Convention Center, Fort Worth, TX.

12. **Fidan, I.**, Chitiyo, G., and Singer, T., "Additive Manufacturing Studios: A New Way of Teaching ABET Student Outcomes and Continuous Improvement," Proceedings of the 2018 ASEE Annual Conference, 2018.

13. Ford, V., Taylor, D., and **Siraj, A.**, "AMIsim: application-layer advanced metering infrastructure simulation framework for secure communication protocol performance evaluation", Proceedings: 11th USENIX Workshop on Cyber Security Experimentation and Test (CSET '18), 2018.

14. Fraley, J., Imeri, A., **Fidan, I.**, and Chandramouli, R., "A Comparative Study on Affordable Photogrammetry Tools," Proceedings of the 2018 ASEE Annual Conference, 2018.

15. **Guo, T.** and **Mahmoud, M.**, "Performance analysis of physical-layer-based authentication for electric vehicle dynamic charging," in 2018 IEEE 88th Vehicular Technology Conference (VTC-Fall), pp. 1-7. IEEE, 2018.

16. **Guo, T.**, Khoo, D., Coultis, M., Pazos-Revilla, M., and **Siraj, A.**, "IoT platform for engineering education and research (IoT PEER)--applications in secure and smart manufacturing," in 2018 IEEE/ACM Third International Conference on Internet-of-Things Design and Implementation (IoTDI) (pp. 277-278). IEEE 2018.

17. Hailesellasie, M., **Hasan, S.R.**, Khalid, F., Wad, F.A., and Shafique, M., "FPGA-based convolutional neural network architecture with reduced parameter requirements," in 2018 IEEE International Symposium on Circuits and Systems (ISCAS), pp. 1-5. IEEE, 2018.

18. Hargis, B.E., Demirjian, W.A., Powelson, M.W., and **Canfield, S.L.**, "Investigation of neural-network-based inverse kinematics for a 6-DOF serial manipulator with non-spherical wrist." In ASME 2018 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, pp. V05BT07A048-V05BT07A048.

19. **Hasan, S.R.**, Kamhoua, C.A., Kwiat, K.A., and Njilla, L., "A novel framework to introduce hardware Trojan monitors using model checking based counterexamples: inspired by game theory," in 2018 IEEE 61st International Midwest Symposium on Circuits and Systems (MWSCAS), pp. 853-856. IEEE, 2018.

20. Hossain, M.M., Hines, T.M., **Ghafoor, S.K.**, Islam, S.R., Kannan, R., and Sukumar, S.R., "A Flexible-blocking Based Approach for Performance Tuning of Matrix Multiplication Routines for Large Matrices with Edge Cases." In 2018 IEEE International Conference on Big Data (Big Data), pp. 3853-3862. IEEE, 2018.

21. Hossain, M.M., Hines, T.M., **Ghafoor, S.K.**, Marshall, R.J., Amanzholov, M.S., and Kannan, R., "Performance Issues of SYRK Implementations in Shared Memory Environments for Edge Cases." In 2018 21st International Conference of Computer and Information Technology (ICCIT), pp. 1-7. IEEE, 2018.

22. Hossain, M.M., **Talbert, D.A.**, **Ghafoor, S.K.**, and Kannan, R., "FAWCA: A flexible-greedy approach to find well-tuned CNN architecture for image recognition problem," in Proceedings of the 14th International Conference on Data Science (ICDATA'18), pp. 214-219, 2018.

23. Imeri, A., **Fidan, I.**, Allen, M., and Perry, G., "Effect of fiber orientation in fatigue properties of FRAM components," Procedia Manufacturing 26 (2018): 892-899.

24. Islam, S.R., Eberle, W., and **Ghafoor, S.**, "Credit default mining using combined machine learning and heuristic approach," Proceedings of the 2018 International Conference on Data Science (ICDATA), pp.16-22.

25. Islam, S.R., **Ghafoor, S.K.**, and **Eberle, W.**, "Mining Illegal Insider Trading of Stocks: A Proactive Approach." In 2018 IEEE International Conference on Big Data (Big Data), pp. 1397-1406. IEEE, 2018.

26. Jaladi, D., **Languri, E.**, Nawaz, K., and **Cunningham, G.**, "Innovative thermal distillation method using solar heat localization," in ASTFE Digital Library. Begel House Inc., 2018.

27. Kerekes, R.A., Karnowski, T.P., Kuhn, M., Moore, M.R., Stinson, B., Tokola, R., **Anderson, A.** and Vann, J.M., "Vehicle classification and identification using multi-modal sensing and signal learning." In *2017 IEEE 85th Vehicular Technology Conference (VTC Spring)*, pp. 1-5. IEEE, 2017.

28. Kettle, R.A. and **Anton, S.R.**, "Multi-tonal based impedance measurements for microsecond state detection," In Sensors and Instrumentation, Aircraft/Aerospace and Energy Harvesting, Volume 8: Proceedings of the 36th IMAC, A Conference and Exposition on Structural Dynamics 2018, p. 111. Springer, 2018.

29. Khalid, F., Nanjiani, S., **Hasan, S.R**., Hasan, O., Awwad, F., and Shafique, M., "Low power digital clock multipliers for battery operated internet of things (IoT) devices," In 2018 IEEE International Symposium on Circuits and Systems (ISCAS), pp. 1-5. IEEE, 2018.

30. Liang, J., Jiang, J., **Ojo, O.**, and Haruna, J., 2018, September. Damping for Multi-Paralleled Grid Tied Inverters with LCL Filters. In 2018 IEEE Energy Conversion Congress and Exposition (ECCE) (pp. 5879-5886). IEEE.

31. Lin, Q. and **Chen, P.**, "Model-based Analysis and Control of SCR Using NOx Sensor Measurements," American Control Conference (ACC) 2018, pp. 5522-5527, 2018.

32. Lin, Q. and **Chen, P.**, "Non-Uniform Combustion Based Mode Switching Control for A Passive SCR System," American Control Conference (ACC) 2018, pp. 5536-5541, 2018.

33. Lin, Q. and **Chen, P.**, "Non-Uniform Cylinder-to-Cylinder Combustion for Cost-Effective Lean NOx Trap Regeneration," American Control Conference (ACC) 2018, pp. 31-36, 2018.

34. Lin, Q., **Chen, P.**, Prikhodko, V.Y., and Parks, J.E., "Configuration and Control Design for a Passive SCR System With NOx Storage Capability," in ASME 2018 Dynamic Systems and Control Conference, 2018, pp. V002T26A005-V002T26A005.

35. Marshall, R., **Ghafoor, S.K.**, and Rogers, M., "A Software Abstraction Method for Efficient 2D Grid Computations in Heterogeneous HPC Environments", in Proceedings of the PMAW: The Programming Models and Algorithms Workshop, IPDPS 2018.

36. Marshall, R., **Ghafoor, S.K.**, and Sharif, M.B., "A System for Performance Porting of Iterative Structured Grid Applications in HPC Environments." In 2018 21st International Conference of Computer and Information Technology (ICCIT), pp. 1-7. IEEE, 2018.

37. Mohammadizadeh, M., **Stretz, H.**, and Mu, R., "IR fluorescent probe for water-based agricultural nutrients," in ABSTRACTS OF PAPERS OF THE AMERICAN CHEMICAL SOCIETY, vol. 255. 1155 16TH ST, NW, WASHINGTON, DC 20036 USA: AMER CHEMICAL SOC, 2018.

38. Mohammed, H., Howell, J., **Hasan, S.R.**, **Guo, N.**, Khalid, F., and Elkeelany, O., "Hardware Trojan based security issues in home area network: a testbed setup," in 2018 IEEE 61st International Midwest Symposium on Circuits and Systems (MWSCAS), pp. 972-975. IEEE, 2018.

39. Nabil, M., Alsharif, A., Sherif, A., **Mahmoud, M**., and Younis, M., "Efficient multi-keyword ranked search over encrypted data for multi-data-owner settings," in IEEE International Conference on Communications (ICC), pp. 1-6). IEEE, 2018.

40. Nabil, M., Ismail, **M., Mahmoud,** M., Shahin, M., Qaraqe, K., and Serpedin, E., "Deep recurrent electricity theft detection in AMI networks with random tuning of hyper-parameters," In 2018 24th International Conference on Pattern Recognition (ICPR), pp. 740-745. IEEE, 2018.

41. Niu, K., Wang, J., **Ting, K.L.**, Tao, F., Cheng, Q., Wang, Q., and Zhang, K., "Output error analysis of planar 2-DOF five-bar mechanism," in IOP Conference Series: Materials Science and Engineering, vol. 324, no. 1, p. 012013. IOP Publishing, 2018.

42. Oriero, E. and **Hasan, S.R.**, "All digital low power aging sensor for counterfeit detection in integrated circuits," in 2018 IEEE 61st International Midwest Symposium on Circuits and Systems (MWSCAS), pp. 33-36. IEEE, 2018.

43. Pasha, A.M., Ibrahim, H.M., **Hasan, S.R.**, Belkacemi, R., Awwad, F., and Hasan, O., "A utility maximized demand-side management for autonomous microgrid," in 2018 IEEE Electrical Power and Energy Conference (EPEC), pp. 1-5. IEEE, 2018.

44. Paudel, R., Dunn, K., **Eberle, W.**, and Chaung, D., "Cognitive health prediction on the elderly using sensor data in smart homes," In The Thirty-First International Flairs Conference. 2018.

45. Paudel, R., **Eberle, W.**, and Holder, L., "Anomaly detection of elderly patient activities in smart homes using a graph-based approach," Proceedings of the 2018 International Conference on Data Science (ICDATA), pp.163-169.

46. Ponder, R.I., Safaei, M., and **Anton, S.R.**, "Validation of impedance-based structural Health monitoring in a simulated biomedical implant system," in ASME 2018 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, pp. V002T05A008-V002T05A008.

47. Safaei, M. and **Anton, S.R.**, "Self-powered multifunctional instrumented knee implant," in ASME 2018 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, pp. V002T06A008-V002T06A008.

48. Safaei, M., Ponder, R.I., and **Anton, S.R.**, "Detection of compartmental forces and location of contact areas with piezoelectric transducers in total knee arthroplasty," In Active and Passive Smart Structures and Integrated Systems XII, vol. 10595, p. 105951Q. International Society for Optics and Photonics, 2018.

49. Shelley, J., Mohammed, H., Zink, L., **Hasan, S.R.**, and Elkeelany, O., "Covert communication channel detection in low-power battery operated IoT devices: leveraging power profiles," in SoutheastCon 2018, pp. 1-6. IEEE, 2018.

50. SherifI, A., Alsharif, A., **Mahmoud, M.**, Abdallah, M., and Song, M., "Efficient privacy-preserving aggregation scheme for data sets," In 2018 25th International Conference on Telecommunications (ICT), pp. 191-195. IEEE, 2018.

51. Shetty, A., Fernandes, B.G., **Ojo, J.O.**, and Ferreira, J.A., 2018, September. Three Phase PWM Rectifier with Integrated Battery for Automotive Applications. In 2018 IEEE Industry Applications Society Annual Meeting (IAS) (pp. 1-6). IEEE.

52. Singh, R., Graves, J.A., and **Talbert, D.A.**, "Subgroup discovery in sequential databases," in The Thirty-First International Flairs Conference. 2018.

53. Singh, R., Graves, J.A., **Talbert, D.A.**, and **Eberle, W.**, "Prefix and suffix sequential pattern mining", In Industrial Conference on Data Mining, pp. 309-324. Springer, Cham, 2018.

54. Singh, R., Graves, J.A., Waitman, L.R., and **Talbert, D.A.**, "Finding a balance between interestingness and diversity in sequential pattern mining," Proceedings of the 14th International Conference on Data Science (ICDATA), 2018, pp. 170-176.

55. Strange, D., **Chen, P.**, Prikhodko, V.Y., and Parks, J.E., "Optimization of Mode Switching Timing Control for a Lean-Burn Gasoline Engine With a Prototype Passive SCR System," in ASME 2018 Dynamic Systems and Control Conference, 2018, pp. V002T27A005-V002T27A005.

56. **Stretz, H.A.** and Altalhi, A., "Montmorillonite-modified aromatic polyamide membrane materials with chlorine resistance," AICHE Annual Proceedings, 2018.

57. **Ting, K.L.** and Chan, C.L., "Curvature theory on contact and transfer characteristics of enveloping curves," in ASME 2018 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, pp. V05BT07A088-V05BT07A088.

58. **Ting, K.L.** and Hsu, K.L., "Over-constrained mechanisms derived from RPRP loops," in ASME 2018 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, pp. V05BT07A069-V05BT07A069.

59. Yang, K. and **Chen, P.**, "Model Predictive Air-Fuel Ratio Control for an Integrated Gasoline Engine and Three-Way Catalytic Converter System," in ASME 2018 Dynamic Systems and Control Conference, 2018, pp. V002T26A001-V002T26A001.

Book Chapters

1. Sherif, A., Ismail, M., Pazos-Revilla, M., **Mahmoud, M.**, Akkaya, K., Serpedin, E. and Qaraqe, K., "Privacy Preserving Power Charging Coordination Scheme in the Smart Grid," Transportation and Power Grid in Smart Cities: Communication Networks and Services, pp.555-576. 2018.

2. Nabil, M., Ismail, M., **Mahmoud, M.**, Shahin, M., Qaraqe, K., and Serpedin, E., "Deep Learning-based Detection of Electricity Theft Cyber-attacks in Smart Grid AMI Networks", Book chapter in book titled: Deep Learning Applications for Cyber Security, Advanced Sciences and Technologies for Security Applications Series, Springer 2018.

3. **Fidan, I.**, Elliott, A., Cossette, M., Singer, T., and Tackett, E. "The Development and Implementation of Instruction and Remote Access Components of Additive Manufacturing." In *Cyber-Physical Laboratories in Engineering and Science Education*, pp. 331-342. Springer, Cham, 2018.

4. **Fidan, I.**, "Section: Research and Development, Academic Activities and Capabilities in Additive Manufacturing," pp. 287-303, Wohlers Report 2018, (Book Chapter), ISBN: 978-0-9913332-4-0.

External Activations

Externally Funded Project Activations
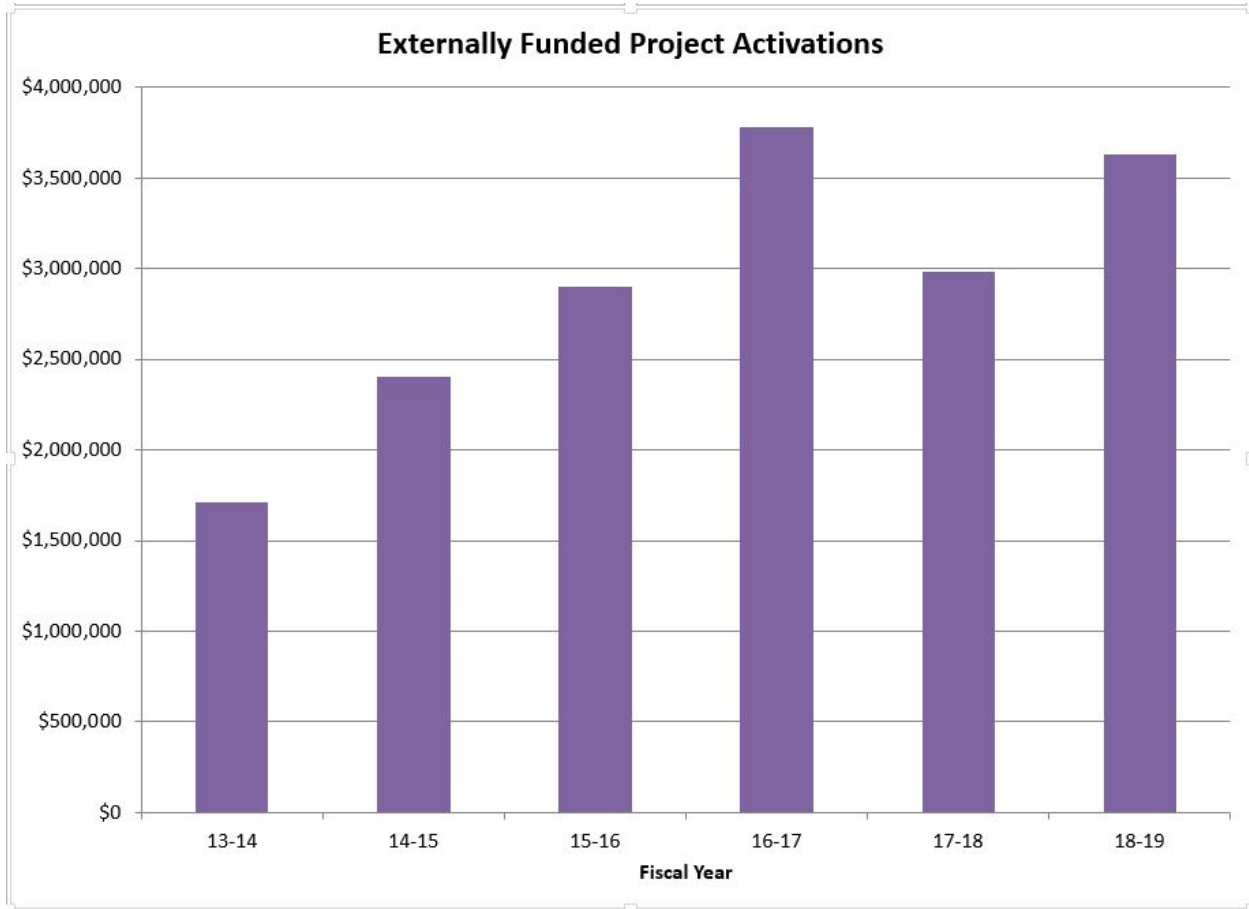
FY	13-14	14-15	15-16	16-17	17-18	18-19
■ External Activations	$1,711,145	$2,403,677	$2,896,320	$3,782,809	$2,981,089	$3,627,332

Proposals Submitted

Proposals Submitted
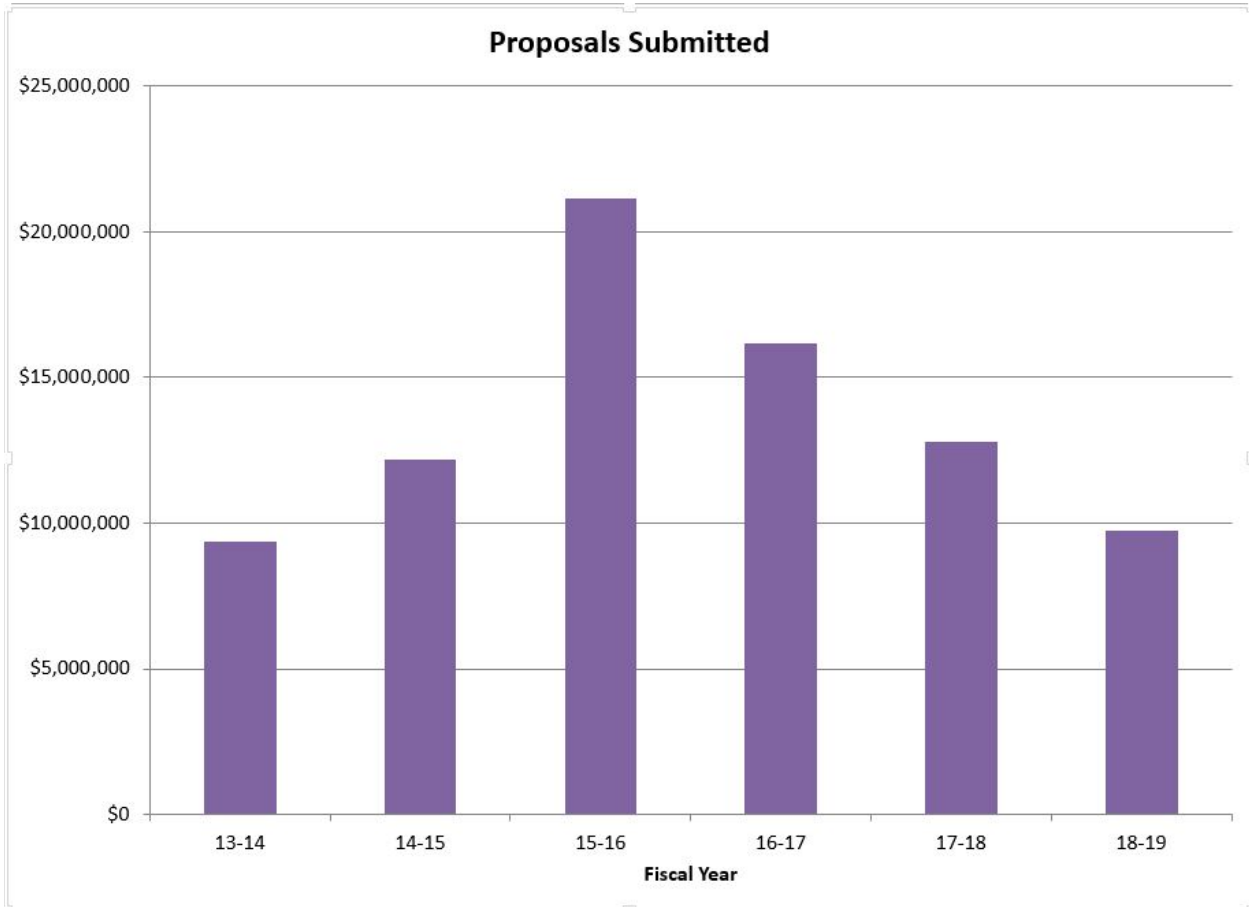
FY	13-14	14-15	15-16	16-17	17-18	18-19
Proposals Submitted	$9,387,001	$12,179,250	$21,117,542	$16,175,678	$12,788.866	$9,754,283

Grants and Contract Awards

	Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending
1	Manufacturing Center Design and Testing - FY 2018-2019 (Activated at end of Fiscal Year) Various Industries Account #: 5-38585	Ying Zhang	$23,888	7/1/2018	6/30/2019
2	UT-CIS Contract (2018-2019) Capstone The University of Tennessee Center for Industrial Services Account #: 5-33506	Meenakshi Sundaram	$15,000	7/1/2018	6/30/2019
3	TTU - NSF Innovation Corps Sites National Science Foundation - Award 1548009 - Year 2 of 3 Account #: 5-31286	Stephen Canfield Ismail Fidan S.Pardue/C.Armstrong	$99,956	1/15/2017	1/14/2018
4	TTU - NSF Innovation Corps Sites National Science Foundation - Award 1548009 - Year 3 of 3 Account #: 5-31286	Stephen Canfield Ismail Fidan S.Pardue/C.Armstrong	$99,956	1/15/2018	12/31/2018
5	Self-Powered In Vivo Force and Implant Wear Sensing in Knee Arthroplasty National Institute of Health - Award IR15AR068663-01A1 - Year 3 of 3 Account #: 5-31307	Steven Anton	$135,561	8/15/2018	7/31/2019
6	Supplement to TENNESSEE CYBERCORPS: A Hybrid Program in Cybersecurity - Community College Inclusion National Science Foundation - Award 1565562, Supplement #1, Year 3 of 3 Account #: 5-31279	Ambareen Siraj Doug Talbert M. Rahman	$35,926	8/18/2018	8/17/2019
7	TENNESSEE CYBERCORPS: A HYBRID PROGRAM IN CYBERSECURITY National Science Foundation - Award 1565562 - Year 3 of 5 Account #: 5-31279	Ambareen Siraj Doug Talbert M. Rahman	$653,539	1/1/2018	12/31/2018
8	TENNESSEE CYBERCORPS: A HYBRID PROGRAM IN CYBERSECURITY National Science Foundation - Award 1565562 Year 4 of 5 Account #: 5-31279	Ambareen Siraj Doug Talbert	$596,415	1/1/2019	12/31/2019
9	AM-WATCH: Additive Manufacturing - Workforce Advancement Training Coalition and Hub National Science Foundation - Award 1601587 - Year 3 of 3 Account #: 5-31289	Ismail Fidan	$278,234	8/1/2018	7/31/2019

	Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending
10	Continuous Real-Time State Monitoring in Highly Dynamic Environments Air Force Office of Scientific Research - Award FA9550-16-1-0440 - Year 3 of 3 Account #: 5-32347	Steven Anton	$120,000	9/1/2018	8/31/2019
11	NeTS: Small: Collaborative Research: Towards Privacy Preserving Autonomous Vehicle Sharing Services National Science Foundation - Award 1618549 - Year 3 of 3 Account #: 5-31290	Mohamed Mahmoud	$43,658	9/1/2018	8/31/2019
12	Public-Private Partnership to Promote Efficient Manufacturing and Workforce Development Department of Energy, Office of Energy Efficiency and Renewable Energy - DE-EE007702 Modification #8 Account #: 5-32278	Glenn Cunningham Ethan Languri	$286,687	9/1/2018	8/31/2019
13	ATE - MANEUVER: MANufacturing Education Using Virtual Environment Resources Purdue University (via NSF funds) - Contract 4104-79545 - Year 2 of 3 Account #: 5-31292	Ismail Fidan	$44,804	5/1/2018	4/30/2019
14	ATE - MANEUVER: MANufacturing Education Using Virtual Environment Resources Purdue University (via NSF funds) - Contract 4104-79545 - Year 3 of 3 Account #: 5-31292	Ismail Fidan	$45,300	5/1/2019	4/30/2020
15	Southeast Combined Heat and Power Technical Assistance Partnership (CHP TAP) North Carolina State University (via DOE funds) - Award DE-EE0008273 Year 1 of 5 Account #: 5-32817	Ethan Languri Glenn Cunningham	$37,702	9/1/2018	9/30/2019
16	Supplement to TENNESSEE CYBERCORPS: A Hybrid Program in Cybersecurity - Community College Inclusion National Science Foundation - Award 1565562, Supplement #2 - Year 2 of 3. Account #: 5-31279	Ambareen Siraj Mohammad Rahman Doug Talbert	$34,250	8/1/2018	7/31/2019
17	Development & Validation of Low-Cost, Highly-Durable, Spinel-Based Contact Materials for SOFC Cathode-Side Contact Application US Department of Energy (DOE), Office of Fossil Energy - Cooperative Agreement DE-FE0031187 - Year 2 of 2 Account #: 5-32289	Jiahong Zhu	$145,139	10/1/2018	9/30/2019
18	Detection and Analysis of Malware in Critical Infrastructure Oak Ridge National Laboratory - Contract 4000158354 Account #: 5-39371	Sheikh Ghafoor	$24,738	10/4/2017	9/30/2019

	Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending
19	SMART2 Smart Manufacturing for America's Revolutionizing Technological Transformation Motlow (via NSF Award 1801120) - Year 1 of 3	Ismail Fidan Yunbo Zhang	$62,690	7/1/2018	6/30/2019
	Account #: 5-31297				
20	Advancement of Cryogenic Electronics MIT Lincoln Laboratory - PO 7000293007, Balance Year 4 Funds	Wayne Johnson Christopher Wilson H.Stretz/S. Mahajan	$300,000	1/1/2018	12/31/2018
	Account #: 5-39376				
21	Electro-codeposition of MCrAlY Coatings for Advanced Gas Turbine Applications AESF-Foundation - Year 2 of 3 - Signed Agreement	Ying Zhang	$25,000	1/1/2019	12/31/2019
	Account #: 5-32438				
22	"Power into Motion Phase IV" Proposed Automotive Powertrain Program at Tennessee Tech Denso North America Foundation	Pingen Chen	$30,000	7/1/2018	5/1/2019
	Account #: 5-35916				
23	Supplement to Tennessee Cybercorps: A Hybrid Program in Cybersecurity - Community College Inclusion - 2018-2021 National Science Foundation - Award 1565562	Ambareen Siraj Doug Talbert M. Rahman	$36,538	8/1/2018	7/31/2019
	Account #: 5-31279				
24	AFRL University Design Challenge Technology Service Corporations (TSC) prime with AFRL for RRTAS, contract no. FA8650-16-C-9205	Mohan Rao	$25,000	8/15/2018	8/14/2019
	Account #: 5-32390				
25	REU Site: Secure and Privacy-Preserving Cyber Physical Systems: Software and Hardware Approaches National Science Foundation - Award 1852126, Year 1 of 3	Mohamed Mahmoud Syed Hasan	$119,424	2/1/2019	1/31/2020
	Account #: 5-31299				
26	Supplement to: Development & Validation of Low-Cost, Highly-Durable, Spinel-Based Contact Materials for SOFC Cathode-Side Contact Application US Department of Energy (DOE), Office of Fossil Energy - Award DE-FE0031187 Cooperative Agreement	Jiahong Zhu	$36,209	9/1/2018	2/28/2019
	Account #: 5-32289				
27	2019 GenCyber Student Camp at Tennessee Tech National Science Foundation & National Security Agency - Award H98230-19-1-0147	Ambareen Siraj	$134,925	5/1/2019	4/30/2020
	Account #: 5-32322				

Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending
28 Establishment of Near-optimal Process Parameters for Wire+Arc Additive Manufacturing via Thermo-Mechanical Tests	Duck Bong Kim	$12,500	1/2/2019	12/31/2019
KITECH (Korea Institute of Industrial Technology) - Signed Agreement				
Account #: 5-35236				
29 Supplement to: Tennessee Cybercorps: A Hybrid Program in Cybersecurity for TNTech Cyber Bootcamp - Summer 2019	Ambareen Siraj Doug Talbert	$45,015	6/1/2019	5/31/2020
National Science Foundation - Award 1565562 - Amendment #9				
Account #: 5-31279				
30 Supplemental to: Public-Private Partnership to Promote Efficient Manufacturing and Workforce Development	Glenn Cunningham Ethan Languri	$60,000	6/1/2019	8/31/2020
Department of Energy, Office of Energy Efficiency and Renewable Energy - Supplement to Award DE-EE007702				
Account #: 5-32278				
31 Materials Research for Digital Clone Modeling Sentient Science Corporation - Signed Agreement	Ying Zhang Wayne Hawkins	$19,278	5/13/2019	11/13/2019
Account #: 5-35234				

Grants and Awards Activated in FY 2018-2019   *$3,627,332*

Schedule 7

CENTERS OF EXCELLENCE
ACTUAL, PROPOSED, AND REQUESTED BUDGET

| Institution | Tennessee Technological University | | | | Center | Center for Manufacturing Research | | | |

	FY 2018-19 Actual			FY 2019-20 Proposed			FY 2020-21 Requested		
	Matching	Appropr.	Total	Matching	Appropr.	Total	Matching	Appropr.	Total
Expenditures									
Salaries									
Faculty	359,860	483,509	843,369	350,000	409,329	759,329	375,000	330,000	705,000
Other Professional	143,238	291,908	435,146	75,000	416,854	491,854	75,000	425,000	500,000
Clerical/ Supporting	0	57,322	57,322	0	50,115	50,115	0	50,000	50,000
Assistantships	157,300	153,770	311,070	250,000	250,417	500,417	250,000	300,000	550,000
Hourly Students	102,731	30,812	133,543	50,000	60,646	110,646	50,000	15,000	65,000
Total Salaries	763,129	1,017,321	1,780,450	725,000	1,187,361	1,912,361	750,000	1,120,000	1,870,000
Fringe Benefits	264,716	392,227	656,943	275,000	442,919	717,919	275,000	375,000	650,000
Total Personnel	1,027,845	1,409,548	2,437,393	1,000,000	1,630,280	2,630,280	1,025,000	1,495,000	2,520,000
Non-Personnel	NOTE: Appropriations Expenditures in Fringe Benefits include $103,236 for Graduate Student Fees for FY 2018-19.								
Travel	118,452	9,236	127,688	100,000	28,463	128,463	100,000	24,000	124,000
Software	0	375	375	0	0	0	0	0	0
Books & Journals	0	0	0	0	0	0	0	0	0
Other Supplies	206,946	35,171	242,117	440,934	76,949	517,883	475,000	60,000	535,000
Equipment	0	88,829	88,829	100,000	71,476	171,476	125,000	75,000	200,000
Maintenance	0	1,082	1,082	0	0	0	0	0	0
Scholarships for Service	1,111,112	0	1,111,112	500,000	0	500,000	500,000	0	500,000
Consultants/Subcontracts	305,761	4,576	310,337	125,000	0	125,000	150,000	0	150,000
Renovation	0	17,400	17,400	0	0	0	0	0	0
Seminars/Workshops/Conf	352,295	0	352,295	100,000	0	100,000	125,000	0	125,000
Total Non-Personnel	2,094,566	156,669	2,251,235	1,365,934	176,888	1,542,822	1,475,000	159,000	1,634,000
GRAND TOTAL	3,122,411	1,566,217	4,688,628	2,365,934	1,807,168	4,173,102	2,500,000	1,654,000	4,154,000
Revenue	NOTE: Actual Matching Funds do not include Indirect Costs of $526,095 for FY 2018-2019.								
New State Appropriation	0	1,543,400	1,543,400	0	1,575,300	1,575,300	0	1,654,000	1,654,000
Carryover State Appropriation	0	254,685	254,685	0	231,868	231,868	0	0	0
New Matching Funds	3,111,002	0	3,111,002	2,250,000	0	2,250,000	2,500,000	0	2,500,000
Carryover from Previous Matching Funds	127,343	0	127,343	115,934	0	115,934	0	0	0
Total Revenue	3,238,345	1,798,085	5,036,430	2,365,934	1,807,168	4,173,102	2,500,000	1,654,000	4,154,000

NOTE: Carryover appropriation funds of $231,868 are designated for new faculty recruitment commitments.

FY 2020 – 2021 Budget Request and Justification

The CMR is requesting a **5.0%** increase in the FY 2020-21 State appropriations to account for increasing salaries, benefits, student support, tuition and fees, supplies, and travel costs as well as annual inflationary increases in these budget areas.

There was an increase in the FY19-20 appropriation that was sufficient to cover projected salary increases of an average of 2% for Center faculty and staff along with associated benefits. The increase should also be sufficient to fund operating expenses as planned for this current fiscal year.

Even though the CMR has been successful in securing substantially increased external funding over the past few years, additional State appropriations are being requested to support the research/operational plans listed below.

- While we anticipate continued growth in FY20, there are functions within the Center in support of the research infrastructure and the State manufacturing industry that cannot be paid for with external grants and cost recovery. It is critical that the CMR plan to allocate partial funding annually to replace capital equipment and maintain state-of-the-art research capabilities.

- The requested budget increase will allow the CMR to continue in an effort to increase the number of graduate students supported by the Center and offer graduate student assistantships at levels consistent with the College of Engineering to remain competitive and treat students fairly. Attracting and retaining quality graduate students are key to CMR's ability to conduct high-impact research in advanced manufacturing and provide service and support to manufacturing industries.

- The increased core funding will also enable the CMR to promote new research initiatives and incentivize faculty associates for research activities and industry engagement in the areas related to advanced manufacturing.

SUPPORTING MATERIALS

CMR Supported Graduate Students Degrees Awarded
In 2018-2019 Fiscal Year

Masters

Alston, William L.
"Energy Efficiency Testing in Belt Driven Applications"
Spring 2019
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

Mashali, Farzin
"Deaggregated and Functionalized Nanodiamond Fluids for Thermal Management"
Spring 2019
Advisor: Dr. Ethan Languri
Mechanical Engineering

Ponder, Robert Isaac
"Replication of Force Sensing Bearings and Feasibility of Structural Health Monitoring in Total Knee Replacements"
Spring 2019
Advisor: Dr. Steven R. Anton
Mechanical Engineering

Russell, Nicholas George
"Determination of Stress-Strain Response for Eutectic 63SN-37PB Soldier at Cryogenic Temperatures Using Instrumented Indentation and Finite Element Analysis"
Spring 2019
Advisor: Dr. Christopher D. Wilson
Mechanical Engineering

Ullah, Mohammad Arman
"Seccan: A Secure Can Based in-Vehicle Network"
Fall 2018
Advisor: Dr. Sheikh Ghafoor
Computer Science

CMR Supported Graduate Student Degrees Awarded
in 2018-2019 Fiscal Year

Ph.D.

Mireshekari, Gholamreza
"Catalytic Activity and Durability of Non-Carbon Supported Platinum Electrocatalysts for Oxygen Reduction Reaction in Proton Exchange Membrane Fuel Cells Environment"
Fall 2018
Advisor: Dr. Cynthia Rice
Mechanical Engineering

Mohammadabadi, Mohsen Safaei
"A Piezoelectric Instrumented Total Knee Replacement for Sensing and Energy Harvesting"
Spring 2019
Advisor: Dr. Steven R. Anton
Mechanical Engineering

Renfro, Michael
"Analysis of Surface Cracks in Plates Loaded in Bending Under Elastic-Plastic and Fully-Plastic Conditions"
Fall 2018
Advisor: Dr. Christopher D. Wilson
Mechanical Engineering

Singh, Rina
"Event-Oriented Analysis and Mitigating the Impact of Redundancy in Sequential Pattern Mining"
Fall 2018
Advisor: Dr. Douglas Talbert
Computer Science

Witman, Jason
"Development and Evaluation of Electro-Codeposited McRal Overlay Coatings"
Fall 2018
Advisor: Dr. Ying Zhang
Mechanical Engineering

Zolghadr, Ali
"Kinetics of Biomass Fast Pyrolysis"
Fall 2018
Advisor: Dr. Joseph J. Biernacki
Chemical Engineering

CMR Graduate Students Supported from State Appropriations

Masters

Farzin Mashali
Advisor: Dr. Ethan Languri
Mechanical Engineering

O. (Dorothy) Oderhohwo
Advisor: Dr. Syed Rafay Hasan
Electrical & Computer Engineering

Micah Rentschler
Advisor: Dr. Indranil Bhattacharya
Electrical & Computer Engineering

Andreas Sauter
Advisor: Dr. Ismail Fidan
Mechanical Engineering

Ali Tanvir
Advisor: Dr. DuckBong Kim
Mechanical Engineering

Ph.D.

Rumman Ahsan
Advisor: Dr. DuckBong Kim
Mechanical Engineering

Ankit Gupta
Advisor: Dr. Ismail Fidan
Mechanical Engineering

Benjamin Hargis
Advisor: Dr. Steve Canfield
Mechanical Engineering

McKenzie Hodge
Advisor: Dr. Pedro Arce
Chemical Engineering

Astrit Imeri
Advisor: Dr. Ismail Fidan
Mechanical Engineering

Qinghua Lin
Advisor: Dr. Pingen Chen
Mechanical Engineering

Gholamreza Mirshekari
Advisor: Dr. Ethan Languri
Mechanical Engineering

Rani Penumaka
Advisor: Dr. Jiahong (John) Zhu
Mechanical Engineering

Hajar Taheri-Afarani
Advisor: Dr. Joe Biernacki
Chemical Engineering

Kuo Yang
Advisor: Dr. Pingen Chen
Mechanical Engineering

CMR Graduate Students Supported from External Funds

Masters

William Alston
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

Aaron Bain
Advisor: Dr. Ethan Languri
Mechanical Engineering

Jonathan Chappell
Advisor: Dr. Chris Wilson
Mechanical Engineering

Abigail Collier
Advisor: Dr. Chris Wilson
Mechanical Engineering

Joshua Daugherty
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

Daniel Gothard
Advisor: Dr. Chris Wilson
Mechanical Engineering

Daniel Hott
Advisor: Dr. Chris Wilson
Mechanical Engineering

Kade Howard
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

Aslan Nasirov
Advisor: Dr. Ismail Fidan
Mechanical Engineering

Eric Nolan
Advisor: Dr. Steve Anton
Mechanical Engineering

Robert Ponder
Advisor: Dr. Steve Anton
Mechanical Engineering

Ph.D.

David Chesson
Advisor: Dr. Jiahong (John) Zhu
Mechanical Engineering

Seymur Hasanov
Advisor: Dr. Ismail Fidan
Mechanical Engineering

Lily Li
Advisor: Dr. Adam Anderson
Computer Science

Mohsen Mohammadabadi
Advisor: Dr. Steve Anton
Mechanical Engineering

Yutian Yu
Advisor: Dr. Jiahong (John) Zhu
Mechanical Engineering

Masters

Nicholas G. Russell
Advisor: Dr. Chris Wilson
Mechanical Engineering

Shane Terry
Advisor: Ismail Fidan
Mechanical Engineering

External Funding – Proposals Submitted

	Status	Title	P.I.	Department	Total Funds
1	779MC 7/19/2018	CAREER: Sensor Integration in Additive Manufacturing for In Situ Process Monitoring, Part Validation, and Health Monitoring National Science Foundation	Steven Anton	ME	$500,000
2	780MC 7/3/2018 4(18-19)	High Performance Laboratory-Scale Gas Atomizer for Materials and Coatings Research The Department of Defense (DoD)	Ying Zhang	CMR	$315,000
3	782MC 7/30/2018 192(16-17) 5-31279	Supplement to Tennessee Cybercorps: A Hybrid Program in Cybersecurity - Community College Inclusion - 2018-2021 National Science Foundation	Ambareen Siraj Mohammad Rahman Doug Talbert	CompS CompS CompS	$137,466
4	783MC 7/30/2018 28(18-19) 5-32390	AFRL University Design Challenge Technology Service Corporations (TSC) prime with AFRL for RRTAS, contract no. FA8650-16-	Mohan Rao	ME	$25,000
5	784MC 8/21/2018 35(18-19)	REU Site: Secure and Privacy-Preserving Cyber Physical Systems: Software and Hardware Approaches National Science Foundation	Mohamed Mahmoud Syed Hasan	ECE ECE	$375,963
6	785MC 8/16/2018 13(17-18) 5-32289	Supplement to: Development & Validation of Low-Cost, Highly-Durable, Spinel-Based Contact Materials for SOFC Cathode-Side Contact Application US Department of Energy (DOE), Office of Fossil Energy - Award DE-FE0031187	Jiahong Zhu	ME	$36,209
7	786MC 10/15/2018	Mobile AMP: The Development of a Mobile Platform for Additive Manufacturing for the 21st Century STEM Workforce Somerset Community College (via National Science Foundation Funds)	Ismail Fidan George Chitiyo	MET C&I	$279,290
8	787MC 10/15/2018	Manufacturing for the Future (M4F) University of Louisville (via NSF funds)	Ismail Fidan	MET	$1,098,566
9	790MC-O 3/27/2019 50(18-19)	2019 GenCyber Student Camp at Tennessee Tech National Science Foundation & National Security Agency	Ambareen Siraj	CEROC	$138,475
10	791MC 10/31/2018	HMMR-SR: Research, Development and Testing of a High-Mobility Maintenance Robot for Ship Repair Naval Surface Warfare Center	Stephen Canfield Yunbo Zhang	ME ME	$378,607

	Status	Title	P.I.	Department	Total Funds
11	792MC 10/29/2018	Traffic Optimization System Based on Secured Crowd Sourced Data Ministry of Education, KSA	Mohamad Mahmoud	ECE	$159,935
12	794MC 12/19/2018 133(18-19)	Collaborative Research: In-Situ Investigation of Bonding and Deformation Mechanisms of Bimetallic Additively Manufactured Structures (BAMSs) University of Tennessee - Knoxville (via National Science Foundation)	Duck Bong Kim	MET	$208,877
13	795MC 5/3/2019 136(18-19)	Engineering the Evolution of Advanced Materials for Robust Automotive Fuel Cell Subzero Cold-Starts National Science Foundation	Cynthia Rice	ChemE	$375,438
14	796MC 11/12/2018 67(18-19)	III: Small: Collaborative Research: Mining Patterns and Anomalies from Dynamic Networks National Science Foundation	William Eberle	CompS	$221,692
15	797MC 11/15/2018 66(18-19)	III: Small: Enabling Self-Improving Research Decision Support through Never-Ending Learning National Science Foundation	Doug Talbert	CompS	$498,948
16	800MC 1/30/2019 134(18-19)	Collaborative Research: MIP: Deuterium Biomaterials Innovation Network University of Tennessee (via NSF funds)	Holly Stretz Robbie Sanders	ChemE ChemE	$750,000
17	801MC 12/7/2018 71(18-19)	Aging Diagnostic Algorithm Development for Cummins SCR Systems Purdue University (via Cummins, Inc. funds)	Pingen Chen	ME	$121,383
18	802MC 3/1/2019 113(18-19)	Low-Cost High-Performance Coatings for sCO2 Power Cycle Components US Department of Energy, Office of Fossil Energy	Ying Zhang	ME	$799,999
19	803MC 2/25/2019 111(18-19)	Blockchain Based Decentralized Access Control of Diverse-type Data for Fossil Power Generation Department of Energy - Office of Fossil Energy	Syed Hasan Nan Guo	ECE CMR	$399,996
20	806MC 2/20/2019 105(18-19)	"CC* Networking Infrastructure: Building a Science DMZ to Support Research and Education at Tennessee Tech University National Science Foundation	Michael Rogers Doug Talbert	CompS CompS	$280,674
21	808MC 2/25/2019 108(18-19)	Blockchain Power Exchange and Control System for Electric Grid Telluric Labs LLC (SBIR funds)	Nan Guo Syed Hasan	CMR ECE	$54,999

	Status	Title	P.I.	Department	Total Funds
22	809MC 2/18/2019 102(18-19) 5-35236	Establishment of Near-optimal Process Parameters for Wire+Arc Additive Manufacturing via Thermo-Mechanical Tests KITECH (Korea Institute of Industrial Technology)	Duckbong Kim	MET	$30,000
23	810MC 2/21/2019 110(18-19)	Development of Surrogate Machine Learning Models for Anomaly Detection and Classification in Metal Additive Manufacturing Process Korean-American Scientist and Engineers Association	Duckbong Kim	MET	$46,000
24	812MC 3/12/2019 119(18-19)	A Reliable, Secure, and Privacy-Preserving Solution for Wireless Electric Vehicle Charging in Smart Grid Hamad Bin Khalifa University (via NRPR-S Funds)	Mohamed Mahmoud	ECE	$105,000
25	813MC 4/19/2019 131(18-19)	Control of Multi-output Contactless Bi-directional Inductive Power Transfer System for Electric Battery Charging Applications in Electric Vehicles National Science Foundation	Joseph Ojo	ECE	$310,088
26	814MC 3/28/2019 126(18-19)	Project-based Learning for Educating Next-Generation Automotive Engineers at Tennessee Tech Denso North America Foundation	Pingen Chen Vahid Motevalli Mohan Rao/Steven Canfield	ME COE ME	$50,000
27	815MC 4/26/2019 5-31279	Supplement to: Tennessee Cybercorps: A Hybrid Program in Cybersecurity for TNTech Cyber Bootcamp - Summer 2019 National Science Foundation	Ambareen Siraj Douglas Talbert	CompS CompS	$69,254
28	816MC 6/7/2019 154(18-19)	Development of Corrosion- and Erosion-Resistant Coatings for Advanced Ultra-Supercritical Materials US Department of Energy	Ying Zhang Jiahong Zhu	CMR ME	$999,999
29	821MC 6/19/2019 162(18-19)	Developing an EV Demonstration Testbed in the Upper Cumberland Region of Tennessee, an Economy Distressed Rural Region U.S. Department of Energy	Pingen Chen I. Bhattacharya/J. Ojo V. Motevalli/S. Canfield	ME ECE COE/ME	$779,819
30	822MC 62(15-16) 5-31289	Supplement to: AM-WATCH: Additive Manufacturing - Workforce Advancement Training Coalition and Hub National Science Foundation	Ismail Fidan	MET	$118,300
31	824MC 6/21/2019 5-32289	Supplement #2 to: Development & Validation of Low-Cost, Highly-Durable, Spinel-Based Contact Materials for SOFC Cathode-Side Contact Application US Department of Energy (DOE), Office of Fossil Energy	Jiahong Zhu	ME	$50,028

Status		Title	P.I.	Department	Total Funds
32	826MC 6/26/2019 35(18-19)	Supplement to: REU Site: Secure and Privacy-Preserving Cyber Physical Systems: Software and Hardware Approaches	Mohamed Mahmoud Syed Hasan ECE	ECE	$20,000
	5-31299	National Science Foundation			
33	M0Test1	Materials Research for Digital Clone Modeling	Ying Zhang Wayne Hawkins	CMR CMR	$19,278
	132(18-19) 5-35234	Sentient Science Corporation - Signed Agreement			

Proposals Submitted in FY 2018-2019   **$9,754,283**