ANNUAL REPORT
FY 2016—2017

Center for Manufacturing Research

Moving Technology Forward

College of Engineering

Tennessee Tech University

Renaissance Engineers are adaptive professionals who are inquisitive, creative and make significant contributions for the betterment of humanity.

Center for Manufacturing Research
Tennessee Tech University
1020 Stadium Avenue
Prescott 233, Box 5077
Cookeville, TN 38505

(931) 372-3362
mfgctr@tntech.edu
www.tntech.edu/engineering/research/cmr

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Tennessee Technological University
Center for Manufacturing Research
Annual Report – FY 2016 – 2017

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 was established in 1985 by THEC and achieved and maintained the Center of Excellence status since 1990.

Director

Vahid Motevalli, Ph.D., P.E.
Interim Director
Center for Manufacturing Research
Associate Dean for Research & Innovation
College of Engineering
Tennessee Tech University
1020 Stadium Drive, Box 5077
Cookeville, TN 38505
(931) 372-3362 (931) 372-6345 Fax
www.tntech.edu/engineering/research/cmr/

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, Mat. Science Lab Mgr.
Suzanne Henry, Center Manager
Tammy Martin, Administrative Associate III
Mike Renfro, R&D Engineer II
Joel Seber, Engr. Computer Support Mgr.
Phyllis Stallion, Administrative Associate V
Darlene Wiegand, Financial Analyst

CMR Faculty Associates

Dr. Ali Alouani, Professor, ECE
Dr. Adam Anderson, Asst. Professor, ECE
Dr. Stephen Anton, Asst. Professor, ME
Dr. Pedro E. Arce, Chair, Professor, ChE
Dr. Curtis P. Armstrong, Chair, Professor, Decision Sciences & Mgt.
Dr. Rabie Belkacemi, Asst. Professor, ECE

Dr. Joe J. Biernacki, Professor, ChE
Dr. Stephen Canfield, Professor, ME
Dr. Jesse D. Carrick, Asst. Professor, Chemistry
Dr. Hicham Chaoui, Asst. Professor, ECE
Dr. Laura H. Arias Chavez, Asst. Prof., ChE
Dr. Pingen Chen, Asst. Professor, ME
Dr. George Chitiyo, Assoc. Professor, Curriculum & Instruction
Dr. Glenn Cunningham, Assoc. Professor, ME
Dr. Corinne Darvennes, Professor, ME
Dr. William Eberle, Assoc. Professor, CS
Dr. Omar ElKeelany, Assoc. Professor, ECE
Dr. Ahmed ElSawy, Chair, Professor, MET
Dr. Ismail Fidan, Professor, MET
Dr. Melissa J. Geist, Assoc. Professor, Nursing
Dr. Sheikh Ghafoor, Assoc. 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, Chair, Professor, ECE
Dr. DuckBong Kim, Asst. Professor, MET
Dr. Ehsan Languri, Asst. Professor, ME
Dr. ChaBum Lee, Asst. Professor, ME
Dr. Satish Mahajan, Professor, ECE/Director, CESR
Dr. Mohamed Mahmoud, Asst. Professor, ECE
Dr. Vahid Motevalli, Assoc. Dean of Research and Innovation, College of Engineering; Professor, ME
Dr. Jordana Navarro, Asst. Professor, Sociology & Political Science
Dr. Lachelle Norris, Professor, Sociology & Political Science
Dr. Scott Northrup, Professor Emeritus, Chemistry
Dr. Sally Pardue, Assoc. Professor, ME/ Director, Millard Oakley STEM Center
Dr. Mohammad Rahman, Asst. Professor, CS
Dr. Mohan Rao, Chair, Professor, ME
Dr. Joseph J. Rencis, Dean, College of Engineering, Professor, ME
Dr. Jonathan (Robby) Sanders, Asst. Prof., ChE
Dr. Stephen Scott, Professor, CSC/ECE
Dr. Alexander Shibakov, Professor, Mathematics
Dr. Pezhman Shirvanian, Asst. Professor, ME
Dr. Ambareen Siraj, Assoc. 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. Jeanette Wolak, Asst. Prof., Earth Sciences
Dr. Liqun “Laura” Zhang, Asst. Prof., ChE
Dr. Ying Zhang, Professor, ME
Dr. John Zhu, Professor, ME

EXECUTIVE SUMMARY

During this past 2016-17 fiscal year, the CMR has experienced an all-time record-high year of external funding. Externally funded research increased by 30.6% from last year while proposal value decreased by 23%. This decrease was due to the high dollar value of proposals submitted in 2015-2016 and timing of deadlines for grant submissions. In FY17, fifty-eight proposals were submitted for $16,175,678, thirty-nine external projects were activated for $3,782,809, and 55 graduate students were supported from the State appropriations and external funds. Please see Table 1 below. The dollar amount in the external grants is significant as, at the same time, the staff support in CMR has been reduced due to retirements and an unfilled Director position. A national search for a new Director is underway.

Tennessee Tech University's recognition under the Carnegie Classification as a "Doctoral Granting University, Limited Research" (previously classified as Masters Granting – Large) in December of 2015 is in large part due to the increase in the number of Ph.D. degrees awarded by the College of Engineering. The degrees conferred is directly tied to the increase in the research grants and State appropriations supporting the graduate students through CMR and CESR.

Twenty-one of the fifty-eight submitted research proposals were submitted by new faculty hires in the Departments of Chemical, Mechanical, and Electrical and Computer Engineering. Thus, the refocusing of State Appropriations towards new faculty investment to support the College of Engineering and the University's Strategic Plan as well as the impact of new faculty hires since 2013 are becoming much more evident in proposal activities and external funding.

Table 1. Summary of CMR Accomplishments

	FY 14-15	FY 15-16	FY 16-17
Value of the Proposals Submitted	**$12,179,250**	**$21,117,542**	**$16,175,678**
Number of Proposals Submitted	**51**	**59**	**58**
Total External Activations	**$2,403,677**	**$2,896,320**	**$3,782,809**
Number of Graduate Students Supported	**32**	**55**	**55**
Number of Undergraduate Students Supported	**54**	**67**	**69**

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.

Table 2. Activated Grants by Research Areas

Strategic Research Area	Activated Amount
Advanced Manufacturing	$1,293,223
Materials for Energy Storage and Conversion	$217,722
Networking and Algorithms for Big Data	$240,492
Tennessee Industry Support	$482,011
Education and Outreach	$1,403,104
Other	$146,257
Total	**$3,782,809**

Selected Highlights from FY 2016 – 2017

External Funding Highlights

The CMR has increased activation funding over previous fiscal year (FY) by 31%. Thirty-nine externally funded projects were activated this past FY, resulting in funding of **$3,782,809** compared to the previous FY 2015 –16 total activation of $2,896,320.

CMR's new matching funds for the past FY were $3,119,213. This amount excludes $688,496 of indirect costs associated with this year's funded projects.

The number of research proposals submitted by CMR faculty and faculty associates remained almost the same as the previous year at fifty-eight proposals in 2016-17, compared with fifty-nine in 2015-16. The dollar value decreased by 23% from last year with a total value of

$16,175,678 submitted during this past FY, compared to a value of $21,117,542 at the end of FY 2015 –16.

CMR supported 55 graduate students during the past FY. Twenty-nine M.S. students and 26 Ph.D. students were funded from both State appropriations and grants received by faculty. Specifically, external grants funded 16 of the M.S. students and 11 of the Ph.D. students. Thus, 60% of CMR graduate student support was provided from external funding. Among the graduate students funded by CMR, two M.S. and four Ph.D. students were from underrepresented minorities.

CMR supported a total of 69 undergraduate students during this past fiscal year from both State Appropriations and externally funded projects.

CMR continues to invest in new faculty with a manufacturing focus hired into the College of Engineering. As a result of this investment, 21 proposals for external funding were submitted by new faculty members in the Departments of Chemical, Electrical and Computer, and Mechanical Engineering.

CMR continued to see a significant increase in external funding of graduate research assistant support as shown in Table 3 below. Table 3 provides a summary of various sources of external revenues for the past three 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
CMR Staff release time	$99,224	$128,231	$142,801
Graduate student stipend and fees from external sponsors	$325,719	$282,994	$481,254
Percentage of GRA support from external sponsors	65%	45%	60%
Total "Soft Money" (F&A return, testing income, GRA support, equipment usage, and release time)	$558,390	$552,393	$796,950

Personnel Highlights

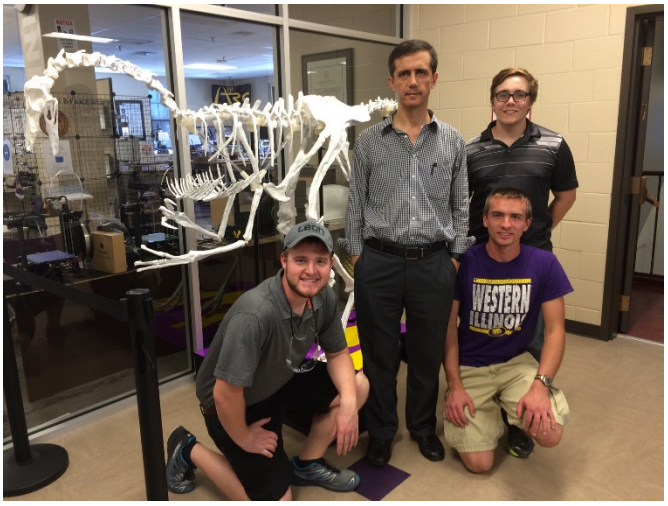
Dr. Vahid Motevalli, Associate Dean for Research and Innovation in TTU's College of Engineering, has continued to serve as the CMR's Interim Director. This appointment is in addition to his regular duties as Associate Dean.

A search for a Center Director was launched in 2016-17 and continues into this fiscal year.

Dr. Stephen Canfield, Professor of Mechanical Engineering, has continued to serve as Faculty Associate Director. In this role, Dr. Canfield is the Strategic Research Area (SRA) Coordinator for Advanced Manufacturing and has encouraged existing CMR faculty to work with other colleagues in this area, seek collaboration with faculty in other SRAs and develop teams to respond to funding opportunities. This is a partial appointment while Dr. Canfield continues his activities as Professor of Mechanical Engineering.

Research Highlights

Faculty Associates Dr. Ambareen Siraj, Dr. Mohammad Rahman, and Dr. Doug Talbert were awarded Year 2 funding from the National Science Foundation (NSF) to continue the Tennessee CyberCorps: Scholarship for Service Program. Additional funding of this program was awarded in two separate supplemental components: 1) Bootcamp Funding Supplement and 2) Community College Inclusion. Dr. Siraj was also awarded a grant from the National Security Agency for GenCyber Camp to take place in Summer 2017. 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. Ismail Fidan and REU students in the iMakerSpace.

CMR supported the establishment of the iMakerSpace. The iMakerSpace was created as a University-wide center under the leadership of the Colleges of Engineering and Business. It is a focal point on campus to provide training, service, partnership, research and evaluation in Innovation and Entrepreneurship to all disciplines. iMakerSpace encourages interdisciplinary teams and provides support and training to extend I&E activities into research and the classroom.

CMR established the Digital Manufacturing Demonstration Lab in PH 227 for use by mostly undergraduate students as a more advanced space to the iMakerSpace, supporting innovation through access to digital manufacturing technologies.

3D printers in the DMDL

Faculty Associate Dr. Mohamed Mahmoud received funding of $119,835 from NSF for Year 2 of a grant entitled “REU Secure and Privacy Preserving Cyber Physical Systems”. Also serving as Co-PI is Faculty Associate, Dr. Syed Rafay Hasan. This REU program focuses 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 seven different universities.

Faculty Associate Dr. Glenn Cunningham received an award of $1,575,000 from the Department of Energy (DOE) for a five-year grant to fund an Industrial Assessment Center (IAC)

entitled Public-Private Partnership to Promote Efficient Manufacturing and Workforce Development. This award will enable the CMR to continue administration of an IAC as they have done since the inception of the IAC in 2006.

IAC Students at a plant assessment – Spring 2017

The National Science Foundation awarded Dr. Joseph Rencis, Dean, College of Engineering, and Dr. Vahid Motevalli, Interim Director of the Center and the Associate Dean of Research and Innovation in the College of Engineering, a grant for $125,009 to host for the third consecutive year a Research Experiences for Undergraduate (REU) Site – Manufacturing and Techno-Entrepreneurship at TTU this summer from June 5 to August 11, 2017. This REU Program focuses on manufacturing-related research and provide techno-entrepreneurship experiences for a total of eleven interns from ten different universities.

REU Interns visiting Oak Ridge National Laboratory's Manufacturing Demonstration Facility – Summer 2017.

Faculty Associate Dr. Ambareen Siraj continued to lead the Collaborative Research in Capacity in Cybersecurity with Tennessee Tech and the University of Arizona hosting the Fourth Annual Women in Cybersecurity Conference (WiCyS) in Tucson, Arizona. This conference, first established by Dr. Siraj under a grant from the National Science Foundation in 2014, attracted 785 registered participants. A total of $399,689 of financial support for the conference was secured from registration fees as well as matching commitments paid from fifty-

five different sponsorships, including Facebook, Cisco Systems, IBM, Fidelity Investments, Google, and other large IT-focused corporations as well as universities including Mississippi State University and Carnegie Mellon University.

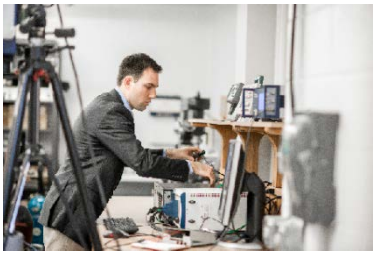
Fourth Annual Women in CyberSecurity Conference, March 30-April 1, 2017, Tucson, Arizona

Dr. Chabum Lee, CMR Faculty Associate, received funding of $184,866 from NSF for a three-year grant entitled "Supplement to Collaborative Research: Edge Surface Topography Characterization for Precision Sensing Technology". It is anticipated that this research will increase the performance envelope of the on-machine nanoscale surface measurement and machining methodology, producing new knowledge in high-precision, on-machine instrumentation.

Dr. Ismail Fidan, CMR Faculty Associate, was awarded funding of $900,000 for 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 will be accomplished through the development of curriculum and the delivery of professional development.

AM-WATCH participants receiving hands-on instruction in Additive Manufacturing in Spring 2017.

CMR Faculty Associate Dr. Steven Anton was awarded funding of $417,372 for a three-year grant entitled “Self-Powered in Vivo Force and Implant Wear Sensing in Knee Arthroplasty” from the National Institute of Health (NIH). This research will investigate 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 in his lab

The CMR recruited two new Visiting International Researchers to Tennessee Tech during 2016-17. One joined the Center’s Wireless Communications/Networking Systems Research Group and one conducted research with Automotive Fuel Cells Applications.

A CAPSTONE grant funded for $15,000 was awarded from UT/CIS. 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 $1,575,000 from the U.S. Department of Energy 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 eleven years, over 190 assessments have been conducted at no cost to the requesting companies, with total implemented savings of $7.4 million. One hundred and fifty-two students have participated in the IAC with 50 receiving DOE certification in the program.

IAC Director Glenn Cunningham and IAC Students conduct an energy assessment at an automotive components manufacturer.

FY 2016 – 2017 IAC Highlights

The IAC has expanded its energy efficiency capabilities into the area of Water and Wastewater Pumping. An assessment was conducted for a municipal water pumping facility and two manufacturing wastewater systems have been analyzed. Glenn Cunningham, IAC Director, has been an invited speaker on Water/Wastewater Pumping Energy Efficiencies at several conferences and workshops in Tennessee. This is the product of a partnership between the IAC and Tennessee's Office of Energy Programs.

Anthony Taylor (ME – MS) **received the 2016-2017 IAC Student of the Year award** and Ian Swagerty (ME – MS) received the 2016-2017 **IAC Alumnus of the Year award**.

IAC Students Anthony Taylor and Ian Swagerty collect data at a plant assessment.

Dr. Ehsan Languri, Associate Director of IAC, received **supplemental funding to develop modeling software for the use of variable frequency drives in industrial cooling towers.**

The mission of the Industrial Assessment Center has expanded to include providing guidance and assistance to manufacturers on **cyber-security and smart manufacturing**. Informal partnerships with Tennessee Tech's Cybersecurity Education, Research, and Outreach Center (CEROC) and Oak Ridge National Laboratory's Manufacturing Demonstration Center provide the expertise to deliver these services.

Seminar Presentations

Golden Eagle Additively Innovative Virtual Lecture Series

3D Printed Joints & Connectors for Assemblies, Nick Russell and Jacob Floyd, Tennessee Tech

The Development of a Framework for 3D Printing, Casting, and Entrepreneurship, Jay Watson, Cookeville High School

Content and Curriculum Development Efforts in 3D Printing, Jesse Roitenbert, Stratasys

Marketing Your Maker Business, TJ McDue, Refine Digital

A Technique for Quick Introduction of 3D Design and Prototyping, Hugh Jack, Western Carolina University

Additive Manufacturing: Instrumental Systems in Research, Education, and Service, Bahram Asiabanpour, Texas State University

Making it Work, Marilyn Barger, Hillsborough Community College

Bioprinting and Tissue Engineering, Yunzhi Peter Yang, University of Texas Health Science Center

REU: Manufacturing and Techno-Entrepreneurship, NSF Award # 1461179

Drug Delivery Nanoparticles, Christian Bossio – Nassau Community College. Faculty Mentor – Holly Stretz, Ph.D.

Manufacturing Microfibrillar Adhesive, Hou Chong Chan – Cooper Union for Advancement of Science & Art and Shane Terry, Tennessee Tech University. Faculty Mentor – Steve Canfield, Ph.D.

Suspension–Based Climbing Robots, Nicole Doughramaji – Kansas State University and Isaac Friedman, Tennessee Tech University. Faculty Mentor – Steve Canfield, Ph.D.

The Effect of Geometrical Properties on FRAM (Fiber Reinforced Additive Manufacturing), Yolnan Chen – Rose-Hulman Institute of Technology and Cesar Ortis Rios – Gonzaga University. Faculty Mentor – Ismail Fidan, Ph.D.

3D Printing Optically Transparent Parts on a Small Scale Printer, Hiroshi Yanagida – University of Tennessee Chattanooga. Faculty Mentor – Holly Stretz, Ph.D.

Fused Deposition Modeling of Optically Transparent Parts and Developments towards a Nanoparticle/Polymer Composite Filament, Samantha Lang – University of Tennessee Knoxville. Faculty Mentor – Holly Stretz, Ph.D.

Classification and Regression Analysis of 3D Printed Objects, Colleen Fritz, University of Alabama and Thomas Mativo, University of Dayton. Faculty Mentor – Ismail Fidan, Ph.D.

REU: Security and Privacy in Future Smart Cities, NSF Award # 1560434

Cognitive Health Prediction on the Elderly Using Sensor Data in Smart Homes, Danielle Chaung – University of North Carolina Wilmington and Kimberlyn Dunn, Tennessee Tech University. Faculty Mentor – William Eberle, Ph.D.

Testbed Design and Implementation for Stealthy Attack Analysis on Power System State Estimation, Jeremiah Russell – Western Kentucky University. Faculty Mentor – Rabie Belkacemi, Ph.D.

Hardware Security Issues in Microcontroller and its Interface, Alhad Daftardar – Georgia Tech University and Dustin Morris – Tennessee Tech University. Faculty Mentor – Syed Rafay Hasan, Ph.D. and Omar Elkeelany, Ph.D.

Smart Home IOT Testbed Implmentation, Xuejiao Chen – University of Alabama. Faculty Advisor – Mohammad Rahman, Ph.D.

Utilizing Anomaly Detection for Internet of Things Security, Jimmy Howell – Southern Illinois University and Nyomar-da Tackie-Yarboi – Hostos Community College and Lizzy Zink – Tennessee Tech University. Faculty Mentors – Syed Rafay Hasan, Ph.D. and Nan Terry Guo, Ph.D.

Privacy and Security in Priority of Dynamic Charging of Electric Vehicles, William Johnson – Tennessee Tech University. Faculty Mentor – Mohamad Mahmoud, Ph.D.

CMR Student Lightning Round Seminar Series

April 4, 2017

Evaluation of Spinels in the Ni-Co-Fe System for SOFC Interconnects, David Chesson, ME

Solar Heat Harvesting for Enhanced Energy Storage and Evaporation Systems, Hamidreza Ghasemi Bahraseman, ME

Cryogenic Properties of Tin-Lead Solder, Zachary Henderson (ME)

Machine Learning Based Diagnosis of Lithium Batteries, Chinemerem Ibe-Ekeocha (ECE)

Role of Compatibilizer in 3D Printed Objects, Matthew Spreeman, ChE

Nonintrusive Compressed Air Flow Measurement, Anthony Taylor, ME

April 6, 2017

Preliminary Advancement of an Electrochemical Biosensor for the Early Diagnosis of Alpha-1-Antityrypsin Deficiency, Bobby Adams, ChE

Microsecond Structural State Detection in Highly Dynamic Environments, Ryan Kettle, ME

Implementation of Piezoelectric Sensor in Total Knee Replacement, Mohsen Safaei Mohammadabadi, ME

Privacy Preserving Ride Sharing Schemes for Autonomous Vehicles, Ahmed Sherif, ECE

Synthesis and Characterization of NiFe2O4 Spinel as Solid Oxide Fuel Cell Cathode-Side Contact Application, Yutian Yu, ME

Cutting Tool Wear Measurement Method Based on Knife Edge Interferometry, Seongkyul Jeon, ME

April 12, 2017

Modeling Pyrolysis-Induced Microstructural Changes in Biomass: A Cellular Automata Approach, Michael Adenson, ChE

A Study of Electromigration from Superconducting to Normal Conducting Metals, Jonathan Dugas, ECE

The Effect of Milling on Microcrystalline Cellulose and Herbaceous Biomass: A Crystallinity Study using TGA and XRD, Matthew Kelley, ChE

Online Parameter Estimation of Lithium Ion Batteries, Sravanthi Mandalapu, ECE

Morphology of Donor/Acceptor Blends in the Active Layer of Polymer Based Solar Cells, Koteswara Medidhi, ChE

The Catalytic Activity and Durability of Metal-Oxide Nanoparticles for Oxygen Reduction Reaction, Gholamreza Mirshekari, ME

A Novel Microsphere Microreactor Approach for Study of Biomass Fast Pyrolysis, Ali Zolghadr, ChE

Visiting Scholars

The following visiting international researchers participated in CMR research activities this past year.

- Dr. Lin Zheng was a member of Dr. Robert Qiu's Wireless Communications/Networking Systems Research Group in 2016-2017 to pursue research in Big Data Using Large Random Matrices Theory and Signal Processing.
- Dr. Christina Roth was a member of Dr. Cynthia Rice's Research Group to train on the electrochemical quartz crystal nanobalance for automotive fuel cell applications.

Faculty, Staff and Student Accomplishments and Awards

Faculty Associate, **Dr. Mohamed Mahmoud** (Assistant Professor of Electrical and Computer Engineering) was one of four authors to win a highly competitive international paper award at the Institute of Electrical and Electronics Wireless Communications and Networking Conference 2016.

CMR Faculty Associate **Dr. Joe Biernacki** (Professor of Chemical Engineering) recently received two international distinctions from the American Ceramic Society.

CMR Faculty Associate **Dr. Ambareen Siraj** (Associate Professor of Computer Science) is serving as Director of Tennessee Tech's Cybersecurity Education, Research, and Outreach Center (CEROC). She was invited to the White House this past year to participate in a meeting on developing the K-12 computer science and technology education pipeline for the national security industry. Dr. Siraj was also selected as a Cybersecurity Fellow by the Cybersecurity Initiative of New America, a think tank and civic enterprise committed to renewing American politics, prosperity, and purpose in the Digital Age.

CMR Faculty Associate Director **Dr. Stephen Canfield** led Mechanical Engineering students in ASME's International Additive Manufacturing 3D Challenge (IAM3D) this past year. Two teams made the finalists to present at the ASME IDETC/AM3D Conference in Charlotte, NC. One team, led by Micah Hardyman and Jonathan Zieger, won the most innovative award while Tennessee Tech's graduate students won an impromptu design challenge and one was a finalist in a NSF poster on design.

The following CMR Faculty Associates received awards at the Tennessee Tech Annual Engineers Week Banquet:

- The Brown-Henderson Engineering Faculty Award was established in honor of the late Dean Emeritus James Seay Brown and the late Dean James M. Henderson. This award was given to **Dr. Ambareen Siraj**, director of the Cybersecurity Education, Research and Outreach Center and an Associate Professor in the Department of Computer Science.

- The Kinslow Engineering Research Award, named in honor of Professor Emeritus Ray Kinslow, was awarded to **Dr. Ehsan Languri**, Assistant Professor of Mechanical Engineering. Dr. Languri's paper, "Effect of Particle Size and Viscosity on Thermal Conductivity Enhancement of Graphene Oxide Nanofluid" was published in International Communications in Heat and Mass Transfer, June 21 2016, co-authored with Dr. Milad Rabbani Esfahani and Maheshwar Rao Nunna.

- **Dr. ChaBum Lee**, Assistant Professor of Mechanical Engineering, received honorable mention for his paper published in the AIP Review of Scientific Instruments, July 2016, entitled "A Curved Edge Diffraction-Utilized Displacement Senor for Spindle Metrology", co-authored with **Dr. Satish Mahajan**, Rui Zhao and Seongkyul Jeon.

- The Rising Renaissance Engineer Faculty Scholar Award recognized two tenured-track faculty, **Dr. Steve Anton**, Assistant Professor of Mechanical Engineering and Director of the Dynamic and Smart Systems Laboratory at Tennessee Tech, and **Dr. Mohamed Mahmoud**, Assistant Professor with the Department of Electrical and Computer Engineering.

Dr. Ismail Fidan, Professor in the Department of Manufacturing and Engineering Technology is the university's team leader for Project MANEUVER, a three-year award to advance the field of digital manufacturing.

Astrit Imeri, a Masters student in Mechanical Engineering assists **Dr. Ismail Fidan** with research supported by an NSF grant to develop an affordable virtual reality framework to support digital manufacturing.

Dr. Ismail Fidan, Mechanical Engineering student Nicholas A. Russell, Electrical and Computer Engineering student Jacob Floyd, and Dr. Amy Elliott of Oak Ridge National Laboratory presented their work building a fully 3D-printed dinosaur at the NSF Advanced Technological Education Principal Investigators Conference.

Publications[1]

Robert Qiu

Journal Publications

1. F. Wen, P. Liu, Y. Liu, R. C. Qiu, and W. Yu, "Robust Sparse Recovery in Impulsive Noise via 1p-11 Optimization," IEEE Transactions on Signal Processing, Vol. 65, No.1, pp. 105-118, 2017.
2. B. Wang, R. C. Qiu and Y. Zhao, "Distributed Source Detection with Dimension Reduction in Multiple-Antenna Wireless Networks," IEEE Transactions on Vehicular Technology, 2017.
3. D.X. Zhang, R. C. Qiu, X. Wang, C. Deng, and S. Liu, "Big Data Applications for Global Energy Internet (in Chinese)," Electrical Information and Communications Technology, No. 3, pp. 20-24, 2016.
4. F. Wen, Y. Yang, P. Liu and R. C. Qiu, "Positive Definite Estimation of Large Covariance Matrix Using Generalized Nonconvex Penalties," IEEE Access, pp. 4168-4182.

Conference Publications

1. F. Wen, P. Liu, R. C. Qiu and W. Yu, "Robust sparse recovery for compressive sensing in impulsive noise using `p-norm model fitting," IEEE International Conference on Acoustics, Speech and Signal, Shanghai, China, 2016.

Books

1. R. C. Qiu and P. Antonik, Smart Grid Using Big Data Analytics: A Random Matrix Approach, John Wiley, 622 pages, 2016.

Cynthia Rice

Journal Publications

1. Refereed Archival Publications

1. Saeed, S., A. Pistono, J. Cisco, C.S. Burke, J.T. Clement, M. Mench, and C. Rice, 'Advanced Selectively Gas Permeable Anode Flow Field Design for Removal of Carbon Dioxide in a Direct Formic Acid Fuel Cell,' Fuel Cells (Weinheim, Ger.) 2017, 17, 48.
2. Pistono, A. and C.A. Rice, 'The Effect of Material Properties on the Subzero Water Storage Capacity of Cathode Catalyst Layers for Proton Exchange Membrane Fuel Cells,' J. Electrochem. Soc., 2017, 164, F582.

Technical Presentations

[1] Only CMR "Center Faculty" scholarly activities are included here.

Electrochemical Society – Honolulu, HI. Oct. 2016

1. C.A. Rice, A. Pistono, 'Bridging the Gap: PEMFC Isothermal Water Storage Capacity Tests and Automotive Cold-Starts,' Oral.
2. B.E. Materi, B.G. Adams, J. Sanders, J. Rice, C .A. Rice, 'Faster Diagnosis of Alpha-1-Antitrypsin Deficiency through Electrochemical and Quartz Crystal Microbalance Testing,' Oral.
3. B.E. Materi, J. Sanders, J. Rice, C. A. Rice, 'Preliminary Advancement for an Electrochemical Biosensor for Early Diagnosis of Alpha-1-Antitrypsin Deficiency,' Poster.

Patents and Copyrights (title, date, agency, patent No., publisher)

1. Rice, C.A., Saeed, S., Renfro, M., Pistono, A. "Advanced Selectively Gas Permeable Anode Flow Field Design for Efficient Removal of Carbon Dioxide in a Direct Formic Acid Fuel Cell," Provisional Patent, EFS ID: 24987426, Application Number: 62298372.

Kwun-Lon Ting

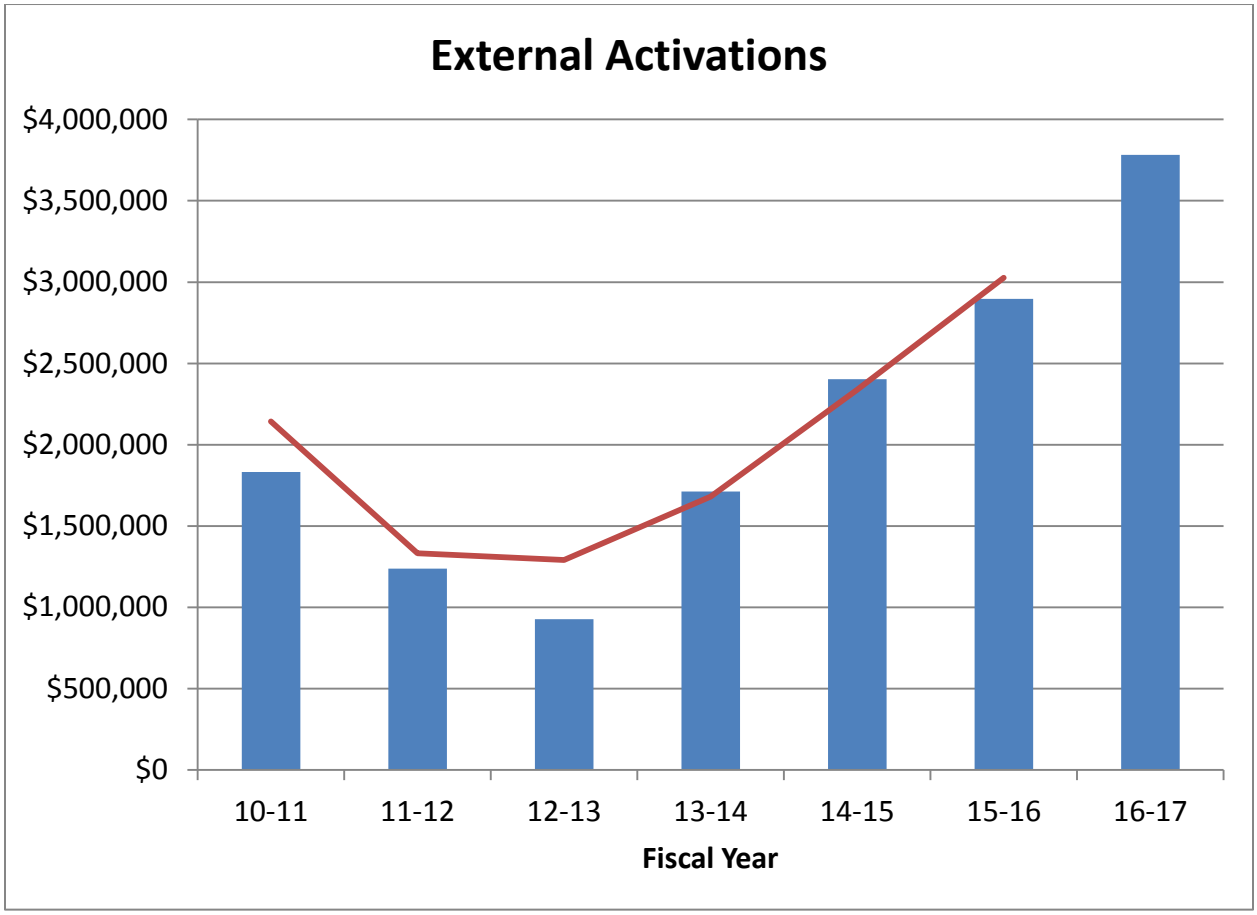
Journal Publications

1. Kwun-Lon Ting, Kuan-Lun Hsu, Zetao Yu, Jun Wang, "Clearance-induced output position uncertainty of planar linkages with revolute and prismatic joints," Journal of Mechanism and Machine Theory, Volume 111, May 2017, pages 66-75.

Conference Publications

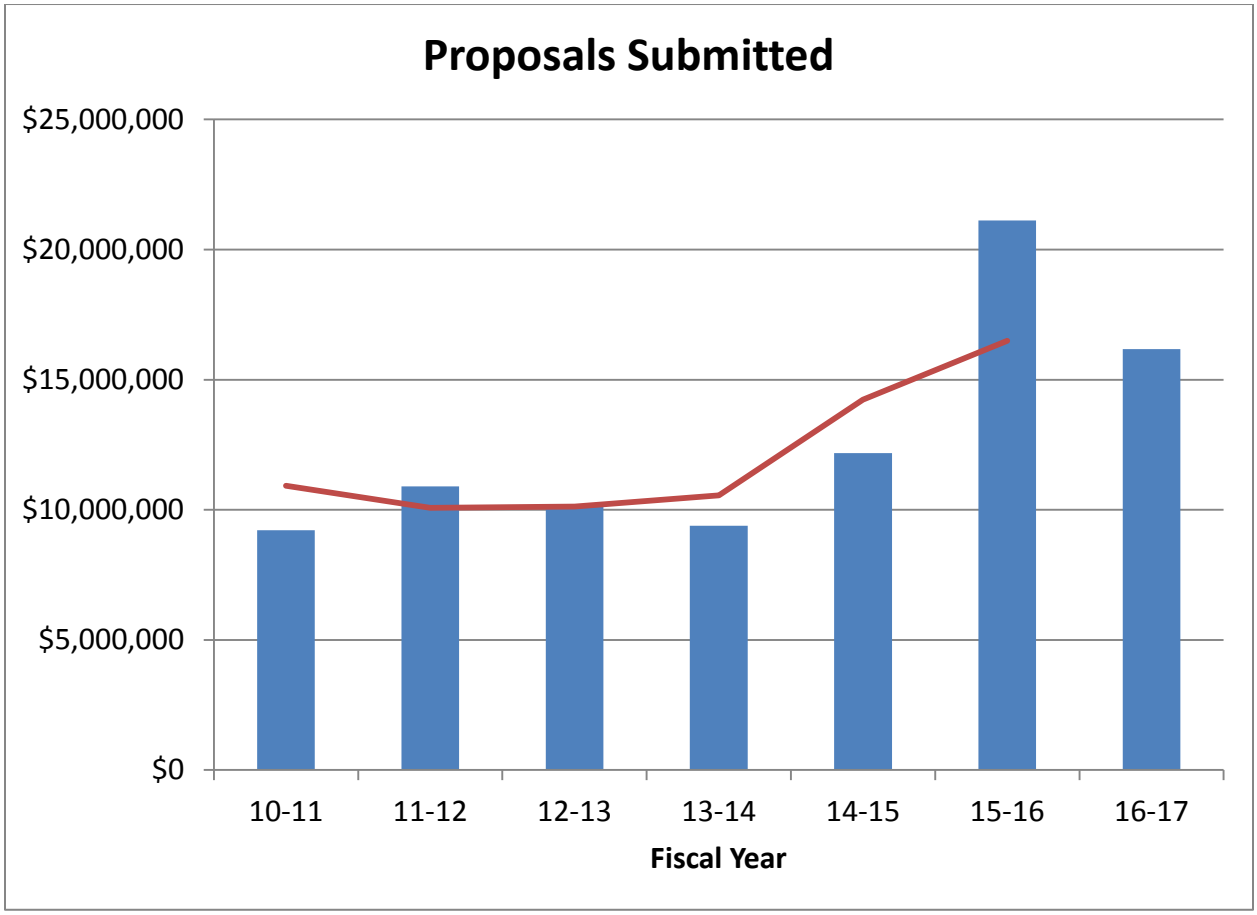
1. Kuan-Lun Hsu and Kwun-Lon Ting, 2016, Topological Reconfigurations of Bennett-Based Linkages, ASME 2016 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, Charlotte, North Carolina, USA, August 21-24.
2. Nie L. Wang, J., Ting, K.L., Zhao, D.X., Wang, Quan, et al., 2016, "Branch Identification of Spherical Six-Bar Linkages," Proceedings of ASME 2016 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (ASME 2016 IDETC/CIE), Charlotte, 2016.8.21-2016.8.24.
3. J. Ren, J. Wang, X. Zhou, J. Sun, Q. Wang, Ting, Kwun-Lon, "A Quick Method for Assessing Transducer Mass Effects on the Measured FRFs," Proceedings of ASME 2016 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (ASME 2016 IDETC/CIE), Charlotte, 2016.8.21-2016.8.24.

External Activations



FY	10-11	11-12	12-13	13-14	14-15	15-16	16-17
3 Year Moving Avg.	$2,142,862	$1,331,496	$1,291,253	$1,680,204	$2,337,047	$3,027,602	
External Activations	$1,831,872	$1,236,826	$925,789	$1,711,145	$2,403,677	$2,896,320	$3,782,809

Proposals Submitted



FY	10-11	11-12	12-13	13-14	14-15	15-16	16-17
3 Year Moving Avg.	$10,927,246	$10,072,301	$10,130,421	$10,558,412	$14,227,931	$16,490,823	
Proposals Submitted	$9,212,641	$10,895,277	$10,108,985	$9,387,001	$12,179,250	$21,117,542	$16,175,678

Grants and Contract Awards

Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
1 CMR Testing and Design - FY2016-2017 Various Industries Account #: 5-38585	Vahid Motevalli	$52,151	7/1/2016	6/30/2017	$52,151
2 UT-CIS - Center for Industrial Services - 2016-2017 University of Tennessee Center for Industrial Services Account #: 5-33509	Meenakshi Sundaram	$20,000	7/1/2016	6/30/2017	$20,000
3 UT-CIS Senior Design Capstone - 2016-2017 The University of Tennessee Center for Industrial Services Account #: 5-33511	Meenakshi Sundaram	$15,000	7/1/2016	6/30/2017	$15,000
4 Public Private Partnership for a Comprehensive Workforce Development Plan to Stimulate Industrial Energy Efficiency and Demand Reduction US Department of Energy Golden Field Office - Modification #14 for DE-EE0005533 Account #: 5-32290	Glenn Cunningham	$92,922	10/1/2015	12/31/2016	$92,922
5 Public Private Partnership for a Comprehensive Workforce Development Plan to Stimulate Industrial Energy Efficiency and Demand Reduction US Department of Energy Golden Field Office - Award DE-EE0005533 - Account #: 5-32290	Glenn Cunningham	$20,000	10/10/2015	12/31/2016	$20,000
6 Program Income for WiCyS 2017 - Sponsor Account 5-31273 - 2016-2017 Various Industries and Organizations Account #: 5-31274	Ambareen Siraj	$399,689	7/1/2016	6/30/2017	$399,689
7 GOALI: Environmentally-Assisted Reactive Sintering of Conductive Spinel Layers for Solid Oxide Fuel Cell Application National Science Foundation - Award CMMI-1362680 Account #: 5-31203	Jiahong Zhu	$110,029	9/15/2014	7/31/2017	$110,029

Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
8 REU Site –Summer Research Internships in Manufacturing and Techno-Entrepreneurship Preparation National Science Foundation - Award 1461179 - Year 3 of 3 Account #: 5-31232	Joseph Rencis Vahid Motevalli	$125,009	3/15/2017	3/14/2018	$125,009
9 Advancement of Cryogenic Electronics MIT Lincoln Laboratory - Contract PO 7000293007 -Modification 4 Additional Account #: 5-39376	Wayne Johnson Mahajan/ Stretz	$174,354	11/1/2015	10/31/2016	$174,354
10 Advancement of Cryogenic Electronics MIT Lincoln Labs - Modification #4 PO 700293007 Account #: 5-39376	Wayne Johnson Satish Mahajan	$100,000	11/1/2015	10/31/2016	$100,000
11 Advancement of Cryogenic Electronics MIT Lincoln Laboratory - PO 70002933007 - Modification #5 Account #: 5-39376	Wayne Johnson Stretz/Cui Satish Mahajan	$250,000	11/1/2016	10/31/2017	$250,000
12 Development of Low-Cost, Highly-Sinterable, Co-free (NiFe3)O4 Spinel-Based Contact Materials for SOFC Cathode-Side Contact Application US Department of Energy - Cooperative Agreement DE-FE0026210 - Year 2 of 2 Account #: 5-32288	Jiahong Zhu	$97,693	10/1/2016	3/31/2017	$97,693
13 Idea to Commercially - Viable Healthcare Solutions: Enhancement and Expansion of Clinical Immersion at Disciplinary Interfaces Course Venturewell Healthcare Solutions - Faculty Grant 13385-15 Account #: 5-35235	Robby Sanders Melissa Geist	$8,501	8/1/2016	7/31/2017	$8,501
14 Self-Powered In Vivo Force and Implant Wear Sensing in Knee Arthroplasty National Institute of Health - Grant IR15AR068663-01A1 - Year 1 of 3 Account #: 5-31307	Steven Anton	$146,257	8/15/2016	8/14/2017	$146,257
15 Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques Oak Ridge National Laboratory - Subcontract 4000140763 Modification #5 Account #: 5-39363	Adam Anderson	$38,860	9/1/2016	5/5/2017	$38,860

Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
16 REU Site: Secure and Privacy-Preserving Cyber Physical Systems National Science Foundation Account #: 5-31263	Mohamed Mahmoud Syed Hasan	$119,835	3/1/2017	2/28/2018	$119,835
17 Collaborative Research: Edge Surface Topography Characterization for Precision Sensing Technology - Award transferred from USC National Science Foundation - Award 1564354 - Year 2 of 2 Account #: 5-31261	Chabum Lee	$67,718	9/1/2016	8/31/2017	$67,718
18 Supplement to: Tennessee Cybercorps: A Hybrid Program in Cybersecurity - for TTU Cyber National Science Foundation - Award - Bootcamp Supplement Year 1 Account #: 5-31279	Ambareen Siraj Doug Talbert	$31,778	7/1/2016	6/30/2017	$31,778
19 Supplement to TENNESSEE CYBERCORPS: A HYBRID PROGRAM IN CYBERSECURITY- Community College Inclusion National Science Foundation Account #: 5-31279	Ambareen Siraj Doug Talbert	$68,130	8/19/2016	8/18/2017	$68,130
20 TENNESSEE CYBERCORPS: A HYBRID PROGRAM IN CYBERSECURITY National Science Foundation Account #: 5-31279	Ambareen Siraj Mohammad Rahman	$542,844	1/1/2017	12/31/2017	$542,844
21 AM-WATCH: Additive Manufacturing - Workforce Advancement Training Coalition and Hub - Award 1601587 - Year 1 of 3 National Science Foundation Account #: 5-31289	Ismail Fidan	$311,007	8/1/2016	7/31/2017	$311,007
22 Continuous Real-Time State Monitoring in Highly Dynamic Environments Air Force Office of Scientific Research - Award FA9550-16-1-0440 - Year 1 of 3 Account #: 5-32347	Steven Anton	$120,000	9/1/2016	3/31/2017	$120,000
23 NeTS: Small: Collaborative Research: Towards Privacy Preserving Autonomous Vehicle Sharing Services National Science Foundation - Award 1618549 - Year 1 of 3 Account #: 5-31290	Mohamed Mahmoud	$52,763	9/1/2016	8/31/2017	$52,763

Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
24 Affordable Integrated Circuit Packaging and Assembly for High-Temperature Intelligent Components Micro-RDC - Subcontract 07060-SC-001 Account #: 5-32440	Wayne Johnson	$37,866	6/1/2016	11/30/2016	$37,866
25 Fabricate Aluminizing Ni-based 31V Alloy Oak Ridge National Laboratory - Contract 4000146841 - Allocation 2 of 2 Account #: 5-39358	Ying Zhang	$10,000	5/2/2016	12/31/2016	$10,000
26 Public-Private Partnership to Promote Efficient Manufacturing and Workforce Development Department of Energy - Office of Energy Efficiency and Renewal - Award DE- Account #: 5-32278	Glenn Cunningham Ehsan Languri	$75,000	9/1/2016	8/31/2017	$75,000
27 Public-Private Partnership to Promote Efficient Manufacturing and Workforce Development Department of Energy, Office of Energy Efficiency and Renewable Energy- Award Account #: 5-32278	Glenn Cunningham Ehsan Languri	$180,000	9/1/2016	8/31/2017	$180,000
28 Public-Private Partnership to Promote Efficient Manufacturing and Workforce Development National Science Foundation - Modification #2 Award DE-EE007702 Account #: 5-32278	Glenn Cunningham Ehsan Languri	$26,938	9/1/2016	8/31/2017	$26,938
29 Supplement to: Idea Generation to Commercially-Viable Healthcare Solutions - VentureWell Grant #13385-15 Venturewell Faculty Grant Program - Grant #13385-15 Account #: 5-35235	Robby Sanders Melissa Geist	$20,000	8/1/2016	7/31/2017	$10,720
30 ATE - MANEUVER: MANufacturing Education Using Virtual Environment Resources - Year 1 of 3 - Subaward 4104-79545 Purdue University (via NSF funds) - Year 1 of 3 - Prime Award DUE-1700674 Account #: 5-31292	Ismail Fidan	$50,142	5/1/2017	4/30/2018	$50,142
31 Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques Oak Ridge National Laboratory - Contract 40000149545 - Allocation #1 Account #: 5-39303	Adam Anderson	$50,000	9/1/2016	5/31/2017	$50,000

Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
32 Collaborative Research: Improved Freeform Measurement through Fiber-based Metrology National Science Foundation - Award 1663210 - Year 1 of 3 Account #: 5-31281	Chabum Lee	$60,540	4/15/2017	4/14/2018	$60,540
33 GenCyber Camp at Tennessee Technological University - Summer 2017 National Security Agency and National Science Foundation Account #: 5-32306	Ambareen Siraj	$99,654	4/15/2017	4/14/2018	$99,654
34 Supplement to: Collaborative Research: Edge Surface Topography Characterization for Precision Sensing Technology - Award 1564354 National Science Foundation Account #: 5-31261	Chabum Lee	$20,229	5/31/2017	7/31/2018	$20,229
35 EAGER: SC2: A Universal Spectral Language for Blind Rendezvous in Open Spectrum Cognitive Intelligent Radio Networks National Science Foundation Account #: 5-31282	Adam Anderson	$98,869	3/1/2017	2/28/2018	$98,869
36 Tether Dynamic Modeling for the Electric Sail Tether Deployment System - Cooperative Agreement NNX17AJ22A Marshall Space Flight Center Account #: 5-32336	Stephen Canfield	$26,500	4/1/2017	9/30/2017	$26,500
37 "Power Into Motion III" Proposed Automotive Powertrain Program at Tennessee Tech - 2017 Grant Agreement DENSO North America Foundation Account #: 5-35915	Joseph Rencis	$50,000	6/1/2017	5/1/2018	$50,000
38 Summer Bridge Program for CyberCorps SFS – 2YR to 4YR Transition National Cyber Watch Center Account #: 5-31301	Ambareen Siraj	$3,000	6/1/2017	9/30/2017	$3,000
39 Summer Undergraduate Research Fellowship (SURF) Program - Gaithersburg National Institute of Standards and Technology Account #: 5-32814	Ambareen Siraj	$9,531	5/22/2017	8/4/2017	$9,531
Total		**$3,782,809**			**$3,063,738**

Schedule 7

CENTERS OF EXCELLENCE
ACTUAL, PROPOSED, AND REQUESTED BUDGET

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

	FY 2016-17 Actual			FY 2017-18 Proposed			FY 2018-19 Requested		
	Matching	Appropr.	Total	Matching	Appropr.	Total	Matching	Appropr.	Total
Expenditures									
Salaries									
Faculty	417,170	356,901	**774,071**	400,000	363,247	**763,247**	420,000	375,000	**795,000**
Other Professional	69,906	384,328	**454,234**	40,000	480,106	**520,106**	50,000	495,000	**545,000**
Clerical/ Supporting	0	43,182	**43,182**	0	60,102	**60,102**	0	57,000	**57,000**
Assistantships	287,262	188,560	**475,822**	300,000	216,440	**516,440**	280,000	210,000	**490,000**
Hourly Students	94,104	45,539	**139,643**	50,000	45,711	**95,711**	50,000	30,000	**80,000**
Total Salaries	**868,442**	**1,018,510**	**1,886,952**	**790,000**	**1,165,606**	**1,955,606**	**800,000**	**1,167,000**	**1,967,000**
Fringe Benefits	325,862	410,627	**736,489**	230,000	347,655	**577,655**	225,000	360,000	**585,000**
Total Personnel	**1,194,304**	**1,429,137**	**2,623,441**	**1,020,000**	**1,513,261**	**2,533,261**	**1,025,000**	**1,527,000**	**2,552,000**
Non-Personnel	**NOTE: Appropriations Expenditures in Fringe Benefits include $131,473 for Graduate Student Fees for FY 2016-17.**								
Travel	141,518	16,184	**157,702**	105,000	16,871	**121,871**	100,000	20,000	**120,000**
Software	0	688	**688**	0	0	**0**	0	0	**0**
Books & Journals	0	0	**0**	0	0	**0**	0	0	**0**
Other Supplies	683,265	21,208	**704,473**	600,000	34,271	**634,271**	575,000	22,000	**597,000**
Equipment	91,000	9,994	**100,994**	150,000	50,022	**200,022**	200,000	0	**200,000**
Maintenance	0	7,076	**7,076**	0	0	**0**	0	0	**0**
Scholarships	0	0	**0**	0	0	**0**	0	0	**0**
Consultants/Subcontracts	101,520	0	**101,520**	120,000	0	**120,000**	100,000	0	**100,000**
Renovation	0	0	**0**	0	0	**0**	0	0	**0**
Seminars/Workshops/Conf	923,250	0	**923,250**	815,113	0	**815,113**	750,000	0	**750,000**
Total Non-Personnel	**1,940,553**	**55,150**	**1,995,703**	**1,790,113**	**101,164**	**1,891,277**	**1,725,000**	**42,000**	**1,767,000**
GRAND TOTAL	**3,134,857**	**1,484,287**	**4,619,144**	**2,810,113**	**1,614,425**	**4,424,538**	**2,750,000**	**1,569,000**	**4,319,000**
Revenue	**NOTE: Actual Matching Funds do not include Indirect Costs of $688,496 for FY 2016-2017.**								
New State Appropriation	0	1,453,000	**1,453,000**	0	1,494,200	**1,494,200**	0	1,569,000	**1,569,000**
Carryover State Appropriation	0	151,512	**151,512**	0	120,225	**120,225**	0	0	**0**
New Matching Funds	3,119,213	0	**3,119,213**	2,750,000	0	**2,750,000**	2,750,000	0	**2,750,000**
Carryover from Previous Matching Funds	75,757	0	**75,757**	60,113	0	**60,113**	0	0	**0**
Total Revenue	**3,194,970**	**1,604,512**	**4,799,482**	**2,810,113**	**1,614,425**	**4,424,538**	**2,750,000**	**1,569,000**	**4,319,000**

NOTE: Carryover appropriation funds of $120,225 are designated for new faculty recruitment commitments.

FY 2018 – 2019 Budget Request and Justification

The CMR is requesting a **5.0%** increase in the FY 2018-19 State appropriations to account for increasing salaries, benefits, student support, tuition and fees, supplies, and travel costs.

Tennessee Tech University had a 1% salary increase as of January 1, 2015 for all faculty and staff. Since this was an approved salary increase for TTU and not a state-wide increase, the Center had to absorb the additional expenses through the appropriated funds. The impact on our budget was further amplified by the corresponding increase in the benefits costs associated with these salary increases. There was also a TTU equity adjustment to faculty and staff salaries effective July 1, 2015 that resulted in an approximate $20,000 increase in salaries and associated benefits. In addition, a 1% COLA and a 1% merit salary increase were implemented for FY 2016-17, which resulted in an approximate $21,000 increase in salaries and associated benefits as well. Finally, the promotion of a Center faculty member taking effect in FY 2016-17 resulted in a separate increase of $7,500 in total expenses. In FY18 (effective July 1, 2017), there was a 1% COLA and 2% merit increase for the staff implemented due to the State-wide approved salary increase. In addition, there was a 1% COLA and additional equity adjustment (averaged at 2%) to the Center faculty salaries effective August 1, 2017.

There was an increase in the FY18 appropriation that offset some of the increased cost, but these increases do not provide enough funding to avoid the overall erosion of CMR funds due to increased cost of operation. Despite these funding reductions, the CMR has been able to appreciably increase its external funding over the past three consecutive years. While we anticipate continuing this growth, the Center will not be able to reach its true potential if the core funding is not increased. Furthermore, there are functions within the Center in support of the research infrastructure and the State manufacturing industry that cannot be paid for by external grants and cost recovery.

The requested budget increase is particularly important to allow CMR to pay the graduate student salaries at a level consistent with the College of Engineering and to be competitive with other universities in Tennessee. Attracting and retaining quality graduate students are key to CMR's ability to continue a high-level of research and service to Tennessee manufacturing industries. In addition, increased core funding will enable the CMR to incentivize more faculty to contribute to the research and industry engagement in the manufacturing area.

SUPPORTING MATERIALS

CMR Supported Graduate Students Degrees Awarded

Masters

Amruth Halematha
Non-thesis
Summer 2016
Advisor: Dr. Mohan Rao/Dr. Ahmed Elsawy
Mechanical Engineering

Patrick Kent
"Recombinant Production of Human Tenascin-C Epidermal Growth Factor Like Repeats for Addition to Therapeutic Hydrogels and Antiproliferative Effects of Toposisomerase lla Against Breast Cancer Cell Lines"
Summer 2016
Advisor: Dr. Jeffrey Rice
Chemical Engineering

Abdul Mohammad
"Molecular Scale Modeling of Biomass Pyrolysis-Transport and Microstructural Changes"
Summer 2016
Advisor: Dr. Joe Biernacki
Chemical Engineering

Maheshwar Nunna
"Flow and Heat Transfer Characteristics of Graphene "Oxide Nanofluids in a Horizontal Tube"
Summer 2016
Advisor: Dr. Ehsan Languri
Mechanical Engineering

Jason Steward
"Hot Corrosion Testing of Ni-Based Alloys and Coatings in a Modified Dean Rig"
Summer 2016
Advisor: Dr. Ying Zhang
Mechanical Engineering

Christopher Blackburn
"Thermomechanical Behavior of Tow Polymer Films at Cryogenic Temperatures"
Fall 2016
Advisor: Dr. Chris Wilson
Mechanical Engineering

Jeffrey Graves
"Walsh Functions as Group Characters"
Fall 2016
Advisor: Dr. Rafal Ablamowicz
Mathematics

Sasiteja Gunukula
"Development of a Portable Hybrid Solar and Vertical Axis Wind Power System for use in Rural Areas"
Fall 2016
Advisor: Dr. Mohan Rao/Dr. Ahmed Elsawy
Mechanical Engineering

Sumit Jamkhindikar
"High Throughput Fiber Reactor Process for Drug Delivery Nanoparticle Production: Alginate, Pnipam and Polyacrylamide"
Fall 2016
Advisor: Dr. Holly Stretz
Chemical Engineering

Aaron Lane
"Designing a Cryogenic Processing Chamber with the Application of CFD Modeling"
Fall 2016
Advisor: Dr. Chris Wilson
Mechanical Engineering

Pallavi Patil
"Dynamic Modeling and Experimental Analysis of an Induced Draft Cooling Tower"
Fall 2016
Advisor: Dr. Ehsan Languri
Mechanical Engineering

Chinemerem Ibe-Ekeocha
"Machine Learning Based Diagnosis of Lithium Batteries"
Spring 2017
Advisor: Dr. Indranil Bhattacharya
Electrical & Computer Engineering

Leora Loftis
"Electrokinetic-Based Microflows in Capillaries of Axially-Varying Rectangular Geometry-Selected Applications in Microfluids and Biomedicine"
Spring 2017
Advisor: Dr. Pedro Arce
Chemical Engineering

Anthony Taylor
"Nonintrusive Compressed Air Flow Meter to Aid in Compressor Analysis"
Spring 2017
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

Sumit Yadav
"Adaptive Control of Nonlinear Dynamic Robotic Systems"
Spring 2017
Advisor: Dr. Stephen Canfield
Mechanical Engineering

CMR Supported Graduate Student Degrees Awarded

Ph.D.

Khaled Rabieh
"Secure and Privacy-Preserving Communication Schemes for Emerging Smart Cities"
Summer 2016
Advisor: Dr. Mohamed Mahmoud
Electrical & Computer Engineering

Kuan-Lun Hsu
Part 1: Modular Constructing of Spatial Mechanisms
Part 2: Computationally Efficient Approach for the Allocation of Tolerances and Clearances in Linkages and Manipulators
Fall 2016
Advisor: Dr. Kwun Ting
Mechanical Engineering

Mehdy Khayamy
"Efficient Operation and Control of an Interior Permanent Magnet Synchronous Motor"
Spring 2017
Advisor: Dr. Ghadir Radam
Electrical & Computer Engineering

CMR Graduate Students Supported from State Appropriations

Masters

Josh Cisco
Advisor: Dr. Cynthia Rice
Chemical Engineering

Jared Davis
Advisor: Dr. Steve Canfield
Mechanical Engineering

Chin Ibe-Ekeocha
Advisor: Dr. Hicham Chaoui
Electrical & Computer Engineering

Sumit Jamkhindikar
Advisor: Dr. Holly Stretz
Chemical Engineering

Matthew Kelley
Advisor: Dr. Joe Biernacki
Chemical Engineering

Patrick Kent
Advisor: Dr. Jeffrey Rice
Chemical Engineering

Leora Loftis
Advisor: Dr. Jennifer Pascal
Chemical Engineering

Farzin Mashali
Advisor: Dr. Ehsan Languri
Chemical Engineering

Sravanthi Mandalapu
Advisor: Dr. Hicham Chaoui
Electrical & Computer Engineering

Abdul Mohammad
Advisor: Dr. Joe Biernacki
Chemical Engineering

Maheshwar Nunna
Advisor: Dr. Ehsan Languri
Mechanical Engineering

Ph.D.

Abolfazi Abbasghaleh
Advisor: Dr. ChaBum Lee
Mechanical Engineering

Bobby Adams
Advisor: Dr. Cynthia Rice
Chemical Engineering

Michael Adenson
Advisor: Dr. Joe Biernacki
Chemical Engineering

Hamidreza Bahraseman
Advisor: Dr. Ehsan Languri
Mechanical Engineering

Corey Cooke
Advisor: Dr. Adam Anderson
Electrical & Computer Engineering

Kuan-Lun Hsu
Advisor: Dr. Kwun-Lon Ting
Mechanical Engineering

Ryan Kettle
Advisor: Dr. Steve Anton
Mechanical Engineering

Mehdy Khayamy
Advisor: Dr. Hicham Chaoui
Electrical & Computer Engineering

Qinghua Lin
Advisor: Dr. Ping Chen
Mechanical Engineering

Koteswara Medidhi
Advisor: Dr. Venkat Padmanabhan
Chemical Engineering

Gholamreza Mirshekari
Advisor: Dr. Pezhman Shirvanian
Mechanical Engineering

Sashankha Tallapudi
Advisor: Dr. Holly Stretz
Chemical Engineering

Sumit Yadav
Advisor: Dr. Hicham Chaoui
Electrical & Computer Engineering

Mohsen Mohammadabadi
Advisor: Dr. Steve Anton
Mechanical Engineering

Khaled Rabieh
Advisor: Dr. Mohamed Mahmoud
Electrical & Computer Engineering

Ahmed Sherif
Advisor**:** Dr. Mohamed Mahmoud
Electrical & Computer Engineering

Amir Soleymani
Advisor: Dr. Pezhman Shirvanian
Mechanical Engineering

CMR Graduate Students Supported from External Funds

Masters

Christopher Blackburn
Advisor: Dr. Chris Wilson
Mechanical Engineering

Ryan Burns
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

Jonathan Chappell
Advisor: Dr. Chris Wilson
Mechanical Engineering

Jonathan Dugas
Advisor: Dr. Satish Mahajan
Electrical & Computer Engineering

Tingke Fang
Advisor: Dr. Jiahong Zhu
Mechanical Engineering

Zachary Henderson
Advisor: Dr. Chris Wilson
Mechanical Engineering

Jay Howard
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

Astrit Imeri
Advisor: Dr. Ismail Fidan
Mechanical Engineering

Seongkyul Jeon
Advisor: Dr. ChaBum Lee
Mechanical Engineering

Joshua Lambert
Advisor: Dr. Wayne Johnson
Electrical & Computer Engineering

Pallavi Patil
Advisor: Dr. Ehsan Languri
Mechanical Engineering

Ph.D.

David Chesson
Advisor: Dr. Jiahong Zhu
Mechanical Engineering

Ekramul Ehite
Advisor: Dr. Steve Anton
Mechanical Engineering

Qing Feng
Advisor: Dr. Robert Qiu
Electrical & Computer Engineering

Aaron Lane
Advisor: Dr. Chris Wilson
Mechanical Engineering

Bryan Materi
Advisor: Dr. Cynthia Rice
Chemical Engineering

Mohammad Mohammadzadeh-Keleshteri
Advisor: Dr. Steve Anton
Mechanical Engineering

Lenin Mookiah
Advisor: Dr. William Eberle
Computer Science

Kyle Reed
Advisor: Dr. Adam Anderson
Electrical & Computer Engineering

Brett Witherspoon
Advisor: Dr. Adam Anderson
Electrical & Computer Engineering

Yutian Yu
Advisor: Dr. Jiahong Zhu
Mechanical Engineering

Ali Zolghadr
Advisor: Dr. Joe Biernacki
Chemical Engineering

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

Serhat Sahin
Advisor: Dr. Ismail Fidan
Computer Science

Matthew Spreeman
Advisor: Dr. Holly Stretz
Chemical Engineering

Christopher Stephanick
Advisor: Dr. Chris Wilson
Mechanical Engineering

Anthony Taylor
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

External Funding – Proposals Submitted

	Status	Title	PI's	Department	Total Funds
1	608MC-M5 9/9/2016 16(15-16) 5-39363	Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques Oak Ridge National Laboratory - Subcontract 4000140763 Modification #5	Anderson	ECE	$38,860
2	663MC 7/8/2016 7(16-17)	Cyber P3i with CEROC NSA USAR	Siraj Brown	CompS SFS/COE	$421,052
3	664MC 7/8/2016 9(16-17)	On RAMPS to Middle Tennessee Cybersecurity Consortium (MTCC) NIST	Siraj Brown	CompS SFS/COE	$204,058
4	666MC 7/21/2016	CAREER: Sensor Integration in Additive Manufacturing for Part Validation and Structural Health Monitoring National Science Foundation	Anton	ME	$500,000
5	667MC 8/2/2016	Real-time Complex Event Recognition on Multiple, Heterogeneous Graph Streams Washington State University (via DARPA funds)	Eberle	CompS	$296,148
6	668MC 7/20/2016	High Performance Laboratory-Scale Gas Atomizer for Materials and Coatings Research". The Department of Defense	Zhang	ME	$366,995
7	669MC 7/21/2016	CAREER: Novel Metrology Tools for In-situ Monitoring and Characterization of Precision Spindle Systems National Science Foundation	Lee	ME	$580,685
8	670MC 7/20/2016	CAREER: Towards Secure and Privacy-Preserving Management and Operation of Automated Transportation Systems National Science Foundation	Mahmoud	ECE	$449,215
9	672MC 9/1/2016 175(16-17)	Social Network Analysis Using Graph Streams for Detecting Dynamic Patterns of Criminal Activity U.S. Department of Homeland Security (DHS) Science and Technology Directorate	Eberle	CompS	$198,789
10	673MC 10/6/2016 54(16-17) 5-31292	ATE - MANEUVER: MANufacturing Education Using Virtual Environment Resources Purdue University (via NSF funds)	Fidan	MET	$140,246

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11	674MC 8/17/2016	Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques Oak Ridge National Laboratory - Award 40000149546 - Year 1 of 1	Anderson	ECE	$114,358
12	676MC 9/15/2016 42(16-17)	Collaborative Research: Improved Freeform Measurement through Fiber-based Metrology National Science Foundation	Lee	ME	$184,866
13	678MC 9/28/2016 51(16-17)	Characterization of GDC Barrier Layers with a Unique Sintering Aid for SOFC Applications Surficon Technologies, LLC	Zhu	ME	$54,694
14	679MC 10/20/2016	Collaborative Research: Electrochemical Biosensors for Detection of Glycosylated Proteins for Early Cancer Diagnosis National Science Foundation	Rice Sanders	CMR ChemE	$290,685
15	680MC 10/11/2016 64(16-170	IIS: Medium: Collaborative Research: Streaming Network Analytics for Pattern Learning and Anomaly Detection in Cyber-Crime Data National Science Foundation	Eberle Navarro	CompS Soc	$380,285
16	681MC	An Instrumental Framework for High-Speed, Large-Range, Low-Cost Nanoscanning Microscopy National Science Foundation	Lee Canfield	ME ME	$299,725
17	682MC 10/20/2016 71(16-17)	Study of Evaporation under Interfacial Localized Heating in Porous Media National Science Foundation	Languri Cunningham	ME ME	$299,585
18	684MC 10/20/2016 72(16-17)	Collaborative Research: A Fundamental Study of Non-Equilibrium Water Foaming Process: Towards Economic and Environmental Benign Processing National Science Foundation	Zhang	ChemE	$222,574
19	687MC 10/20/2016 79(16-17)	A Universal Spectral Language to Enable Spectrum Access Learning Global Technology Connection	Anderson	ECE	$45,001
20	688MC 10/20/2016	Outreach to Support Workforce and Professional Development Project for CHSQA Center for Homeland Security Quantitate Analysis (CHSQA) (via DHS funds)	Siraj	CompS	$308,889
21	689MC 11/14/2016 84(16-17)	Mixing and Structure of Water in Complicated Aromatic and Aliphatic Liquids US Department of Energy	Zhang	ChemE	$750,014

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22	690MC	Profinet to Profinet Encryption Dongle, Phase II Aerospace Testing Alliance, Arnold Engineering Development Center	Alouani	ECE	$20,000
23	691MC 11/4/2016 5-32306	GenCyber Camp at Tennessee Technological University - Summer 2017 National Security Agency and National Science Foundation	Siraj	CompS	$99,654
24	692MC 11/16/2016 88(16-17)	III:Small: Autonomously Learning to Learn How to Improve Decision Support National Science Foundation	Talbert	CompS	$332,118
25	693MC 11/21/1016 92(16-17)	Method to Develop Thermal and Motion Sensor Development for Vehicle Occupants under Severe Weather Conditions All American Air Conditioning and Foam Insulation, Inc.	Languri	ME	$86,495
26	694MC 11/21/2016	A Method for Providing Energy and Water Savings in Residential Showerheads using Thermal Energy Storage Systems All American Air Conditioning and Foam Insulation, Inc.	Languri	ME	$83,143
27	695MC	Graph Merging and Activity Detection on Multiple, Heterogeneous Graph Streams Washington State University (via DARPA funds)	Eberle	CompS	$424,937
28	697MC 1/31/2017 43(15-16) 5-31261	Supplement to: Collaborative Research: Edge Surface Topography Characterization for Precision Sensing Technology - Award 1564354 National Science Foundation	Lee	ME	$20,229
29	699MC	Framework of On-Machine BRDF (Bidirectional Reflectance Distribution Function) Measurement for the Holographical Optical Element Mold Surface Characterization National Science Foundation	Lee Kim	ME MET	$296,661
30	700MC	A Cognitive Science-Based Approach to Planning for and Controlling Mass Customization National Science Foundation	Kim	MET	$212,701
31	701MC	Instrumentation Approach to Large-Area Nanoscanning Atomic Force Microscopy Oak Ridge Associated Universities (ORAU) Ralph E. Powe Junior Faculty Enhancement	Lee	ME	$5,000

	Status	Title	PI's	Department	Total Funds
32	702MC	MRI: Acquisition of an Advanced Versatile Ultra-High Resolution Scanning Electron Microscopy with Cryogenic Capabilities for Advanced Material Research National Science Foundation	Rice Stretz/Zhang	CMR ChemE	$749,592
33	703MC	Collaborative Research: Engaged Student Learning at Disciplinary Interfaces National Science Foundation	Sanders Geist	ChemE Nursing	$299,866
34	704MC 1/26/2017 117(14-15)	Development & Validation of Low-Cost, Highly-Durable, Spinel-Based Contact Materials for SOFC Cathode-Side Contact Application - Phase II Department of Energy Office of Fossil Energy	Zhu	ME	$599,990
35	705MC	E-MAA Pre-natal Remote Monitoring Unit: High Impact, Maximum Outreach US Aid	Hasan	ECE	$171,606
36	706MC	GOALI: Characteristics and Synthesis of Contact Relationships and Application National Science Foundation	Ting Shibakov	ME Math	$299,377
37	707MC	Low Cost Corrosion and Oxidation Resistance Coatings for Improved System Reliability Faraday Technology, Inc.	Zhang	ME	$32,980
38	708MC 2/6/2017 133(16-17)	FlexSens Bracket: Force Sensitive Dental Bracket for High Precision Multimode Orthodontic Force Measurement Using Capacitive Nanosensor University of Maryland - Baltimore County (via NIH funds)	Lee	ME	$589,290
39	709MC 2/15/2017 132(16-17)	Developing the HMMR-EM: A High-mobility Maintenance MU2 Robot for Inspection, Welding Repair and Support Emergency Response U.S. Department of Energy, Idaho Operations Office	Canfield	ME	$1,500,000
40	710MC	GOALI: DMREF: Collaborative Research: In Silico Design with Experimental Synthesis and Validations of Advanced Catalysts for High Performance Hydrogen Fuel Cells. National Science Foundation	Shirvanian	ME	$575,759
41	711MC 2/20/2017 147(16-17)	Low Cost Coatings for Improved CSP System Durability and Lifetime Faraday Technology, Inc. (via DOE funds)	Zhang	ME	$49,997

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42	712MC 2/21/2017 135(16-17) 5-31282	EAGER: SC2: A Universal Spectral Language for Blind Rendezvous in Open Spectrum Cognitive Intelligent Radio Networks National Science Foundation	Anderson	ECE	$98,869
43	713MC 2/24/2017 143(16-17)	Investigation on hBD-3 Structure, Dynamics and Interactions with Chemokine Receptor National Institute of Health	Zhang	ChemE	$426,000
44	714MC 5/24/2017	Decoupling Observer Design for NOx Sensor in Selective Catalytic Reduction System Applications. Cummins Technical Center	Chen	ME	$54,877
45	715MC 3/24/2017 165(16-170	Enabling Clean and Efficient Lean Gasoline Engine-Aftertreatment Systems with Non-Uniform Cylinder-to-Cylinder Combustion-Based Emission Control Strategies US Department of Energy - Office of Energy Efficiency and Renewable Energy	Chen	ME	$1,388,481
46	716MC 2/15/2017 128(16-17)	Investigation on Binding and Dynamics of hBD-3 with CD98 Heavy Chain National Institute of Health	Zhang	ChemE	$141,307
47	718MC 2/16/2017 137(16-17)	Professional Formation of Holistic, T-Shaped Chemical Engineers National Science Foundation	Arce Sanders	ChemE ChemE	$199,996
48	719MC 2/24/2017 141(16-17)	Makers on the Move: An Engineering Outreach, Recruitment, and Retention Program TBR	Ingle Powell	COE COE	$35,000
49	720MC 3/20/2017 158(16-17)	BIGDATA:F: Collaborative Research: Complex Event Detection on Multiple Heterogeneous Graph Streams National Science Foundation	Eberle	CompS	$262,861
50	721MC 3/24/2017 162(16-17) 5-32336	Tether Dynamic Modeling for the Electric Sail Tether Deployment System - Cooperative Agreement NNX17AJ22A Marshall Space Flight Center	Canfield	ME	$26,500
51	722MC 3/16/2017 160(16-17)	Phase 2: Affordable Integrated Circuit Packaging and Assembly for High-Temperature Intelligent Components Micro-RDC (via federal funds)	Johnson Wilson	ECE ME	$231,135
52	723MC 3/15/2017 161(16-17)	Southeast Combined Heat and Power Technical Assistance Partnership (CHP TAP) North Carolina State University	Languri Cunningham	ME ME	$219,927

	Status	Title	PI's	Department	Total Funds
53	724MC 3/14/2017 159(16-17)	Molecular Dynamics Simulation on Wax Inhibition using Polymer Pour Point Depressants American Chemical Society Petroleum Research Fund	Zhang	ChemE	$110,000
54	725MC 3/23/2017 163(16-17)	"Power Into Motion III" Proposed Automotive Powertrain Program at Tennessee Tech - 2017 Grant Agreement	Rencis	COE	$50,000
	5-35915	DENSO North America Foundation			
55	726MC 5/30/2017 187(16-17)	Development of High-Resolution, High-Temperature, Large-Range, Low-Cost Atomic Force Microscopy for Nano-Textured Surface Measurement	Lee	ME	$99,999
		Samsung Electronics Co., Ltd.			
56	727MC 5/31/2017 192(16-17)	Supplement to Tennessee Cybercorps: A Hybrid Program In Cybersecurity - Community College Inclusion - 2017-2018	Siraj	CompS	$226,607
	5-31279	National Science Foundation			
57	728MC 5/23/2017 188(16-17)	Strengthening Innovation and Entrepreneurship Partnerships: The Freshman WARFF	Stretz	ChemE	$5,000
		VentureWell			
58	731MC 6/28/2017 203(16-17)	Summer Bridge Program for CyberCorps SFS - 2YR to 4YR Transition	Siraj	CompS	$3,000
		National Cyber Watch Center			
				Proposals Submitted in FY 2016-2017	$16,175,678
				Total New Proposals in FY 2016-2017	$16,175,678