ANNUAL REPORT
FY 2015—2016

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.

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Tennessee Technological University
Center for Manufacturing Research
Annual Report – FY 2015 – 2016

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.

Interim Director

Vahid Motevalli, Ph.D., P.E.
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Faculty Associate Director

Stephen Canfield, Ph.D.
Faculty Associate Director
Center for Manufacturing Research

CMR Faculty and Staff

Dr. Robert Qiu, Professor, ECE
Dr. Cynthia Rice, Associate 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, Contract Compliance Asst.
Tammy Martin, Administrative Associate III
Mike Renfro, R&D Engineer II
Joel Seber, Engr. Computer Support Mgr.
Phyllis Stallion, Administrative Associate, III
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 and Management
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. 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 Sci.
Dr. Stephen Idem, Professor, ME
Dr. Wayne Johnson, Chair, Professor, ECE
Dr. Ehsan Languri, Asst. Professor, ME
Dr. ChaBum Lee, Asst. Professor, ME
Dr. Wayne Liemer, Professor, Earth Sciences
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. Lachelle Norris, Professor, Sociology & Political Sci.
Dr. Jennifer Pascal, Asst. Professor, ChE
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. Jeffrey Rice, Asst. Professor, ChE
Dr. Jonathan (Robby) Sanders, Asst. Professor, ChE
Dr. Stephen Scott, Professor, CSC/ECE
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. Professor, Earth Sciences
Dr. Liqun “Laura” Zhang, Asst. Professor, ChE
Dr. Ying Zhang, Professor, ME
Dr. John Zhu, Professor, ME

EXECUTIVE SUMMARY

During this past 2015-16 fiscal year, the CMR has experienced another consecutive year of increased research activity, funding, and accomplishments by our faculty and staff. Externally funded research has increased by 21% from last year while proposal activity was increased by 73% as highlighted in the tables below. Fifty-nine proposals were submitted for $21,117,542, thirty-seven external projects were activated for $2,896,320, and 55 graduate students were supported by both State appropriations and external funds.

Tennessee Tech University achieved a higher level of recognition under the Carnegie Classification to a "Doctoral Granting University, Limited Research" (previously classified as Masters Granting – Large) in December of 2015. This reclassification is in large part due to the increase in the number of Ph.D. degrees awarded by the College of Engineering, which in turn has been mostly supported by the research grants and State appropriations supporting the graduate students through CMR and CESR.

The CMR has invested in new faculty hires by supporting their research and specifically their Ph.D. students. These have resulted in large increases in proposals submitted for external funding and in fact in the increase of external funds, as exemplified in this table.

	FY 13-14	FY 14-15	FY 15-16
Proposals Submitted	**$9,387,001**	**$12,179,250**	**$21,117,542**
External Activations	**$1,711,145**	**$2,403,677**	**$2,896,320**

Table 1. Proposals Submitted and External Activations

Center Research Areas

The CMR focuses on several research 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	$359,795
Materials for Energy Storage and Conversion	$636,732
Networking and Algorithms for Big Data	$221,848
Tennessee Industry Support	$395,934
Education and Outreach	$949,463
Other	$332,548
Total	**$2,896,320**

Selected Highlights from FY 2015 – 2016

External Funding Highlights

The CMR has increased activation funding over previous fiscal year (FY) by 21%. Thirty-seven externally funded projects were activated this past FY, resulting in funding of $2,896,320 compared to the previous FY 2014 –15 total activation of $2,403,677.

CMR's new matching funds for the past FY were $2,465,442. This amount excludes $461,686 of indirect costs associated with this year's funded projects.

Research proposals submitted by CMR faculty and faculty associates increased 73% over the previous year. Fifty-nine proposals with a total value of $21,117,542 were submitted during this past FY, compared to a value of $12,179,250 at the end of FY 2014 –15.

CMR supported 55 graduate students during the past FY. Twenty-six M.S. students and 29 Ph.D. students were funded from both State appropriations and grants received by faculty. Specifically external grants funded 17 of the M.S. students and 16 of the Ph.D. students. Among the graduate students funded by CMR, six M.S. and three Ph.D. students were from underrepresented minorities. This is a 56% increase of graduate students funded as compared to the previous year 2014-2015.

CMR supported a total of 67 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 2013-14	FY 2014-15	FY 2015-16
CMR Staff release time	$82,503	$99,224	$128,231
Graduate student stipend and fees from external sponsors	$265,734	$325,719	$282,994
Percentage of GRA support from external sponsors	63%	65%	45%
Total "Soft Money" (F&A return, testing income, GRA support, equipment usage, and release time)	$457,172	$558,390	$552,393

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.

Discussions with CMR Faculty Associates, Faculty, and Staff will be conducted and plans are being made to launch a search for a Center Director during the coming 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 Associate Dr. Ambareen Siraj was awarded approval by National Security Agency (NSA) and Department of Homeland Security (DHS) of her submission for Tennessee Tech University to be designated as a National Center of Academic Excellence in Cyber Defense Education (CAE-CD) through AY 2021.

Faculty Associates Dr. Ambareen Siraj, Dr. Mohammad Rahman, and Dr. Doug Talbert were awarded a nearly $4 million grant from the National Science Foundation (NSF) to establish the Tennessee CyberCorps: Scholarship for Service Prog(in production)ram. To date, this is the largest grant ever received by the CMR and one of the largest grants for TTU, while making TTU one of the highly visible cyber defense education programs in the country.

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.

Faculty Associate, Dr. Mohamed Mahmoud, received funding of $360,000 from NSF for a 3-year grant, entitled "REU Secure and Privacy Preserving Cyber Physical Systems. Also serving as Co-PI is Faculty Associate, Dr. Syed Rafay Hasan.

Dr. Mahmoud with REU Interns at the final research symposium – Summer 2016

CMR Faculty Associate Director Dr. Stephen Canfield was awarded an Innovation Corps Sites Training Grant of almost $300,000 for a three-year period to establish TTU as a training site. Serving as Co-PI's on this Grant with Dr. Canfield will be Drs. Ismail Fidan, Sally Pardue, and Curtis Armstrong. This I-Corps program was designed to ease the transition of technological developments to the marketplace and train researchers to evaluate their discoveries for commercial potential.

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 $134,321 to host for the second consecutive year a Research Experiences for Undergraduate (REU) Site – Manufacturing and Techno-Entrepreneurship at TTU this summer from June 6, to August 12, 2016. This REU Program will focus on manufacturing-related research and provide techno-entrepreneurship experiences for a total of nine interns from seven different universities.

Dr. Vahid Motevalli and REU Interns at the final research symposium – Summer 2016.

Faculty Associate, Dr. Ambareen Siraj organized the Third Annual Women in Cybersecurity Conference (WiCyS) in Dallas, TX. This conference, first established by Dr. Siraj under a grant from the National Science Foundation in 2014, attracted over 800 registered participants. A supplement of $50,000 was received from NSF to help organize this year's conference along with Program Income of approximately $320,000, which was generated by over 50 external sponsors of the Conference. Associate Dean Motevalli officially opened the conference on behalf of Tennessee Tech University.

Third Annual Women in CyberSecurity Conference, March 31-April 2, 2016, Dallas, Texas

Seven CAPSTONE grants funded for a total of $78,000 during the AY from ORNL, TVA, AEDC, and UT/CIS. These grants 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) was established in the CMR in 2006 with funding from the U.S. Department of Energy. 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 ten years, over 180 assessments have been conducted at no cost to the requesting companies, with total implemented savings of $6.7 million. One hundred and thirty-nine students have participated in the IAC with 40 receiving DOE certification in the program.

Dr. Ehsan Languri (CMR Faculty Associate, ME Assistant Professor and Associate Director of the IAC), Marco Gonzalez, and Anthony Taylor conduct an energy assessment at an automotive components manufacturer.

FY 2015 – 2016 IAC Highlights

Dr. Ehsan Languri, Associate Director of IAC, and two students became **certified as a DOE AIRMaster+ Qualified Specialists**. Anthony Taylor (ME – MS) became certified as a DOE FSAT Qualified Specialist.

Workshops on compressed air efficiencies and fan system efficiencies were taught by Dr. Glenn Cunningham, Director of the IAC, across the state. About 100 industry end-users and stakeholders participated. These workshops were funded through a partnership between area electric distributors, TVA, and DOE.

The IAC entered into **a formal collaboration between the Tennessee Valley Authority (TVA), the University of Alabama IAC, and the University of Kentucky IAC** to facilitate the involvement of electric power distributors and TVA representatives in industrial energy assessments.

The IAC entered into **partnership with Tennessee's Office of Energy Programs** to jointly assess water and wastewater opportunities for energy reduction.

Anthony Taylor, a MS student in Mechanical Engineering, **submitted an invention disclosure** resulting from his thesis research on developing a novel compressed air flow meter.

IAC Students Ian Swagerty (ME – MS), Anthony Taylor (ME – MS), and Melissa Moffet (CEE – undergraduate) were the **winners of the national IAC Video Submission contest**. Students at 24 IAC Centers were invited to contribute a short video on an aspect of assessing energy efficiency. There were 15 submissions and our IAC Center was chosen as one of three winners. Their topic was Safe Methods of Taking Power Readings on Electric Panels.

Four students participated in **summer internships with manufacturers** such as Nissan and Schneider Electric. The students planned and conducted projects related to industrial energy efficiency improvements.

Other Center Activities

Dr. John Zhu, CMR Faculty Associate, implemented the following curriculum changes into Mechanical Engineering courses: Life-related examples and applications of "Advanced Materials" were added into ME 3010 to increase the students' interest in course topics. Course materials for ME 4460/5460 were modified to make them more suitable for ME students.

Dr. Ying Zhang, CMR Faculty Associate, expanded "Additive Manufacturing" (particularly 3D printing of metal parts) into ME3010 and ME3110 to help students understand the manufacturing process.

Center faculty, **Dr. Robert Qiu** and faculty associate **Dr. Adam Anderson** continue to support the onsite Ph.D. program at the Oak Ridge National Laboratory.

CMR Faculty Associate **Dr. Stephen Canfield** maintained the EIME Program while engaging 70+ students and delivering 12 assistive devices to children with special needs in the State of Tennessee in 2015.

Seminar Presentations

Golden Eagle Additively Innovative Virtual Lecture Series

Additive Manufacturing Today and in the Future – Terry Wohlers, Wohlers Associates

History of Additive Manufacturing – David Bourell, Temple Foundation, University of Texas at Austin

To 3-D Print or Not to 3-D Print – Jennifer Loy, Griffith University, Australia

Perspectives on Additive Manufacturing – Ed Tackett, University of Louisville

Additive Manufacturing as a Driver for Innovation – Ian Campbell, Loughborough University, United Kingdom

AM/3DP: Point-Counterpoint – Tim Shinbara, Association for Manufacturing Technology

Biomaterials and Tissue Engineering Bioengineers' Fantasy, Dilemma, and Bioprinting – Peter Yang, Stanford University

A Quick Tour of Manufacturing Demonstration Facility (MDF) and Opportunities in Additive Manufacturing – Amy Elliott, Oak Ridge National Laboratory

Additive Manufacturing at the University of Waterloo – Ehsan Toyserkani, University of Waterloo, Canada

3-D Printing – Future of Manufacturing. The Fourth Wave of Human Civilization – Wenchao Zhou, University of Arkansas

National Resource Center for Materials Technology Education (MatEd) – Mel Cossette and Robin Ballard, Edmonds Community College

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

3-D Printed Properties of Interfaces in Fatigue, Faculty Mentor – Holly Stretz, Ph.D.
Haley Finegan – University of Virginia
Oliver Kisielius – University of Connecticut
Marsalis Pullen – Tennessee Tech University

Printing Multiphase Material Products for Novel Sensors, Actuators, and Mechanical Joints in Robotics Systems, Faculty Mentor – Stephen Canfield, Ph.D.
Jonathan Bown – Florida International University
Amalia Pena – Lone Star College and San Jacinto College
Ryan Seal – Lipscomb University

3-D Printed Joints and Connectors for Assemblies, Faculty Mentor – Ismail Fidan, Ph.D.
Joe Caston – Western Illinois University
Jacob Floyd – Tennessee Tech University
Nicholas Russell – Tennessee Tech University

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

Optimal Deployment of Charging Stations for Electric Vehicles: A Formal Approach, Brian Ledbetter – Tennessee Tech University

Securing and Privacy Preserving the Communications for Dynamic Charging of Electric Vehicles, Briana Ausby – Indiana University / Purdue University Indianapolis

Graph Based Anomaly Detection in Smart Grids, Christopher Dean – University of Tennessee

Efficient LTE Handover Schemes, Bethany Hinman – Northeastern State University

Formal Verification of Ladder Logic Programs Using NuSMV, Samuel Kottler- Colorado College

Detection of Hardware Trojans in the Advanced Encryption Standard, Austin Mitchell – Mississippi State University

Privacy-Preserving Ride Sharing Scheme for Autonomous Vehicles Using Public Key System, Jacob Moran – Tennessee Tech University

Implementing the Internet of Things on 3-D Printers, Cyd Marie Rivera Rodriguez – University of Puerto Rico in Mayaguez

Artificial Neural Network Prediction of Advanced Encryption Standard Key Values, Kameron Wells – Knox College

CMR Student Lightning Round Seminar Series

December 1, 2015

New Trends in Induction Machine Drive, Sima Aznavi, ME

Online Diagnostics of Energy Storage Devices, Chris Ibe Ekeocha, ECE

Modeling Strong Base Anion Exchange for Molecular Imprinted Polymer, Clinton McCullough, ChE

A Unified Scheme for Analysis of Kinematic and Tolerance for Linkage Mechanisms, Kuan-Lun Hsu, ME

Non-Intrusive Compressed Air Flow Measurement, Anthony Taylor, ME

December 3, 2015

Production of Monodisperse Nano-Particles with High Throughput Using Fiber Reactor for Medicinal Use, Sumit Jamkindikar, ChE

Steam Generation by Solar Heat Using Porous Media, Hamidreza Ghasemi Bahraseman, ME

Micro- and Nano-Thermal Management, Houman Bbazadehrokni, ME

March 28, 2016

Microsecond State Detection Using Electromechanical Impedance, Ryan Kettle, ME

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

Security and Privacy Preservation Schemes in Smart Cities, Khaled Rabieh, ECE

Bringing Mobile Robots into Shipyard Manufacturing, Jin Chew, ME

April 11, 2016

Mathematical Modeling of Electrohydrodynamic Flow in Tumor Cells for Tumor Treating Fields (Ttf) Therapy, Leora Loftis, ChE

Production of Mono-Disperse Lithium Carbonate Nano-Particles Using Chemtor Fiber Reactor and Achieve High Throughput, Sashanka Tallapudi, ChE

An Investigation of Natural Gas Fireplace Heat Exchangers, Ian Swagerty, ME

Fostering Innovation through the Development of the iMakerspace, Scott Hill, ME

Dynamic Modeling and Experimental Analysis of an Induced Draft Cooling Tower, Pallavi Patil, ME

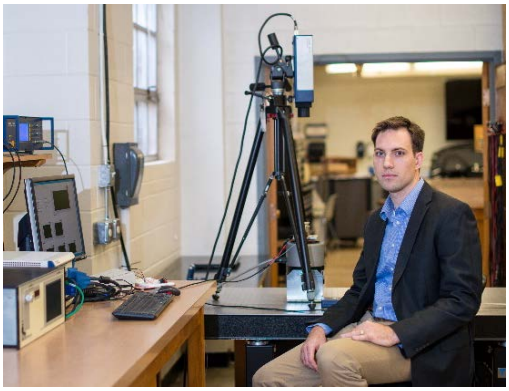
Visiting Scholars

The following visiting international researchers participated as members of Dr. Robert Qiu's Wireless Communications/Networking Systems Research Group in 2015-2016 to pursue research in Big Data Using Large Random Matrices Theory and Signal Processing.

- Dr. Guangrong Yue
- Dr. Mei Dong
- Ms. Qing Feng
- Dr. Guohong Liu

Faculty, Staff and Student Accomplishments and Awards

Faculty Associate, **Dr. Adam Anderson** received 1st place in Rounds 1 and 2 of the Virginia Tech SHARC (Cognitive Radio Competition) in January and March, 2016.



Faculty Associate, **Dr. Steven Anton**, received the Young Investigator Award from the Air Force Office of Scientific Research in January 2016. Anton will be representing TTU among 41 other research institutions and small businesses.
(http://www.wpafb.af.mil/News/Article-Display/Article/818455/the-air-force-office-of-scientific-research-awards-grants-to-59-scientists-and)
https://www.tntech.edu/news/releases/ttu-professor-receives-young-investigator-award

Faculty Associate, **Dr. Joe Biernacki**, received two outstanding teaching honors during the past year: TTU Department of Chemical Engineering 2016 Outstanding Teacher Award and TTU 2016 Outstanding Honors Faculty Award.

Faculty Associate, **Dr. Joe Biernacki**, has received recognition on the American Ceramic Society's website for leading a workshop on 3-D printing of cement-based materials.

Graduate Student, **Bo Bonning** (advised by Faculty Associate, Dr. Pezhman Shirvanian,) was offered the Distinguished Scholar Program (ORAU/ORNL).

CMR Faculty Associate Director **Dr. Stephen Canfield** was selected as the Faculty Advisor Winner in August 2015 for the ASME IAM3D (International Additive Manufacturing 3D Challenge). Canfield's team of three TTU students was named as a finalist in the competition. Their design featured an anthropomorphic robotic hand which won best innovative design.

The Industrial Assessment Center (IAC), funded by the DoE Manufacturing Division to reduce energy use by manufacturing facilities, has been thriving under the leadership of Faculty Associate, **Dr. Glenn Cunningham,** and he is currently competing for the next 5-year grant. IAC Students, **Ian Swagerty** (ME – MS), **Anthony Taylor** (ME – MS), and **Melissa Moffet** (CEE – undergraduate) were the winners of the national IAC Video Submission contest. Students at 24 IAC Centers were invited to contribute a short video on an aspect of assessing energy efficiency. There were 15

submissions and our IAC Center was chosen as one of three winners. Their topic was Safe Methods of Taking Power Readings on Electric Panels. This short video can be seen on the IAC's Facebook page. https://www.facebook.com/TnTechIAC/videos

Faculty Associate, **Dr. Ismail Fidan**, was recognized as a Distinguished Faculty Advisor by the Society of Manufacturing Engineers. Fidan was one of three professors to receive the award this year.

Faculty Associate, **Dr. Wayne Johnson,** was the recipient of the 2015 International Microelectronics Assembly and Packaging Society Lifetime Achievement Award for "exceptional, visible and sustained impact on the microelectronics packaging industry."

Lenin Mookiah, a Ph.D. student, won in the Computer Science Division for his poster presentation at the 2016 Research and Creative Activities Day.

CMR Interim Director and Associate Dean for Research and Innovation, **Dr. Vahid Motevalli,** was Invited to **the White House Forum** on Connecting Regional Innovation Ecosystems with Federal Labs, November 3, 2015, as the sole representative of Tennessee Tech University.

Dr. Vahid Motevalli was reappointed to the National Academies TRB Committee AV090 – Aviation Security and Emergency Preparedness for the 3rd consecutive term (April 2016-19), first term (April 2010-2013).

Mohsen Safaei Mohammadabadi, a Ph.D. student, won in the Mechanical Engineering Division for his poster presentation at the 2016 Research and Creative Activities Day.

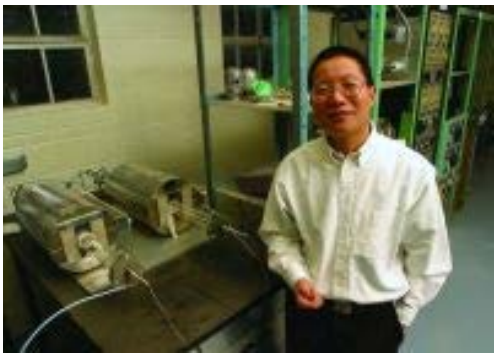
Mohsen Safaei Mohammadabadi, a Ph.D. student in the Dynamics and Smart Systems Laboratory, received the Best Poster Award for graduate research in Mechanical Engineering at the 2016 TTU Research and Creative Activities Day. Mohsen presented a poster entitled "Energy Harvesting and Load Sensing by Piezoelectric Transducer in Total Knee Arthroplasty."

Mohsen Safaei Mohammadabadi, a Ph.D. student in the Dynamics and Smart Systems Laboratory, received an Eminence Award from the College of Engineering for Doctor of Philosophy Best Paper for his paper entitled "The Effects of Dimensional Parameters on Sensing and Energy Harvesting of an Embedded PZT in a Total Knee Replacement." The paper was presented at the 2016 SPIE Smart Structures and NDE Conference in Las Vegas, NV in March, 2016.

Zach Seibers, (collaborative Ph.D. researcher at UTK and former Chemical Engineering undergraduate research student advised by Faculty Associate Dr. Holly Stretz), won the state-wide presentation competition at "TN-SCORE Celebrates 5 years of statewide collaboration in energy research".

Ph.D. Mechanical Engineering Graduate Student, **Jason Witman**, received the 2016 Leighton E. Sissom Innovation and Creativity Award from the College of Engineering.

Faculty Associate, **Dr. Jiahong (John) Zhu**, received this year's Centennial Scholar-Mentor Award from the University.



Publications[1]

Robert Qiu

Journal Publications

1. C. Zhang and R. C. Qiu, “Massive MIMO as a big data system: Random Matrix Models and Testbed,” *IEEE Access,* Vol. 3, pp. 837-851, May 2015.
2. X. He, Q. Ai, R. C. Qiu, W. Huang, and L. Piao, “A Big Data Architecture Design for Smart Grids Based on Random Matrix Theory,” *IEEE Transactions on Smart Grid,* DOI: 10.1109/TSG.2015.2445828, July 10, 2015.
3. X. Xu, X. He, Q. Ai, and R. C. Qiu, “A Correlation Analysis Method for Power Systems Based on Random Matrix Theory,” *IEEE Trans. Smart Grid,* DOI: 10.1109/TSG.2015.2508506, December 29, 2015.

Cynthia Rice

Journal Publications

1. Refereed Archival Publications

1. Atkinson, R.W., S. St. John, O. Dyck, K.A. Unocic, R.R. Unocic, C.S. Burke, J.W. Cisco, C.A. Rice, T.A. Zawodzinski, Jr., and A.B. Papandrew, 'Supportless, Bismuth-Modified Palladium Nanotubes with Improved Activity and Stability for Formic Acid Oxidation', ACS Catal., July 22, 2015, 5, 5154.
2. Urchaga, P., T. Kadyk, S.G. Rinaldo, A.O. Pistono, J. Hu, W. Lee, C. Richards, M.H. Eikerling, and C.A. Rice, 'Catalyst Degradation in Fuel Cell Electrodes: Accelerated Stress Tests and Model-based Analysis', Electrochimica Acta, April 2015, 176, 1500.

Technical Presentations

Electrochemical Society – Phoenix, AZ, Oct. 2015

1. C.A. Rice, P. Urchaga, J. Hu, T. Kadyk, M. Eikerling, ‘Accelerated Stress Tests on Fuel Cell Cathode Catalysts: A Material Balance Approach Combining Modeling and Experiment,’ Oral.

Kwun-Lon Ting

Journal Publications

1. Jun Wang[1], Kwun-Lon Ting and Daxing Zhao, “Equivalent Linkages and Dead Center Positions of Planar Single-Degree-of-Freedom Complex Linkages,” *J. Mechanisms Robotics* 7(4), 044501 (Nov 01, 2015) (6 pages)

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

2. B. Yu, and K. L. Ting, “Compensated Conjugation And Gear Tooth Design and Modification,” J. of Mechanical Design, (in press). http://mechanicaldesign.asmedigitalcollection.asme.org/article.aspx?articleid=2478745

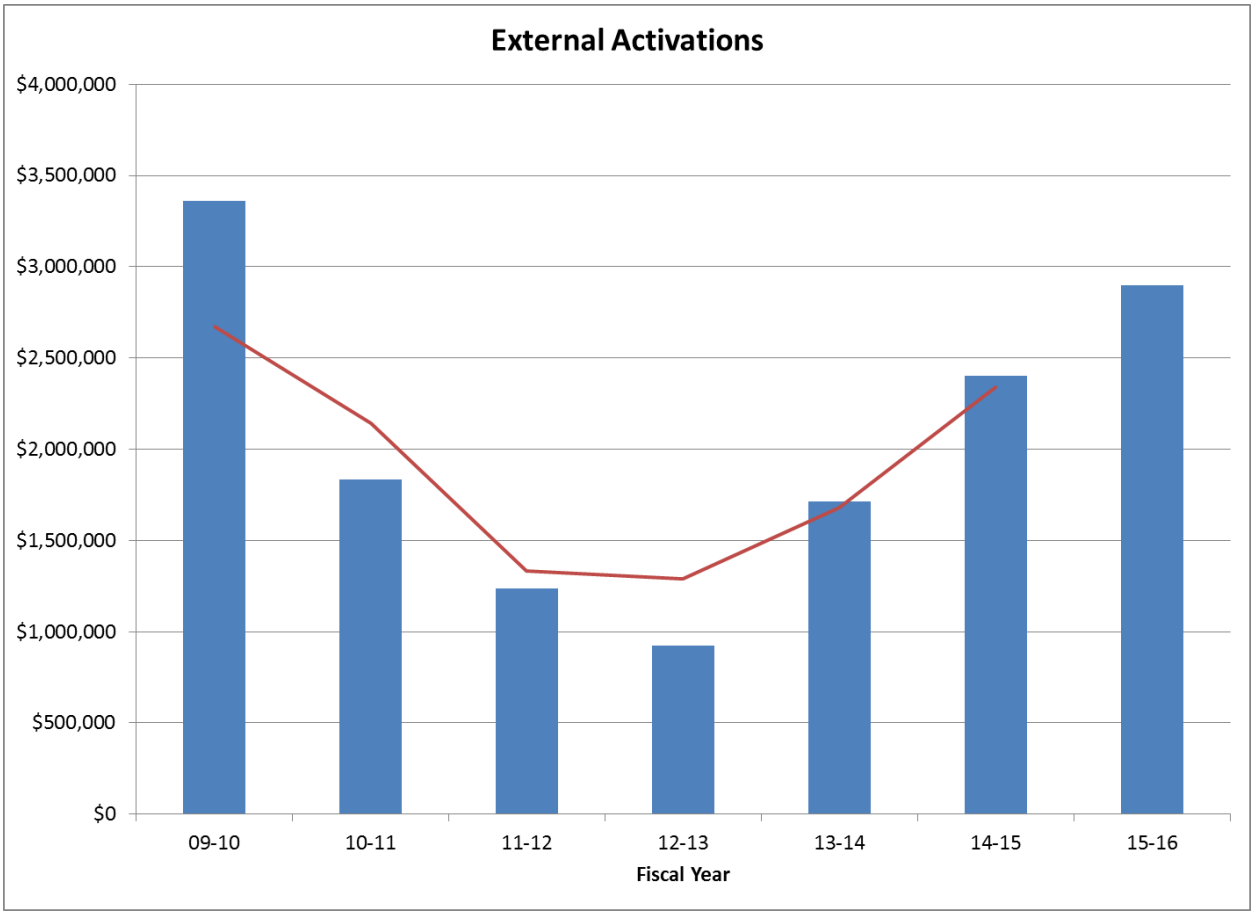
Conference Publications

1. Zetao Yu, Kwun-Lon Ting, Kuan-Lun Hsu, Jun Wang, and Wesley Waggoner, Uncertainty of Coupler Point Position of Slider Crank Mechanisms, Proceedings of ASME 2015 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference.
2. Kwun-Lon Ting, Kuan-Lun Hsu, Zetao Yu, and Jun Wang, Output position Uncertainty of Linkages with Prismatic Joints, 2015 IFToMM World Congress.
3. J. Ren[1], Jun Wang[1], Kwun-Lon Ting[2],Q. Wang[1], Q. Wei[1], J. Sun[1,] “Calibration of measured FRFs based on mass identification method,” Proceedings of ASME 2015 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference.

Invited Seminars

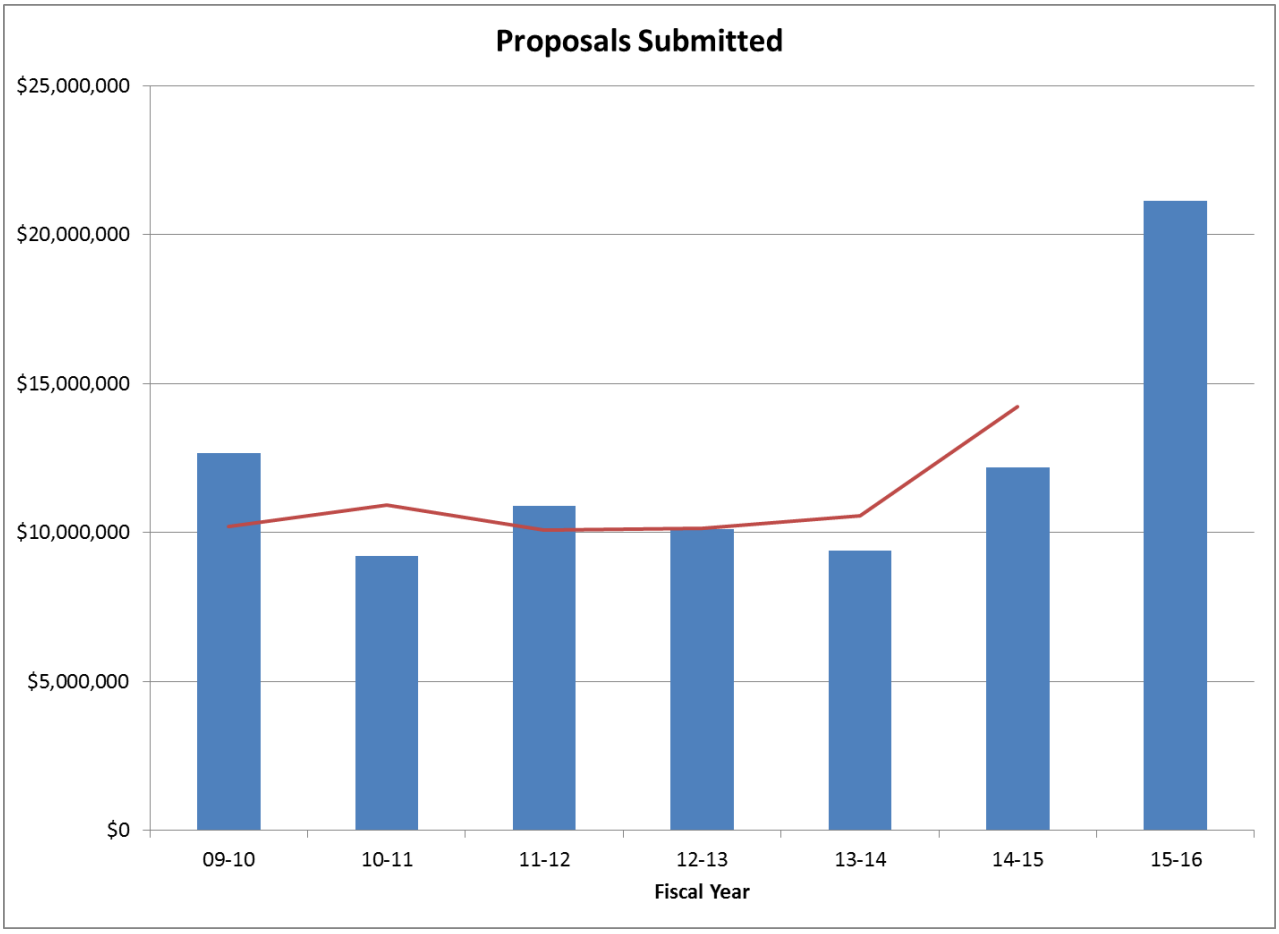
1. “Ting’s Rotatability Laws of N-bar Chains”, Invited speaker, Graduate and Faculty Seminar, National Tsing-Hua University, Hsin-Chu, Taiwan, October 2015
2. Harmonic Drives, Invited speaker, Graduate and Faculty Seminar, Hubei University of Science and Technology, Wehan, China, June 2015

External Activations



FY	09-10	10-11	11-12	12-13	13-14	14-15	15-16
3 Year Moving Avg.	$2,671,969	$2,142,862	$1,331,496	$1,291,253	$1,680,204	$2,337,047	
External Activations	$3,359,888	$1,831,872	$1,236,826	$925,789	$1,711,145	$2,403,677	$2,896,320

Proposals Submitted



FY	09-10	10-11	11-12	12-13	13-14	14-15	15-16
3 Year Moving Avg.	$10,200,289	$10,927,246	$10,072,301	$10,130,421	$10,558,412	$14,227,931	
Proposals Submitted	$12,673,820	$9,212,641	$10,895,277	$10,108,985	$9,387,001	$12,179,250	$21,117,542

Grants and Contract Awards

Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
1 CMR Testing and Design - FY2015-2016 Various Industries Account #: 5-38585	Vahid Motevalli	$47,934	7/1/2015	6/30/2016	$55,387
2 UT-CIS 2015-16 University of Tennessee Center for Industrial Services Account #: 5-33512	Meenkashi Sundaram	$20,000	7/1/2015	6/30/2016	$0
3 UT-CIS 2015-16 Capstone University of Tennessee Center for Industrial Services Account #: 5-33513	Meenkashi Sundaram	$15,000	7/1/2015	6/30/2016	$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 - Award DE-EE0005533 - Mod. #11 Account #: 5-32290	Glenn Cunningham	$210,000	9/30/2014	9/30/2016	$210,000
5 Public-Private Partnership for a Comprehensive Workforce Development Plan to Stimulate Industrial Energy Efficiency and Demand Reduction U.S. Department of Energy- Award DE-EE0005533 - Modification #12 Account #: 5-32290	Glenn Cunningham	$50,000	9/30/2015	9/30/2016	$50,000
6 Program Income - Fiscal Year 2015-16 - on NSF WiCyS Conference - TTU Index 5-31273 Various Individuals, Educational Institutions, and Companies Account #: 5-31274	Ambareen Siraj	$319,896	7/1/2015	6/30/2016	$201,750

	Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
7	Supplement to: Capacity Building in Cybersecurity Broadening Participation of Women in Cybersecurity through Women in Cybersecurity Conference and Professional Development National Science Foundation - Award DUE-130441 Supplement Account #: 5-31273	Ambareen Siraj	$50,000	8/11/2015	7/31/2016	$50,000
8	III: Small: Collaborative Research: Anomaly Detection in Graph Streams National Science Foundation - Award IIS-1318957 - Year 3 of 3 Account #: 5-31271	William Eberle	$70,821	9/15/2015	9/14/2016	$62,000
9	Collaborative Research: A Multi-Scale Environmental and Kinetics Study on the Pyrolysis of Sustainable Biomass Feedstock National Science Foundation - Award CBET-1337033 - Year 3 of 3 Account #: 5-31222	Joseph Biernacki Scott Northrup	$121,874	9/1/2015	8/31/2016	$110,000
10	Supplement to: Collaborative Research: A Multi-Scale Environmental and Kinetics Study on the Pyrolysis of Sustainable Biomass Feedstock National Science Foundation - Award CBET-1337033 Account #: 5-31222	Joseph Biernacki Scott Northrup	$6,000	9/1/2013	8/31/2016	$6,000
11	Stephen Scott JFA FY2014-2015 - Summer 2015 Oak Ridge National Laboratory - Subcontract 4000102091 - Modification 10 Account #: 5-39305	Doug Talbert	$4,718	5/11/2015	9/30/2015	$4,718
12	Development of Marinized Pt-Modified MCrAlX Coatings with Improved Hot Corrosion and Oxidation Resistance Synthesized via a Low-Cost Electrodeposition Process Office of Naval Research - Award N0014-14-1-0341 - Modification #3 Account #: 5-32367	Ying Zhang	$250,000	3/25/2015	9/30/2016	$183,260

	Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
13	Development of Marinized Pt-Modified MCrAlX Coatings with Improved Hot Corrosion and Oxidation Resistance Synthesized via a Low-Cost Electrodeposition Process Office of Naval Research - Award: N0014-14-1-0341, Modification #4 Account #: 5-32367	Ying Zhang	$140,000	3/25/2016	9/30/2017	$140,000
14	GOALI: Environmentally-Assisted Reactive Sintering of Conductive Spinel Layers for Solid Oxide Fuel Cell Application National Science Foundation - Year 2 of 3 - Award CMMI-1362680 Account #: 5-31203	Jiahong Zhu	$129,425	8/15/2015	8/14/2016	$129,425
15	REU Supplement to: 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	$5,000	12/17/2015	12/8/2016	$5,000
16	REU Site –Summer Research Internships in Manufacturing and Techno-Entrepreneurship Preparation National Science Foundation - Award 1461179 - Year 2 of 3 Account #: 531232	Joseph Rencis Vahid Motevalli	$124,321	3/15/2016	3/14/2017	$117.155
17	RET Supplement to REU Site - Summer Research Internships in Manufacturing and Techno-Entrepreneurship Preparation - Award 1461179 National Science Foundation Account #: 5-31232	Joseph Rencis Vahid Motevalli	$10,000	3/15/2016	3/14/2017	$10,000
18	Advancement of Cryogenic Electronics MIT Lincoln Labs - Modification #3 PO 700293007 Account #: 5-39376	Wayne Johnson Satish Mahajan	$100,000	11/1/2015	10/31/2016	$100,000

	Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
19	Development of Low-Cost, Highly-Sinterable, Co-Free (NiFe2) o4 Spinel-Based Contact Materials for SOFC Cathode-Side Contact Application US Department of Energy - Award DE-FE26210 - Year 1 of 2 Account #: 5-32288	Jiahong Zhu	$102,307	10/1/2015	9/30/2016	$102,307
20	Idea to Commercially - Viable Heathcare Solutions: Enhancement and Expansion of Clinical Immersion at Disciplinary Interfaces Course Venturewell Account #: 5-35235	Robby Sanders Melissa Geist	$11,499	8/1/2015	7/31/2016	$ 6,000
21	Improving Interfacial Strength of 3-D Printed ABS Weld Lines: Compatibilitzed "Stripe" Deposition Oak Ridge National Laboratory - Subcontract 4000145173 Account #: 5-39364	Holly Stretz	$99,336	2/15/2016	2/14/2017	$99,336
22	TTU - NSF Innovation Corps Sites National Science Foundation - Award 1548009 - Year 1 of 3 Account #: 5-31286	Stephen Canfield Sally Pardue	$99,956	1/1/2016	12/31/2016	$99,956
23	iPDC: Integrating Parallel and Distributed Computing in Introductory Programming National Science Foundation - Award 1549812 Account #: 5-31260	Sheikh Ghafoor Michael Rogers	$49,973	9/1/2015	8/31/2016	$49,973
24	Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques Oak Ridge National Laboratory - Subcontract 4000140763 Account #: 5-39363	Adam Anderson	$31,809	8/6/2015	12/31/2015	$31,809

	Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
25	Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques Oak Ridge National Laboratory - Modification #1 Subcontract 4000140763 Account #: 5-39363	Adam Anderson	$9,900	8/6/2015	12/31/2015	$9,900
26	Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques - Spring 2016 - Tasks 1, 2 & 3 Oak Ridge National Laboratory- Modification #2 Subcontract 4000140763 Account #: 5-39363	Adam Anderson	$59,345	1/1/2016	5/31/2016	$59,345
27	REU Site: Secure and Privacy-Preserving Cyber Physical Systems National Science Foundation - Award 1560434 - Year 1 of 3 Account #: 5-31263	Mohamed Mahmoud Syed Hasan	$119,034	3/1/2016	2/28/2017	$111,000
28	Design and Development of a Digital Frequency Counter Aerospace Testing Alliance - Arnold Engineering Development Center Account #: 5-32377	Ali Alouani	$12,000	8/15/2015	12/31/2015	$12,000
29	Profinet to Profinet Encryption Dongle - CAPSTONE Project Aerospace Testing Alliance, Arnold Engineering Development Center Account #: 5-32376	Ali Alouani	$12,000	8/17/2015	5/31/2016	$12,000
30	Pacific Instrumentation Data Acquisition Scanner Emulator (PIDASE) Aerospace Testing Alliance, Arnold Engineering Development Center Account #: 5-32378	Ali Alouani	$12,000	8/17/2016	12/31/2016	$12,000
31	Automated Module for Emulation of Load Serving Capacity Tennessee Valley Authority	Ali Alouani	$5,000	9/19/2015	5/31/2016	$5,000

Project/Source/Account Number	Principal Investigators	Amount	Beginning	Ending	Estimated - 12 months
Account #: 5-32812					
32 Collaborative Research: Edge Surface Topography Characterization for Precision Sensing Technology National Science Foundation - Year 1 of 2 - Award 1564254 Account #: 531261	ChaBum Lee	$116,138	8/15/2015	8/31/2016	$100,000
33 Tennessee Cybercorps: A Hybrid Program in Cybersecurity National Science Foundation - Award 1565562 - Year 1 of 5 Account #: 5-31279	Ambareen Siraj Mohammad Rahman	$399,034	1/1/2016	12/31/2016	$399,034
34 Reflective Memory to Ethernet Interface Card Design & Development Aerospace Testing Alliance, Arnold Engineering Development Center Account #: 5-32381	Ali Alouani	$12,000	1/15/2016	12/31/2016	$12,000
35 Enabling Microsecond Condition Monitoring for Real-Time Assessment of Critical Infrastructure Vibration Institute Account #: 5-35222	Steven Anton	$10,000	1/15/2016	5/14/2017	$10,000
36 Fabricate Aluminizing Ni-based 31V Alloy - Subcontract 400146841 - Allocation #1 Oak Ridge National Laboratory Account #: 5-39358	Ying Zhang	$10,000	5/2/2016	12/31/2016	$10,000
37 Power into Motion- Proposed Automotive Powertrain Program at Tennessee Tech DENSO North America Foundation Account #: 5-36812	Joseph Rencis	$50,000	6/17/2016	6/16/2017	$50,000
		$2,896,320			**$2,641,355**

Schedule 7

CENTERS OF EXCELLENCE
ACTUAL, PROPOSED, AND REQUESTED BUDGET

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

	FY 2015-16 Actual			FY 2016-17 Proposed			FY 2017-18 Requested		
	Matching	Appropr.	Total	Matching	Appropr.	Total	Matching	Appropr.	Total
Expenditures									
Salaries									
Faculty	397,791	372,301	**770,092**	400,000	505,954	**905,954**	450,000	506,000	**956,000**
Other Professional	52,166	377,496	**429,662**	40,000	386,117	**426,117**	40,000	390,500	**430,500**
Clerical/ Supporting	0	38,093	**38,093**	0	56,903	**56,903**	0	39,100	**39,100**
Assistantships	176,650	199,410	**376,060**	200,000	219,000	**419,000**	225,000	220,000	**445,000**
Hourly Students	63,724	49,200	**112,924**	50,000	31,250	**81,250**	50,000	10,000	**60,000**
Total Salaries	**690,331**	**1,036,500**	**1,726,831**	**690,000**	**1,199,224**	**1,889,224**	**765,000**	**1,165,600**	**1,930,600**
Fringe Benefits	240,832	429,145	**669,977**	230,000	361,736	**591,736**	260,000	360,000	**620,000**
Total Personnel	**931,163**	**1,465,645**	**2,396,808**	**920,000**	**1,560,960**	**2,480,960**	**1,025,000**	**1,525,600**	**2,550,600**
Non-Personnel	**NOTE: Appropriations Expenditures in Fringe Benefits include $144,896 for Graduate Student Fees for FY 2015-16.**								
Travel	81,961	30,286	**112,247**	85,000	23,055	**108,055**	85,000	12,000	**97,000**
Software	0	455	**455**	0	0	**0**	0	0	**0**
Books & Journals	0	0	**0**	0	0	**0**	0	0	**0**
Other Supplies	554,396	27,259	**581,655**	175,000	20,599	**195,599**	175,000	10,000	**185,000**
Equipment	181,480	0	**181,480**	300,000	0	**300,000**	325,000	0	**325,000**
Maintenance	0	14,152	**14,152**	0	0	**0**	0	0	**0**
Scholarships	0	0	**0**	0	0	**0**	0	0	**0**
Consultants/Subcontracts	205,288	0	**205,288**	120,000	0	**120,000**	140,000	0	**140,000**
Renovation	0	0	**0**	0	0	**0**	0	0	**0**
Seminars/Workshops/Conf	541,653	0	**541,653**	225,757	0	**225,757**	250,000	0	**250,000**
Total Non-Personnel	**1,564,778**	**72,152**	**1,636,930**	**905,757**	**43,654**	**949,411**	**975,000**	**22,000**	**997,000**
GRAND TOTAL	**2,495,941**	**1,537,797**	**4,033,738**	**1,825,757**	**1,604,614**	**3,430,371**	**2,000,000**	**1,547,600**	**3,547,600**
Revenue	**NOTE: Actual Matching Funds do not include Indirect Costs of $461,686 for FY 2015-2016.**								
New State Appropriation	0	1,476,800	**1,476,800**	0	1,453,100	**1,453,100**	0	1,547,600	**1,547,600**
Carryover State Appropriation	0	212,511	**212,511**	0	151,514	**151,514**	0	0	**0**
New Matching Funds	2,465,442	0	**2,465,442**	1,750,000	0	**1,750,000**	2,000,000	0	**2,000,000**
Carryover from Previous Matching Funds	106,256	0	**106,256**	75,757	0	**75,757**	0	0	**0**
Total Revenue	**2,571,698**	**1,689,311**	**4,261,009**	**1,825,757**	**1,604,614**	**3,430,371**	**2,000,000**	**1,547,600**	**3,547,600**

NOTE: Carryover appropriation funds of $151,514 are designated for new faculty recruitment commitments.

FY 2017 – 2018 Budget Request and Justification

The CMR is requesting a **6.5%** increase in the FY 2017-18 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 are planned for FY 2016-17, which could result 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 will result in a separate increase of $7,500 in total expenses.

The above paragraph simply provides a snapshot of increased expenses for the CMR in salaries and benefits. During this same period, there has been an annual decrease in appropriated funds for the CMR. This has resulted in a significant erosion of the Center's ability to invest in research that would move the center forward. Despite this erosion, 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

Brita Anderson
"Enhancing Nerve Tissue Regeneration: Optimizing Growth Factors and Extracellular Matrix Proteins with Dimensionally-Specific Culture Parameters"
Fall 2015
Advisor: Dr. Jeffrey Rice
Chemical Engineering

Seth Latture
"The Development and Optimization of a 3D Printed Device for the in Vitro Culture of Cells and Potential Drug Screening"
Summer 2015
Advisor: Dr. Jeffrey Rice
Chemical Engineering

Jonathan Miller
"Electrochemical Performance and Cycle Life of Selected Carbon-Based and Carbon-Free Air Cathodes"
Fall 2015
Advisor: Dr. Jiahong Zhu
Mechanical Engineering

Clint McCullough
"Modeling Spherical Dicyanoargentate Imprinted Anion Exchange Resins"
Spring 2016
Advisor: Dr. Jennifer Pascal
Chemical Engineering

Ian Swagerty
"An Investigation of Natural Gas Fireplace Hear Extractors; Their Applications and Impact"
Spring 2016
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

Linzhu Zhang
"Characterization of NI-Craly and Nico-Craly Coatings Fabricated by Electrolytic Codeposition"
Fall 2015
Advisor: Dr. Ying Zhang
Mechanical Engineering

CMR Supported Graduate Student Degrees Awarded

Ph.D.

William Aderholdt
"Towards a Framework for Survivable Clouds"
Spring 2016
Advisor: Dr. Stephen Scott
Engineering

Antonio Pistono
"An Investigation of Fuel Cell Subzero Cold Start"
Fall 2015
Advisor: Dr. Cynthia Rice
Chemical Engineering

CMR Graduate Students Supported from State Appropriations

Masters

Surya Teja Gunukula
Advisor: Dr. Mohamed Mahmoud
Electrical & Computer Engineering

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

Patrick Kent
Advisor: Dr. Jeffrey Rice
Chemical Engineering

Seth Latture
Advisor: Dr. Jeffery Rice
Chemical Engineering

Leora Maxwell Loftis
Advisor: Dr. Jennifer Pascal
Chemical Engineering

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

Jonathan Miller
Advisor: Dr. Jiahong Zhu
Mechanical Engineering

Abdul Salam Mohamed
Advisor: Dr. Joe Biernacki
Chemical Engineering

Maheshwar Nunna
Advisor: Dr. Ehsan Languri
Mechanical Engineering

Ph.D.

Michael Adenson
Advisor: Dr. Joe Biernacki
Chemical Engineering

Sima Aznavi
Advisor: Dr. Hicham Chaoui
Electrical & Computer Engineering

Houman Babazadehrokni
Advisor: Dr. Ehsan Languri
Mechanical Engineering

Bo Bonning
Advisor: Dr. Pezhman Shirvanian
Mechanical Engineering

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

Ryan Kettle
Advisor: Dr. Steven Anton
Mechanical Engineering

Clint McCullough
Advisor: Dr. Jennifer Pascal
Chemical Engineering

Koteswara Medidhi
Advisor: Dr. Jennifer Pascal
Chemical Engineering

Gholamreza Mirshekari
Advisor: Dr. Pezhman Shirvanian
Mechanical Engineering

Mohsen Safaei Mohammadabadi
Advisor: Dr. Steve Anton
Mechanical Engineering

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

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

Paige Spencer
Advisor: Dr. Jeffrey Rice
Chemical Engineering

CMR Graduate Students Supported from External Funds

Masters

Brita Anderson
Advisor: Dr. Jeffrey Rice
Chemical Engineering

Christopher Blackburn
Advisor: Dr. Chris Wilson
Mechanical Engineering

Morgan Bocci
Advisor: Dr. Jeffrey Rice
Chemical Engineering

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

Tingke Fang
Advisor: Dr. Jiahong Zhu
Mechanical Engineering

Marco Gonzalez Rivas
Advisor: Dr. Glenn Cunningham
Electrical & Computer Engineering

Zachary Henderson
Advisor: Dr. Chris Wilson
Mechanical Engineering

Sumit Jamkhindikar
Advisor: Dr. Holly Stretz
Chemical Engineering

Seongkyul Jeon
Advisor: Dr. ChaBum Lee
Mechanical Engineering

Matthew Kelley
Advisor: Dr. Joe Biernacki
Chemical Engineering

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

Ph.D.

Bobby Adams
Advisor: Dr. Cynthia Rice
Chemical Engineering

William Aderholdt
Advisor: Dr. Stephen Scott
Computer Science

David Chesson
Advisor: Dr. Jiahong Zhu
Mechanical Engineering

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

Aaron Lane
Advisor: Dr. Chris Wilson
Mechanical Engineering

Bryan Materi
Advisor: Dr. Cynthia Rice
Chemical Engineering

Lenin Mookiah
Advisor: Dr. Bill Eberle
Computer Science

Behnaz Papari
Advisor: Dr. Adam Anderson
Electrical & Computer Engineering

Antonio (Tony) Pistono
Advisor: Dr. Cynthia Rice
Chemical Engineering

James Pogge
Advisor: Dr. Stephen Scott
Computer Science

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

Zachary Parchman
Advisor: Dr. Stephen Scott
Computer Science

Pallavi Pandit Patil
Advisor: Dr. Ehsan Languri
Mechanical Engineering

Jason Steward
Advisor: Dr. Ying Zhang
Mechanical Engineering

Ian Swagerty
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

Sashanka Tallapudi
Advisor: Dr. Holly Stretz
Chemical Engineering

Anthony Taylor
Advisor: Dr. Glenn Cunningham
Mechanical Engineering

Jason Whitman
Advisor: Dr. Ying Zhang
Mechanical Engineering

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

Zhiyuan Yu
Advisor: Dr. Kwun Ting
Mechanical Engineering

Yuitan Yu
Advisor: Dr. Jiahong Zhu
Mechanical Engineering

Ali Zolghadr
Advisor: Dr. Joe Biernacki
Chemical Engineering

External Funding – Proposals Submitted

	Status	Title	PI's	Department	Total Funds
1	100MC-13	CMR Testing and Design - FY2015-2016	Motevalli	CMR	$47,934
	5-38585	Various Industries			
2	189MC-15	UT-CIS 2015-16	Sundaram	ME	$20,000
	23(15-16) 5-33512	University of Tennessee Center for Industrial Services			
3	189-SD2	UT-CIS 2015-16 Capstone	Sundaram	ME	$15,000
	24(15-16) 5-33513	University of Tennessee Center for Industrial Services			
4	487Sup 8/6/2015 39(12-13)	Supplement to: Capacity Building in Cybersecurity Broadening Participation of Women in Cybersecurity through Women in Cybersecurity Conference and Professional Development	Siraj	CompS	$50,000
	5-31273	National Science Foundation - Award DUE-130441 Supplement			
5	500RSup2 2/16/2016 160(15-16)	Supplement to: Collaborative Research: A Multi-Scale Environmental and Kinetics Study on the Pyrolysis of Sustainable Biomass Feedstock	Biernacki Northrup	ChemE ChemE	$6,000
	5-31222	National Science Foundation - Award CBET-1337033			
6	559MCSUP 4/20/2016 162(15-16)	RET Supplement to REU Site - Summer Research Internships in Manufacturing and Techno-Entrepreneurship Preparation	Rencis Motevalli	COE COE	$10,000
	5-31232	National Science Foundation			
7	600MC-R3 11/2/2015 75(15-16)	Improving Interfacial Strength of 3-D Printed ABS Weld Lines: Compatibilized "Stripe" Deposition	Stretz	ChemE	$99,336
	5-39364	Oak Ridge National Laboratory - Subcontract 4000145173			
8	607MC 7/21/2015 19(15-16)	CAREER: Autonomous Wireless Access in Congested Smart City Spectrum	Anderson	ECE	$543,039
	Pending	National Science Foundation			
9	608MC 7/23/2015 16(15-16)	Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques	Anderson	ECE	$31,809
	5-39363	Oak Ridge National Laboratory - Subcontract 4000140763			
10	608MC-M1	Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques	Anderson	ECE	$9,900
	5-39363	Oak Ridge National Laboratory - Modification #1 Subcontract 4000140763			

	Status	Title	PI's	Department	Total Funds
11	608MC-M2 12/1/2015 16915-16) 5-39363	Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques - Spring 2016 - Tasks 1, 2 & 3 Oak Ridge National Laboratory- Modification #2 Subcontract 4000140763	Anderson	ECE	$59,345
12	609MC 8/26/2015 35(15-16) National Science Foundation	REU Site: Security and Privacy in the Future Smart Cities	Mahmoud Hasan	ECE ECE	$359,738
13	610MC 8/28/2015 27(15-16) 5-32377	Design and Development of a Digital Frequency Counter Aerospace Testing Alliance - Arnold Engineering Development Center	Alouani	ECE	$12,000
14	611MC 9/4/2015 41(15-16) Chemtor (via NIH funds)	High Throughput Manufacturing of Nanoparticles for Biomedicine - Phase II	Stretz	ChemE	$257,108
15	613MC 9/1/2015 56(15-16) 5-32376	Profinet to Profinet Encryption Dongle - CAPSTONE Project Aerospace Testing Alliance, Arnold Engineering Development Center	Alouani	ECE	$12,000
16	614MC 10/2/2015 57(15-16) 5-32378	Pacific Instrumentation Data Acquisition Scanner Emulator (PIDASE) Aerospace Testing Alliance, Arnold Engineering Development Center	Alouani	ECE	$12,000
17	616MC 9/15/2015 National Science Foundation	Collaborative Research: On-Machine Measurement of Cutting Tool Damage Based on Knife-Edge Interferometer	Lee Ting	ME CMR	$250,000
18	618MC 55(15-16) 5-32812	Automated Module for Emulation of Load Serving Capacity Tennessee Valley Authority	Alouani	ECE	$5,000
19	619MC 5-31261	Edge Surface Topography Characterization for Precision Sensing Technology National Science Foundation - Award to be transferred from USC	Lee	ME	$182,647
20	620MC 9/25/2015 52(15-16) 5-31279	Tennessee Cybercorps: A Hybrid Program in Cybersecurity National Science Foundation	Siraj Rahman	CompS CompS	$3,951,889

	Status	Title	PI's	Department	Total Funds
21	620MC-BC 6/30/2016 214(15-16)	Supplement to: Tennessee Cybercoprs: A Hybrid Program in Cybersecurity - for TTU Cyber Bootcamp	Siraj Rahman	CompS CompS	$99,862
	5-31279	National Science Foundation			
22	620MC-CC 6/30/2016 216(15-16)	Supplement to TENNESSEE CYBERCORPS: A HYBRID PROGRAM IN CYBERSECURITY- Community College Inclusion	Siraj Rahman	CompS CompS	$214,991
	5-31279	National Science Foundation			
23	621MCRev 10/8/2015 62(15-16)	AM-WATCH: Additive Manufacturing - Workforce Advancement Training Coalition and Hub	Fidan	MET	$900,000
		National Science Foundation			
24	622MC 10/8/2015 63(15-16)	Continuous Real-Time State Monitoring in Highly Dynamic Environments	Anton	ME	$360,000
		Air Force Office of Scientific Research			
25	624MC 10/20/2015	Modeling and Analysis of Tumor and Primary Cell Response to Alternating Current Applied Electrical Fields	Pascal Rice	ChemE ChemE	$301,925
		National Science Foundation			
26	625MC 11/2/2015 73(15-16)	Collaborative Research: Design, Analysis and Implementation of Millimeter Wave Distributed Massive MIMO Network	Qiu Guo	CMR CMR	$299,987
		National Science Foundation			
27	626MC 11/18/2015 108(15-16)	III: Small: Collaborative Research: Multi-Phase, Multi-Stream Graph Mining	Eberle	CompS	$206,774
		National Science Foundation			
28	627MC 11/18/2015 110(15-16)	NeTS: Small: Collaborative Research: Autonomous Traffic Management System through Participatory-Sensing and Secure Data Sharing	Mahmoud	ECE	$194,997
		National Science Foundation			
29	628MC 11/18/2015	RI: Small: Robust Adaptive Intelligence Based Universal Control for Electric Motor Drives with Unknown Dynamics	Chaoui Belkacemi	ECE ECE	$499,826
		National Science Foundation			
30	629MC 11/18/2015	CRS: NeTS: Small: Research Platform for Terabit Optical SDN Based Interface on HPC Clusters	Scott	CompS	$499,997
		National Science Foundation			
31	630MC 11/18/2015 109(15-16)	NeTS: Small: Collaborative Research: Towards Privacy Preserving Autonomous Vehicle Sharing Services	Mahmoud	ECE	$192,611
		National Science Foundation			

	Status	Title	PI's	Department	Total Funds
32	631MC 1/11/2016	MRI: Acquisition of a Field Emission Electron Microscope for Advanced Energy System Research National Science Foundation	Rice Chavez/Zhang	CMR ME/ChemE	$375,758
33	632MC 2/16/2016	US/South Korea Collaborative Research: Characterization of Laser-Material Interactions within Near-Surface Region for Laser-Assisted Manufacturing Technology National Science Foundation	Lee	ECE	$290,650
34	633MC 12/2/2015	Developing a Multi-Platform Land and Aerial-Based Integrated Robotic System to “R”emote “A”ccess, “I”nvestigate and Perform “D”ata “E”valuation and “R”eview (RAIDER) in Unstructured Space within a Nuclear Facility U.S. Department of Energy, Idaho Operations Office	Canfield	ME	$3,000,000
35	634MC 12/15/2015	IUSE/PFE: RED: Preparing 21st Century Computing Professionals through an Agile Co-curricular/Curricular Model for Equipping, Engaging, and Exciting (ACME3) Computer Science Undergraduates National Science Foundation	Talbert Eberle/Ghafoor	CompS CompS	$2,000,000
36	635MC 1/27/2016	Accurate System Identification of Solid-State Batteries with Thermal and Aging Uncertainties ECS Toyota Young Investigator Fellowship	Chaoui	ECE	$80,000
37	636MC 2/16/2016	Collaborative Research: On-Machine Diagnosis of Precision Cutting Tool Wear Utilizing Knife-Edge Interferometry National Science Foundation	Lee	ME	$164,236
38	638MC 1/26/2016 129(15-16) 5-32381	Reflective Memory to Ethernet Interface Card Design & Development Aerospace Testing Alliance, Arnold Engineering Development Center	Alouani	ECE	$12,000
39	639MC 2/1/2016	Developing Additive Manufacturing Design Protocols for Mechanisms with Embedded Sensing and Control and Integrating into Engineering Education through the EIME Model (Merging Assistive Technology for Children and Mechanical Engineering) Tennessee Board of Regents	Anton Canfield	ME ME	$40,000
40	640MC 2/1/2016	Robust Motion Control of Wireless Self-Charging Unmanned Aerial Vehicles with Unknown Disturbances Tennessee Board of Regents	Chaoui Belkacemi	ECE ECE	$40,000
41	641MC 2/16/2016	Higher Order Conjugation Synthesis and Applications in Gearing National Science Foundation	Ting	CMR	$299,531

	Status	Title	PI's	Department	Total Funds
42	642MC 2/25/2016 141(15-16)	Development of Low Molecular Weight Compounds for Improved Treatment of Alpha-1 Antitrypsin Deficiency National Institute of Health	Sanders Carrick	ChemE Chem	$406,749
43	643MC 2/12/2016	Affordable Integrated Circuit Packaging and Assembly for High-Temperature Intelligent Components Micro-RDC	Johnson	ECE	$37,866
44	644MC 2/17/2016	Enhancing Compressor Stator Dehydration and Cooling Bristol Compressors, International, Inc.	Idem Cunningham	ME ME	$115,599
45	645MC 2/17/2016	Noise Radiation from Compressors Used in Residential HVAC Units: Phase II-Effects of External Temperature. Bristol Compressors, International, Inc.	Rao Darvennes	ME ME	$23,312
46	647MC 3/3/2016 145(15-16)	Molecular Dynamics Simulation on Wax Inhibition Using Polymer Pour Point Depressants American Chemical Society Petroleum Research Fund	Zhang	ChemE	$110,000
47	648MC 2/25/2016	BD Spokes: PLANNING: SOUTH: Collaborative: Enabling a National Phase Measurement Unit Data Repository University of Oklahoma (NSF)	Qiu	CMR	$5,000
48	650MC 3/8/2016 146(14-16) 5-35222	Enabling Microsecond Condition Monitoring for Real-Time Assessment of Critical Infrastructure Vibration Institute	Anton	ME	$10,000
49	651MC 3/28/2016 149(15-16)	Engineered Thin Film Ink Technology as a Novel Fuel Cell Electro-catalyst US Department of Energy, Office of Energy Efficiency and Renewable Energy	Shirvanian	ME	$905,348
50	652MC 4/5/2016 154(15-16)	Measurement Limits Due to Grating Topography Properties in Laser Encoder DARPA	Lee	ME	$428,073
51	653MC 4/4/2015 153(15-16)	High Throughput Manufacturing of Nanoparticles for Biomedicine - Phase II Chemtor, L.P. (via NIH funds)	Stretz	ChemE	$265,013
52	654MC	In-Situ Health Monitoring of Precision Spindle System for Smart Manufacturing NIST	Lee Fidan	ME MET	$275,889

Status		Title	PI's	Department	Total Funds
53	655MC 4/14/2016 159(15-16)	Fabricate Aluminizing Ni-based 31V Alloy Oak Ridge National Laboratory	Zhang	ME	$20,000
54	658MC	Public-Private Partnership to Promote Efficient Manufacturing and Workforce Development Department of Energy, Office of Energy Efficiency and Renewable Energy	Cunningham Languri	ME ME	$1,749,842
55	659MC	Supplement to: Idea Generation to Commercially-Viable Healthcare Solutions - VentureWell Grant #13385-15 Venturewell Faculty Grant Program - Grant #13385-15	Sanders Geist	ChemE Nursing	$20,000
56	660MC 6/7/2016	CPS: Synergy: Collaborative Research: Autonomous Traffic Management System through Participatory-Sensing and Secure Data Sharing National Science Foundation	Mahmoud	ECE	$211,154
57	661MC	Enabling Real-Time Structural Integrity Monitoring of Safety-Critical Infrastructure Using NI LabVIEW and PXI FlexRIO National Instruments	Anton	ME	$50,000
58	662MC	Investigation on hBD-3 Structure, Dynamics and Interactions with Chemokine Receptor National Institute of Health	Zhang	ChemE	$425,807
59	665MC 6/29/2016 209(15-16) 5-36812	Power into Motion- Proposed Automotive Powertrain Program at Tennessee Tech DENSO North America Foundation	Rencis	COE	$50,000
			Proposals Submitted in FY 2015-16		***$21,117,542***

Index number = funded.