

TEXAS TECH UNIVERSITY
National Wind Institute™

Welcome to
All Things Wind

July/August edition 2017



MESSAGE FROM INTERIM DIRECTOR



Nearing the end of FY17, I couldn't be prouder of what NWI has accomplished. Total value of new awards reaches \$7.7m, almost three times of what we had last year. Among them, \$4m comes from federal sources, including NSF, DOE, DOD, NOAA, and DHS. This speaks to both the diversity of our research activities as well as the productivity of our faculty affiliates and researchers around four major themes: wind energy, smart grid, wind engineering, and severe storm.

While celebrating our success, NWI is coping with declining financial supports from the State and central administration in the coming years. As the result, one staff position has been eliminated. Nevertheless, our goal is to increase, not to reduce, our support to research through efficiency improvement and resource reallocation. In such a hyper competitive environment, if you don't pedal you don't go forward. Look forward to a new semester and lots of exciting things.

Go Raiders!
Daan Liang, NWI Interim Director

RESEARCHER RECOGNIZED WITH INNOVATION AWARD

May 10, 2017
By: [George Watson](#)



Beibei Ren received the 2017 National Innovation Award at the TechConnect National Innovation Summit for the patent addressing parallel operation of power electronic converters.

One of the biggest concerns when running parallel power electronic converters is to ensure the loads carried by the generators are shared in proportion to their power ratings.

Beibei Ren, an assistant professor in the Department of Mechanical Engineering at Texas Tech University, has been recognized with the 2017 National Innovation Award for the patent pending, "Robust Droop Control for Parallel Operated Inverters."

The TechConnect Innovation Awards select the top early-stage innovations from around the world through a review process with rankings based on the potential positive impact the submitted technology will have on a specific sector of the industry.

"I am very pleased and honored to receive this innovation award, which recognizes the potential values of our technology disclosure in grid modernization with high penetration of renewable energy sources," Ren said.

Ren will receive the award at the TechConnect National Innovation Summit May 14-17 in Washington, D.C.

At Texas Tech, Ren leads the Dynamic Intelligent Systems, Control and Optimization (DISCO) research group. DISCO focuses on pushing the boundaries of control theory for systems with model uncertainties and external disturbances, and also exploring the impacts of control in broad applications, such as grid integration of renewables and unmanned aerial vehicles.

"Dr. Ren's outstanding research and professional achievements demonstrate her exceptional breadth in the theory and applications of controls engineering and her multidisciplinary expertise in the development of power electronics and microdevices

for mechanical systems,” said [Oliver McGee](#), professor and chair of Texas Tech’s Department of Mechanical Engineering. “Providing a strategic way forward for Texas Tech’s academic and research quality requires exciting technological innovations disclosed by Dr. Ren, which serves to collectively raise the public’s understanding of the societal impact of science, engineering and technology not only across the Texas Tech community but also across the state of Texas, the nation and around the world.”

The popularity of renewable energies, such as wind and solar, and the ability to distribute them along the power grid, is growing at a very rapid rate. Normally, power inverters are adopted in these applications to interface with the utility grid, or microgrid. However, with the growing capacity of renewable energies, such as megawatt-level wind turbines and large-scale solar farms, power electronic devices face big challenges with the need for high current and high power.

Power inverters are required in parallel operation due to current and cost limitations of power electronic devices. Another reason for the need of parallel operation of inverters is to provide system redundancy and high reliability from the requirements of critical customers.

Power sharing based on droop characteristics is widely used in parallel operation of inverters. The conventional droop control is not able to achieve accurate power sharing among parallel units due to the mismatched output impedance. Also, system uncertainty and disturbances such as large or fast changes of the load, variations of output impedance and fluctuating DC-link voltage, often affect the power sharing performance.

All these challenges will be addressed by the technology -- Uncertainty and Disturbance Estimator (UDE)-based Robust Droop Control for Parallel Operated Inverters. It will provide a modification to the conventional droop control with advanced control algorithms.

“Our work focuses on developing advanced-control algorithms to operate power electronic converters as a smart unified interface for grid integration of renewable energies in a stable and reliable manner, with minimal human intervention,” Ren said.

For more information on the TechConnect National Innovation Awards, visit its [website](#).

MEHTA SERVES ON NACWIR COMMITTEE

Dr. Mehta is a member of the National Advisory Committee for Windstorm Impact Reduction (NACWIR). He is one of the thirteen members on the committee which has representation from various stakeholders who have worked in reducing impact of windstorms on people and communities. The membership includes disciplines of engineering, architecture, meteorology, economy (Dr. Kevin Simmons, TTU graduate), and sociology; individuals from academics as well as practicing professionals from all over the country. The committee is monitored by Dr. Marc Levitan (TTU graduate), acting director of wind program at National Institute of Standards and Technology. The committee is charged with two tasks; 1. Provide recommendations on the draft of strategic plan developed by federal agency working group (NIST, NSF, NOAA, and FEMA), and 2. Review and recommend coordination between federal agencies pursuing windstorm impact reduction. The committee met on June 27-28 in Gaithersburg, Maryland to review draft of the Strategic Plan and develop future trends in windstorm impact reduction. A second meeting will take place at NIST on August 23-24. Through this effort by Dr. Mehta we are able to guide windstorm impact reduction efforts at the national level.

NWI RESEARCHER: HARVEY HAD STRONGEST WINDS EVER MEASURED WITH STICKNETS

August 28, 2017,
By: [Glenys Young](#)

The National Wind Institute team deployed 14 instrument platforms along the Texas coast.

Most college students – and faculty, for that matter – would probably love to spend the last weekend before school starts at the beach. Of course, that’s assuming there’s not a Category 4 hurricane barreling straight for you.

But as two researchers from the [National Wind Institute](#) (NWI) at Texas Tech University drove toward Corpus Christi last Wednesday, they knew what was then a weak Tropical Storm Harvey had the potential to become a hurricane. And if it did, they wanted to be right in the thick of it.

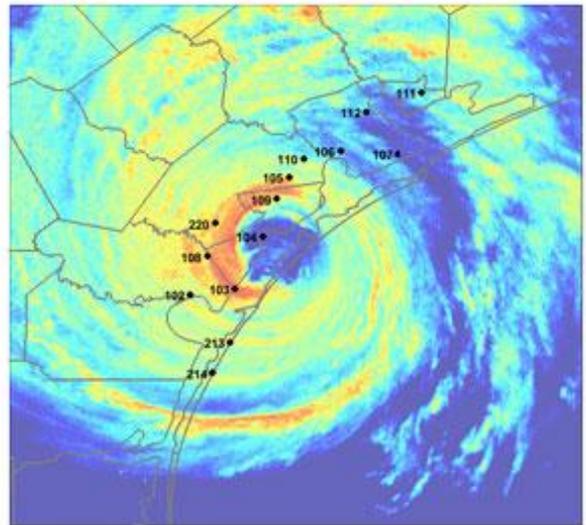


“As someone fascinated by weather, these types of events are really neat and interesting to me,” said [Brian Hirth](#), a research professor with the NWI. “I have a tremendous respect and appreciation for the devastating impact they can cause. We have so much to learn still on how to make our buildings and communities more resilient to storms like Harvey. We’re never rooting for this type of disaster to happen, but if it’s going to, we want to be there to collect valuable measurements to advance the science.”

Armed with 14 StickNet platforms to collect wind measurements, Hirth and NWI doctoral candidate [James Duncan](#) spent Thursday and the first half of Friday scouting locations and then deploying the instruments between Mustang Island and Point Comfort with help from John Schroeder, a professor of [atmospheric science](#), the principal investigator for the Texas Tech Hurricanes at Landfall Project and founder of the [Texas Tech Hurricane Research Team](#). Schroeder remained in Lubbock relaying forecast updates to the team. As soon as the StickNets were in place, Hirth and Duncan headed back to Corpus Christi to ride out the storm.

“Our objective was to distribute these platforms along the coastal region that was to be most impacted by the winds of Harvey

to not only capture the maximum winds within the storm, but also understand the spatial distribution of the hurricane’s wind field,” Hirth said. “It’s actually a considerable amount of work identifying suitable deployment locations, making sure the platforms are adequately spaced relative to the expected size and distribution of the storm’s wind field, and then being flexible enough to adapt as the forecast landfall point shifts and the structure of the storm and its winds evolve.”



Even with the complexity of planning the optimum locations, the team was right on. “The deployment itself was perfect,” Hirth said. “The center and eyewall region of Harvey moved over several of our instruments.”

“To our knowledge, the winds of Harvey are the strongest measured by the platforms since the StickNet program began roughly a decade ago,” Hirth said. The StickNets measured wind, barometric pressure, temperature and relative humidity.

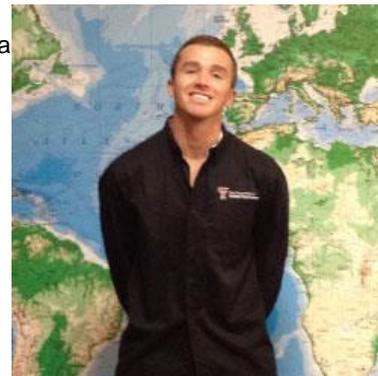
Some of the older StickNets were affected by water, which compromised the wind readings, and one platform near the northern eyewall was knocked over by debris at the peak of the storm. Despite that, data gathered from Harvey was impressive.

“To our knowledge, the winds of Harvey are the strongest measured by the platforms since the StickNet program began roughly a decade ago,” Hirth said.

They knew going in that Harvey had the potential to be a strong storm.



“No two hurricanes are the same, and Harvey fit the bill,” Hirth said. “Many times, hurricanes have reached peak intensity and are weakening as they make landfall in the U.S. and enter a more hostile atmospheric environment. Atmospheric conditions surrounding Harvey were very supportive all the way up to landfall allowing for a continuous, rapid strengthening trend to a Category 4 hurricane on the Saffir-Simpson hurricane wind scale.”



Hirth and Duncan headed out first thing Saturday morning to retrieve the StickNets, getting half that day and half on Sunday. The longer they wait to pick them up, the more difficult it becomes as first responders and locals begin returning to the area. As soon as the last StickNets were retrieved, the pair began the long drive home.

Even though the team's hotel in northwest Corpus Christi lost power during the storm, Hirth said he never felt unsafe.

“I personally have been deploying instruments in hurricanes since 2004 and Dr. Schroeder since the late 1990s,” he said, “so the experience is very helpful.”

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NWI RESEARCHERS RECEIVE THE CH FOUNDATION AWARD

Project Title: “Mapping Local Community Preparedness to Tornado Hazards in Lubbock, Texas”

PIs: Guofeng Cao and Daan Liang

Amount: \$29,500

Source: CH Foundation

The objective of the project is to develop an effective way to measure and evaluate the tornado preparedness of local communities. Using the city of Lubbock as a pilot study, we will use GIS to integrate heterogeneous geospatial data sources including a social survey to map the geographic variations of the preparedness across the city. We will collaborate with the Office of Emergency Management of Lubbock (Mr. Jay Parchman) on this project.

Congrats to Drs. Cao and Liang on their achievement.



NSF I/UCRC Planning Meeting in Miami

The progress to form a NSF I/UCRC for Wind Hazard and Infrastructure Performance (WHIP) has moved into a new phase. Thanks to the participation of our new partner - Florida International University (FIU), a planning meeting took place on Friday, August 18 at FIU's campus in Miami, FL. At the meeting, industry representatives gained insight to value proposition of WHIP Center; reviewed and commented on six potential projects; and voted on project selection. TTU researchers who attended this meeting were Drs. John Schroeder, Delong Zuo, Doug Smith, Kishor Mehta, and Daan Liang.

EXPERTS AVAILABLE TO DISCUSS 2017 HURRICANE SEASON

June 20, 2017

By: [Karin Slyker](#)

NOAA's Climate Prediction Center forecasts 11 to 17 named storms, including two to four major hurricanes.

Texas Tech University leads the nation in wind research. Texas Tech has a number of researchers with extensive experience researching hurricanes such as Rita, Katrina and Ike and can speak as experts about various aspects of these devastating storms.

[John Schroeder](#), professor of atmospheric sciences, is the principal investigator for the Texas Tech Hurricanes at Landfall (TTUHAL) Project and founder of the [Texas Tech Hurricane Research Team](#). He visited affected areas after both hurricanes Rita and Katrina to deploy instrumented towers that gather high-resolution storm data at a time when most conventional observation systems fail. Schroeder can offer insight into how hurricanes develop, move and react to various meteorological elements. He is an expert on hurricane winds and has been actively intercepting hurricanes since 1998. Schroeder can be reached at (806) 834-5678 or john.schroeder@ttu.edu.

[Ernst Kiesling](#), research professor at Texas Tech's [National Wind Institute \(NWI\)](#) and executive director of the National Storm Shelter Association (NSSA), recommends that homeowners who live above the flood plain in hurricane-prone areas buy a storm shelter for their home. As was seen in Houston preceding Hurricane Rita, evacuations are stressful and expensive. They often put immense strain on traffic corridors, leading to traffic jams and – in the case of Houston – fatalities. By using in-home shelters, some families who are not required to evacuate can remain where they are and ease the traffic flow. However, Kiesling urges buyers to look for a seal of the NSSA when they buy a safe room for their home, because not all shelters are verified to be fully compliant with current standards for storm shelters and to provide full protection from extreme winds. Kiesling has more than 35 years of experience in the design, standards-writing and quality control of storm shelters. Kiesling can be reached at (806) 834-1931 or ernst.kiesling@ttu.edu.

[Larry Tanner](#), research associate in civil engineering, completed a six-month investigation working with the Federal Emergency Management Agency (FEMA) mitigation assessment team on the wind damage to residential structures from Hurricane Ike in Texas and Louisiana. He also was a member of the FEMA mitigation assessment team that studied Hurricane Katrina. He led a team that recorded wind and water damage along the coastline in Louisiana and Mississippi. Much of the damage done by Katrina, he said, resulted from structures being built below the base flood elevation, or the elevation that flood waters will rise to during a 100-year storm event (meaning the storm only has a 1 percent chance of happening in a year). Tanner can be reached at (806) 834-2320 or larry.tanner@ttu.edu.

[Bradley Ewing](#), professor of operations management in the [Rawls College of Business](#), has studied the economic impact of hurricanes and tornadoes. He can speak to the impact of hurricanes and tornadoes in cities like Oklahoma City; Corpus Christi; Wilmington, North Carolina; Miami, Florida; and Nashville, Tennessee. Ewing can be reached at (806) 834-3939 or bradley.ewing@ttu.edu.

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200M TOWER LED LIGHTING SYSTEMS UPGRADE

By: Jeff Livingston

In October, 2016, the FAA changed the classification of the 200m Tower. This classification now allows towers below the height of 700 feet to utilize Medium Intensity LED lighting systems and also changes the number of lights required. Previously, the upkeep and costs of the High Intensity Light system has been quite a burden for NWI. On June 14th, 2017, Lee Wilks, Superintendent and Jeff Livingston, Assistant Director of Operations finished the installation and commissioning of a new TWR, Inc., medium intensity obstruction lighting system for the 200m Tower at the RTC. This system is a FAA approved Medium Intensity Advanced LED lighting system and will lower the costs of maintenance, which can be maintained by our staff instead of contracting out the work. Additionally, the power consumption is greatly reduced. We are grateful to those that contributed to acquiring this new system including: the TTU Office of the Vice President for Research, Sandia National Laboratories, National Wind Institute and the West Texas Mesonet.

NWI COMPLETES ANOTHER YEAR OF RUN ON THE WIND CAMP



Above: Dr. Chris Pattison assists with the set up for land sailing. Dr. Andy Swift (R) and a student (middle) enjoy sailing at Run on the Wind camp.

By: Dr. Chris Pattison

This past July, 10 middle school students from around Texas participated in the “Run on the Wind” summer camp at TTU. Students designed and built wind turbines, competing against each other in blade design and total power output. They also built foam land racers seeing whose design could roll the farthest down the hallway using a box fan. Simultaneously, twenty high school students, from as far away as Houston, participated in the “Generation Tech” summer camp, building a wind turbine, foam land racer, and designing a solar home. Morning and afternoon demonstrators were Dr. Swift, Dr. Sundari, and two summer TA’s Zack McNutt and Josh Williams.

THE FALL BRINGS CHANGES FOR NWI

The NWI has experienced quite a few changes over the summer. Liz Inskip-Paulk has taken a position as an Instructor in Mass Communications and has left her Unit Coordinator position. Additionally, our IT support, Zack Hutton, has taken a new opportunity with Tyler Technologies. We wish both Liz and Zack the best on their future endeavors.

2017 Storm Shelter Conference



Lead Sponsor: National Storm Shelter Association

November 8-9 | McKinney, Texas

Event Location

Simpson Strong-Tie Plant

2221 Country Lane
McKinney, TX

The conference will feature technical sessions, committee meetings and a social event Wednesday night at [Tupps Brewery](#)

For details regarding sessions, registration, hotel accommodations and more [click here](#)
or

Go to www.nssa.cc and click the "Events" tab at the top of our home page.

Please join us!

PO Box 41166 | Lubbock, TX 79409-1166 | 877-700-6772 | info@nssa.cc

CHECK OUT NWI FACULTY IN OTHER RECENT ARTICLES:

August 3, 2017 NWI's Debris Impact Facility and the National Storm Shelter Association are featured in a great article in [Popular Mechanics Magazine](#)

[Texas Tech Expert Explains What Makes Hurricane Harvey Tick](#)

RECENT PUBLICATIONS BY NWI AFFILIATES (reported by Web of Science)

Skipper, Ben R.; **Boal, Clint W.**; Tsai, Jo-Szu; Fuller, Mark R. (2017) Assessment of Frequency and Duration of Point Counts When Surveying for Golden Eagle Presence, WILDLIFE SOCIETY BULLETIN, 41 (2):212-223; 10.1002/wsb.770 JUN 2017

Subburaj, Anitha; Arra, Ankith Reddy; **Bayne, Stephen** (2017) Stability Analysis of A.C and D.C Microgrids using OPAL-Real Time Digital Simulator, 2017 NINTH ANNUAL IEEE GREEN TECHNOLOGIES CONFERENCE (GREENTECH 2017), 39-45; 10.1109/GreenTech.2017.12 2017

Shamim, Nimat; Subburaj, Anitha; **Bayne, Stephen** (2017) Model Predictive Control Analysis for the Battery Energy Storage System, 2017 NINTH ANNUAL IEEE GREEN TECHNOLOGIES CONFERENCE (GREENTECH 2017), 34-38; 10.1109/GreenTech.2017.11 2017

Wang, Dahai; **Chen, Xinzhong**; Li, Jie (2017) Prediction of wind-induced buffeting response of overhead conductor: Comparison of linear and nonlinear analysis approaches, JOURNAL OF WIND ENGINEERING AND INDUSTRIAL AERODYNAMICS, 167

23-40; 10.1016/j.jweia.2017.04.008 AUG 2017

Feng, Changda; Chen, Xinzhong (2017) Crosswind response of tall buildings with nonlinear aerodynamic damping and hysteretic restoring force character, JOURNAL OF WIND ENGINEERING AND INDUSTRIAL AERODYNAMICS, 167 62-74; 10.1016/j.jweia.2017.04.012 AUG 2017

Xu, Jiaqi; Spencer, Billie F., Jr.; Lu, Xilin; **Chen, Xinzhong**; Lu, Lei (2017) Optimization of Structures Subject to Stochastic Dynamic Loading, COMPUTER-AIDED CIVIL AND INFRASTRUCTURE ENGINEERING, 32 (8):657-673; 10.1111/mice.12274 AUG 2017

Zhao, Naizhuo; Hsu, Feng-Chi; **Cao, Guofeng**; Samson, Eric L. (2017) Improving accuracy of economic estimations with VIIRS DNB image products, INTERNATIONAL JOURNAL OF REMOTE SENSING, 38 (21):5899-5918; 10.1080/01431161.2017.1331060 2017

Zhong, Qing-Chang; **Wang, Yeqin; Ren, Beibei** (2017) UDE-Based Robust Droop Control of Inverters in Parallel Operation, IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, 64 (9):7552-7562; 10.1109/TIE.2017.2677309 SEP 2017

Tang, Haojun; Li, Yongle; **Chen, Xinzhong**; Shum, K. M.; Liao, Haili (2017) Flutter performance of central-slotted plate at large angles of attack, WIND AND STRUCTURES, 24 (5):447-464; 10.12989/was.2017.24.5.447 MAY 2017

Miao, Dongyu; Zhao, Heng; Hong, Hong; Zhu, Xiaohua; **Li, Changzhi** (2017) Doppler Radar-based Human Breathing Patterns Classification Using Support Vector Machine, 2017 IEEE RADAR CONFERENCE (RADARCONF), 456-459; 2017

Zhang, Li; Xiong, Junjun; Zhao, Heng; Hong, Hong; Zhu, Xiaohua; **Li, Changzhi** (2017) Sleep Stages Classification by CW Doppler Radar Using Bagged Trees Algorithm, 2017 IEEE RADAR CONFERENCE (RADARCONF), 788-791; 2017

Wang, Dahai; **Chen, Xinzhong**; Xu, Kang (2017) Analysis of buffeting response of hinged overhead transmission conductor to nonstationary winds, ENGINEERING STRUCTURES, 147 567-582; 10.1016/j.engstruct.2017.06.009 SEP 15 2017

CONTRACTS AND AWARDS

July, 2017	Unit	Amounted Credited	Title	Sponsor
Schroeder, John L	Geosciences	11,250	NWI: TTU/SNL Wind Farm 01/01/2017- 12/31/17	DOE Sandia Ntl Laboratories
Young ,Anna	National Wind Institute (NWI)	11,250	NWI: TTU/SNL Wind Farm 01/01/2017- 12/31/17	DOE Sandia Ntl Laboratories
Liang ,Daan	Civil, Env and Construction Engr	2,500	NWI: TTU/SNL Wind Farm 01/01/2017- 12/31/17	DOE Sandia Ntl Laboratories

Schroeder, John L	Geosciences	341,000	Supporting the Global Laboratory for Energy Asset Management & Microgrid (GLEAMM)	TX Emerging Technology Fund
Ancell, Brian C	Geosciences	341,000	Supporting the Global Laboratory for Energy Asset Management & Microgrid (GLEAMM)	TX Emerging Technology Fund
Liang ,Daan	Civil, Env and Construction Engr	93,000	Supporting the Global Laboratory for Energy Asset Management & Microgrid (GLEAMM)	TX Emerging Technology Fund
Pattison, Chris C	National Wind Institute (NWI)	124,000	Supporting the Global Laboratory for Energy Asset Management & Microgrid (GLEAMM)	TX Emerging Technology Fund
Ren, Beibei	Mechanical Engr	310,000	Supporting the Global Laboratory for Energy Asset Management	TX Emerging Technology Fund

			nt & Microgrid (GLEAMM)	
Bayne, Stephen B	Electrical and Computer Engr	341,000	Supporting the Global Laboratory for Energy Asset Management & Microgrid (GLEAMM)	TX Emerging Technology Fund
Giesselmann, Michael G	Electrical and Computer Engr	341,000	Supporting the Global Laboratory for Energy Asset Management & Microgrid (GLEAMM)	TX Emerging Technology Fund
Bilbao, Argenis V	Electrical and Computer Engr	341,000	Supporting the Global Laboratory for Energy Asset Management & Microgrid (GLEAMM)	TX Emerging Technology Fund
He, Miao	Electrical and Computer Engr	341,000	Supporting the Global Laboratory for Energy Asset Management & Microgrid (GLEAMM)	TX Emerging Technology Fund
Chen, Xinzhong	Civil, Env and Construction Engr	877	FM Global Summer	FM Global

			Internship (Changda Feng)	
Chen, Yong	Computer Sci	16,000	MRI Collaborati ve: Developme nt of a Data- Intensive Scalable Computing Instrument for High Performanc e Computing	Ntl Science Foundation
Bayne, Stephen B	Ctr for Pulsed Pwr, Pwr Electronics	2,000	NWI: The REAP program	Academy of Applied Science
Ren, Beibei	Mechanical Engr	182,286	Feedback- Enabled Realization of VO2 Reconfigur ability (FERVOR)	Ntl Science Foundation
Westergaard, Carsten H	Mechanical Engr	2,492	NWI: GLEAMM: Collegiate Wind Competitio n	National Institute for Renewable Energy
Jay, Kyle R	National Wind Institute (NWI)	2,492	NWI: GLEAMM: Collegiate Wind Competitio n	National Institute for Renewable Energy
Marshall, Kacey L	National Wind Institute (NWI)	2,492	NWI: GLEAMM: Collegiate Wind Competitio n	National Institute for Renewable Energy

Swift, Andrew H	National Wind Institute (NWI)	2,492	NWI: GLEAMM: Collegiate Wind Competitio n	National Institute for Renewable Energy
Liang ,Daan	Civil, Env and Construction Engr	26,820	NWI: Training program on industrial internet and manufacturi ng	Huadian Heavy Industries
August, 2017				
Bruning, Eric C	Geosciences	49,419	NWI VORTEX- SE: Insights into the Structure and Predictabilit y of Southeaster n U.S. Tornadic Storms Afforded by Intensive Observation and High- Resolution Numerical Modeling	Ntl Oceanic & Atmospheric Administration
Dahl, Johannes	Geosciences	49,419	NWI VORTEX- SE: Insights into the Structure and Predictabilit y of Southeaster n U.S. Tornadic Storms	Ntl Oceanic & Atmospheric Administration

			Afforded by Intensive Observation and High-Resolution Numerical Modeling	
Weiss, Christopher C	Geosciences	50,916	NWI VORTEX-SE: Insights into the Structure and Predictability of Southeastern U.S. Tornadoic Storms Afforded by Intensive Observation and High-Resolution Numerical Modeling	Ntl Oceanic & Atmospheric Administration
Liang ,Daan	Civil, Env and Construction Engr	226,022	NWI: A Multi-Level Dynamically Coupled Model For Evaluating Older Adults' Vulnerability And Resiliency To Disasters	Ntl Science Foundation
Cong, Zhen	Human Dvpt & Family Studies	276,249	NWI: A Multi-Level Dynamically Coupled Model For Evaluating Older	Ntl Science Foundation

			Adults' Vulnerability And Resiliency To Disasters	
Zuo, Delong	Civil, Env and Construction Engr	20,373	NWI: Natural Hazards Engineering Research Infrastructure: Network Coordinating Office	Ntl Science Foundation
Zuo, Delong	Ctr for MDisciplinary Research in Transportation	10,310	NWI: Evaluating the Effectiveness of Vibration-Mitigation Devices for Structural Supports of Signs, Luminaires, and Traffic Signals	Transportation Research Board/Univ of Connecticut
Bayne, Stephen B	Ctr for Pulsed Pwr, Pwr Electronics	59,775	NWI: GLEAMM: Reliability Analysis of Wide Band Gap Power Devices	U.S. Dept of Energy/North Carolina State Univ
Bilbao, Argenis V	Ctr for Pulsed Pwr, Pwr Electronics	59,775	NWI: GLEAMM: Reliability Analysis of Wide Band Gap Power Devices	U.S. Dept of Energy/North Carolina State Univ
Gale, Richard O	Ctr for Pulsed Pwr, Pwr Electronics	59,775	NWI: GLEAMM: Reliability	U.S. Dept of Energy/North Carolina State Univ

			Analysis of Wide Band Gap Power Devices	
Giesselmann, Michael G	Ctr for Pulsed Pwr, Pwr Electronics	19,925	NWI: GLEAMM: Reliability Analysis of Wide Band Gap Power Devices	U.S. Dept of Energy/North Carolina State Univ
Ewing, Bradley T	Business Admin (RCB)	390,830	Collaborative Research: CRISP Type 2: Defining and Optimizing Societal Objectives for the Earthquake Risk Management of Critical Infrastructure	Ntl Science Foundation
Dahl, Johannes	Geosciences	241,336	The Origin of Rotation in Tornadoes	Ntl Science Foundation