



## Program Progress Performance Report for University Transportation Centers

- **Federal Agency and Organization Element to which Report is Submitted**  
United States Department of Transportation (USDOT), Office of the Assistant Secretary of Transportation for Research and Technology (OST-R)
- **Federal Grant or Other Identifying Number Assigned by Agency:** DTRT13-G-UTC59
- **Project Title:** University Transportation Center for Railway Safety (UTCRS)
- **Project Director (PD) Name, Title, and Contact Information**  
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- **Submission Date:** October 30, 2015
- **DUNS and EIN Numbers**  
DUNS: 069444511 and EIN: 465292740
- **Recipient Organization:**  
The University of Texas Rio Grande Valley (UTRGV)  
1201 West University Drive, Edinburg, TX 78539-2999
- **Recipient Identifying Number or Account Number:** 410000049 and 410000232
- **Project/Grant Period:** September 30, 2013 – September 30, 2018
- **Reporting Period End Date:** September 30, 2015
- **Report Term or Frequency (annual, semi-annual, quarterly, other):**  
Semi-annual
- **Signature of Submitting Official**

*Constantine Tarawneh*

Dr. Constantine Tarawneh, Director, University Transportation Center for Railway Safety (UTCRS)



## 1. ACCOMPLISHMENTS

### What are the main goals and objectives of the program?

The UTCRS will develop knowledge, diverse human resources, and innovative technology in support of strategic safety plans for the U.S. rail transportation industry. The Center will engage and focus its partners' established expertise and leverage and expand their existing resources to establish comprehensive programs of railway safety research, education, technology transfer and implementation, and workforce development.

UTCRS Strategic Research Goals aim to fundamentally improve railway safety outcomes by the following means:

- 1) Reducing fatalities and injuries at highway-rail grade crossings (HRGCs)
- 2) Reducing failures by developing more durable materials and systems
- 3) Developing advanced technology for infrastructure monitoring
- 4) Developing innovative safety assessments and decision-making tools

In working towards the overall goal of establishing comprehensive programs of railway safety research, education, technology transfer and implementation, and workforce development, the following was accomplished for this reporting period:

| Research Activities  | Status      | % Complete |
|--|-------------|------------|
| Call for Problem Statements  | Complete    | 100%       |
| Request for 2015-2016 Proposals  | On Schedule | 67%        |
| 2015-2016 Proposals Reviewed by Executive Committee  | On Schedule | 67%        |
| Review Budgets of 2015-2016 Proposals  | On Schedule | 67%        |
| Final 2015-2016 Proposal Ranking & Selection   | On Schedule | 67%        |
| 2015-2016 Research Projects under Contract   | On Schedule | 33%        |
| Technology Transfer Briefs, Webinars, Symposiums, and Presentations on Research Results                                    | On Schedule | 33%        |
| Applicable Slides, Handouts, Videos, Pictures Posted   | On Schedule | 33%        |
| Final Reports Due and All Research Projects Completed  | On Schedule | 28%        |
| Leadership Activities  |             |            |
| Coordination with UTCRS Directors  | Complete    | 100%       |
| Establishment of UTCRS Advisory Board  | Complete    | 100%       |
| UTCRS Leadership Update  | Complete    | 100%       |
| USDOT Grant Managers' Summer Meeting with UTCRS Executive Committee, Staff, and Students, and University Administration    | Complete    | 100%       |
| Educational & Outreach Activities  |             |            |
| 2015 UTCRS K-12 Summer Camps   | Complete    | 100%       |
| 2015 UTCRS Transportation Engineering Summer Enrichment Program (TESEP)  | Complete    | 100%       |
| 2015 UTCRS Research Experience for Undergraduates (REU) Program  | Complete    | 100%       |
| 2015 UTCRS Research Experience for Teachers (RET) Program  | Complete    | 100%       |
| Call for 2016 UTCRS Research Experience for Undergraduates (REU) Program   | On Schedule | 50%        |
| Review and Selection of the Students to Participate in the 2016 UTCRS Research Experience for Undergraduates (REU) Program | Forthcoming | 0%         |

### Technology Transfer Activities

|  |             |      |
|--|-------------|------|
| Development of Elementary, Middle School, and High School Transportation Related STEM Curricula Available for Use in K-12 Classrooms | Complete    | 100% |
| UTCRS Website Information Dissemination Update   | Complete    | 100% |
| UTCRS Open Educational Resources Tab / Borrowing Agreement   | Completed   | 100% |
| UTCRS Social Media Sites Information Dissemination   | On Schedule | 50%  |
| UTCRS Supported Journal and Conference Publications and Presentations  | On Schedule | 40%  |
| UTCRS Supported Presentations, Symposiums, Workshops, and Short Courses  | On Schedule | 25%  |
| 2015 REU Research Symposium  | On Schedule | 25%  |

### USDOT OST-R: Reporting

|  |             |      |
|--|-------------|------|
| Update of Directory of Key Center Personnel                        | Complete    | 100% |
| UTC Program Progress Performance Reports (Quarterly)               | Complete    | 100% |
| Federal Financial Reports (Quarterly)                              | Complete    | 100% |
| Map 21 UTC Performance Indicators Report (Annual)                  | Complete    | 100% |
| UTC Specific Performance Indicators Report (Annual)                | Complete    | 100% |
| Transition from UTPA to UTRGV (Lead Institution)                   | Complete    | 100% |
| Posting of Newly Funded Research Project Descriptions (Exhibit Fs) | On Schedule | 33%  |

### What was accomplished under these goals?

UTCRS maintained all research, education, workforce development, technology transfer, and outreach activities and programs on schedule while transitioning from the former University of Texas-Pan American (UTPA) to the newly established regional institution The University of Texas Rio Grande Valley (UTRGV), which is the lead institution for the UTCRS.

Five research projects initially funded as part of the inaugural 2014CY Call for Proposals were completed on-schedule during this reporting period and the final report projects can be found in the UTCRS Web Site (<http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2014>). The remaining nine projects funded through the initial 2014CY Call for Proposals are still ongoing and are on schedule. Four new projects have been funded as part of the 2015CY Call for Proposals, which was reviewed and approved by the UTCRS advisory board. To facilitate the project review and selection process, the UTCRS Leadership Team decided to have the proposal review for each of the three consortium institutions to be conducted consecutively starting with the projects at UTRGV, which has already concluded its projects from the 2014CY. TAMU is close to finalizing its projects for the 2015CY Call for Proposals, and UNL will follow. In each case, four reviewers were involved in the proposal review process. The reviewers were selected based on their expertise and relevance to the railway safety research area. The UTCRS Leadership team met to discuss the reviews and comments that were received, and based their final project selection decision largely on these reviews. The following table lists all the projects that have been funded through the UTCRS to date, and summarizes the main goals and outcomes of the newly funded projects.

### RESEARCH AREAS Addressed in Prospectus: (Inaugural 2014CY Call for Proposals)

#### Completed Projects

1. **Structural Integrity of Railroad Bearing Adapters with Modifications for Onboard Monitoring Applications.** A final report has been indexed by TRB and posted on the UTCRS Web Site at <http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2014/adapter-structural-fea>

|   |
|---|
| 2. <b>Single Bearing Test Rig with Vertical, Lateral, and Impact Load Capabilities.</b> The UTCRS test rig has been fully instrumented and is operational and is currently being used to run tests for several projects aimed at improving railroad bearing performance and optimizing bearing health monitoring. A final report has been indexed by TRB and posted on the UTCRS Web Site at <a href="http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2014/single-bearing-tester">http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2014/single-bearing-tester</a>  |
| 3. <b>Effects of Vapor Grown Carbon Nanofibers on Electrical and Mechanical Properties of a Thermoplastic Elastomer.</b> A final report has been indexed by TRB and posted on the UTCRS Web Site at <a href="http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2014/conductive-pad">http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2014/conductive-pad</a>   |
| 4. <b>Modeling the Residual Useful Life of Bearing Grease.</b> A final report has been indexed by TRB and posted on the UTCRS Web Site at <a href="http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2014/lubrication-study">http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2014/lubrication-study</a>   |
| 5. <b>Applications of Magnetostrictive Materials for Real-Time Monitoring of Vehicle Suspension Components.</b> A final report has been indexed by TRB and posted on the UTCRS Web Site at <a href="http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2014/sensor-technologies">http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2014/sensor-technologies</a>  |
| <b>On-going Projects</b>  |
| 6. <b>Development of Corridor-based Traffic Signal Preemption Strategies at Signalized Intersections near Highway Railway Grade Crossings.</b> All phases of this project are progressing on schedule.  |
| 7. <b>Drivers' Perceptions of Highway-Rail Grade Crossing Safety and Their Behavior.</b> All phases of this project are progressing on schedule.  |
| 8. <b>Safety Modeling of Highway Railway Grade Crossings using Intelligent Transportation System Data.</b> All phases of this project are progressing on schedule.  |
| 9. <b>Improving Safety at Rural Highway-Rail Grade Crossings by Utilizing Light Detection and Ranging (LiDAR) Technology.</b> All phases of this project are progressing on schedule.   |
| 10. <b>Rail Neutral Temperature In-Situ Evaluation.</b> All phases of this project are progressing on schedule.   |
| 11. <b>Ultrasonic Tomography for Infrastructure Inspection.</b> All phases of this project are progressing on schedule.   |
| 12. <b>High Speed Train Geotechnics.</b> All phases of this project are progressing on schedule.  |
| 13. <b>Optimizing Performance of Railroad Rail through Artificial Wear.</b> All phases of this project are progressing on schedule.   |
| 14. <b>Vehicle-Borne Autonomous Railroad Bridge Impairment Detection Systems.</b> All phases of this project are progressing on schedule.   |
| <b>RESEARCH AREAS Addressed in UTCRS 2<sup>nd</sup> Call for Proposal (2015CY Projects):</b>  |
| 15. <b>The Effect of Heat Generation in the Railroad Bearing Thermoplastic Elastomer Suspension Element on the Thermal Behavior of Railroad Bearing Assembly.</b> The main purpose of the proposed study is to investigate the effect of heat generation in the railroad thermoplastic elastomer suspension element to develop an experimentally informed and validated finite element thermal model which can be used to attain temperature distribution maps of railroad bearing assemblies under a variety of normal and abnormal service conditions. Among other things, these maps will be useful for sensor data interpretation and identifying ideal locations for sensor placement for continuous temperature tracking of railroad bearings (e.g. IONX motes). Specifically, the main objectives of this project are: 1) to explore and quantify the heat generation in the railroad bearing elastomer suspension element with different material systems and under different loads, frequencies, and temperature scenarios; and 2) to determine the effect of this heat generation on the thermal behavior of railroad bearing assembly under different operating conditions. To that end, the contribution of the elastomer pad to the system energy balance will |

be modeled using data from dynamic mechanical analysis (DMA) of common materials in use for that part. DMA will provide a full characterization of the elastic deformation (energy storage) and viscous dissipation (energy dissipation) behavior of the material as a function of load, frequency, and temperature. In parallel, CAD models of the railroad bearing assembly will be developed using SolidWorks™ commercial software to be used in constructing finite element models utilizing the ALGOR commercial software. The finite element (FE) model will be used to conduct thermal finite element analyses using some of the expected operational boundary conditions and loads including the heat generation in the elastomer suspension system. The FE models will then be validated with some physical laboratory experiments. Finally, based on the simulations and experimental results, bearing assembly recommendations will be suggested to further ensure the safe operation of railroad bearings.

<http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2015/pad-heat-generation>

16. **Development of Predictive Models for Spall Growth in Railroad Bearing Rolling Elements.** The mechanics of spall growth in a railroad rolling element bearing will be studied using a number of bearings with spalls of various sizes. Bearings undergoing simulated service life testing will be monitored and the developing spalls will be periodically measured. From this data, a model for spall growth as a function of bearing loading, speed, and mileage will be developed. The thermal signature and vibration response of bearings with the spalls will also be obtained during testing. This signal information will permit the eventual coupling of a model of spall growth to spall detection technology to permit economical scheduling of bearing replacement after spall detection without a reduction of safety margin. Given advancements in monitoring technologies which are likely to emerge in the near future, operators will be able to identify the initiation of a spall on a bearing in service. However, a bearing with a spall is not necessarily in danger of imminent failure. To minimize disruption to operations while providing the same level of accident prevention that early detection provides, it will be necessary to understand the growth process and the associated signals generated by various size spalls to permit timely and economical replacement of failing components.

<http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2015/spall-growth-models>

17. **Radiative Heat Transfer Analysis of Railroad Bearings Using a Single Bearing Test Rig for Wayside Thermal Detector Optimization.** Testing of tapered-roller bearings for freight railcars is an area of active research at The University of Texas Rio Grande Valley (UTRGV). Current efforts are aimed at bearing health monitoring utilizing emerging temperature and vibration sensor technologies. UTRGV currently possesses two four-bearing test rigs that are used to perform laboratory experiments required to support the ongoing development of rolling stock condition monitoring research projects. Recently two bearing testers were built that allow for vertical, lateral, and impact loading capabilities in a dynamic single railroad bearing configuration. The newest single bearing test rig, built through a UTCRS funded project, provides a testing environment that more closely simulates the conditions experienced by railroad bearings in field service. The test rig will enable detailed laboratory testing that correlates realistic field service loading with railroad bearing temperature profiles. A better understanding of the correlation between loading conditions, including loads caused by defects, and temperature profiles at the bearing surface allow for greater predictive capabilities using wayside thermal detector data (e.g. data collected by Hot Box Detectors – HBDs). The data and correlations derived from the proposed in-depth thermal analysis will help identify key target areas for hot box detectors and greater understanding about the causes of particular thermal signatures detected. The impact on railway safety will be fewer temperature related failures that could potentially cause catastrophic derailments and fewer bearings pulled that do not pose a significant safety concern.



<http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2015/wayside-thermal-detector-analysis>

18. **Demonstration of Magnetostrictive Materials for Self-Powered Monitoring of Rail Vehicle Suspension Components.** The purpose of the proposed project is to demonstrate the use of magneto-strictive materials for self-powered sensors in railroad suspension components. Results obtained in a previously funded UTCRS project have shown that Terfenol-D has the capability to harvest significant amounts of energy (on the order of 100 mW/cm<sup>3</sup>) under conditions typical of those found in railcar bearing adapters, and is also capable of acting as a real time load sensor. Both applications use the same mounting fixture and static magnetic field bias, indicating that a single Terfenol-D core could simultaneously provide load sensing as well as sufficient power generation to supply its own support electronics, multiple additional sensors, and a low-power RF transceiver for wireless monitoring. The primary deliverable for this project will be an integrated, self-powered prototype comprising (a) a magneto-strictive core biased and packaged appropriately for mounting in or on a railroad bearing adapter, (b) support electronics simultaneously extracting power and providing calibrated load measurement, and (c) a basic wireless transceiver. The prototype will be tested in the UTCRS laboratory on a railroad bearing tester that closely simulates field service operating conditions.

<http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2015/power-generation-applications>

During this reporting period, UTCRS funded a total of 63 undergraduate and graduate students actively engaged in the various research, educational, workforce development, technology transfer, and community outreach activities. The UTCRS has been successful in attracting populations typically underrepresented in the transportation workforce, which is highlighted by the fact that, for the second consecutive year, at least 35% of the students involved in the center activities are female. The latter statistic more than doubles the national average of 15.7% female workforce in Transportation and Materials Moving Occupations reported by the Department of Labor Statistics in 2014.

| Undergraduate and Graduate Students Actively Involved in the UTCRS Research Projects |       |      |        |
|--|-------|------|--------|
| Classification   | Total | Male | Female |
| Undergraduate Research Assistants  | 42    | 28   | 14     |
| Masters' Research Assistants   | 12    | 7    | 5      |
| Doctoral Research Assistants   | 9     | 6    | 3      |
| Totals   | 63    | 41   | 22     |

In addition to the students involved in UTCRS sponsored research assistantships, **12** undergraduate students (10 female and 2 male) from the College of Education funded by the **Uteach Program** at UTRGV, and **13** undergraduate student volunteers from the various student organizations within the College of Engineering and Computer Science at UTRGV assisted in the 2015 UTCRS Summer Camps that attracted more than **1000** K-12 students. The number of participants in our annual UTCRS summer educational programs for K-12 students increased from **700** students in 2014 to over a **1000** students in 2015. The following table summarizes the results of the various educational activities and programs implemented by UTCRS over the reporting period from April 1, 2015 to September 30<sup>th</sup>, 2015:

## EDUCATION & OUTREACH ACTIVITIES for period (April 1, 2015 - September 30, 2015)

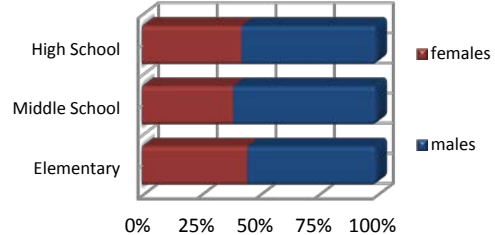
Outreach and Educational Activities aimed at Increasing Awareness of Transportation Engineering and Railway Safety Careers

A total of **975** students, grades 3-12 participated in the largest STEM camp ever held at UTRGV, June 8<sup>th</sup> through July 10<sup>th</sup> 2015. During the five weeks of camp, UTCRS hosted 500 elementary students, 400 middle school students, and 75 high school students. Demographics of program participants confirm the success of the efforts to recruit underrepresented groups in the STEM fields.

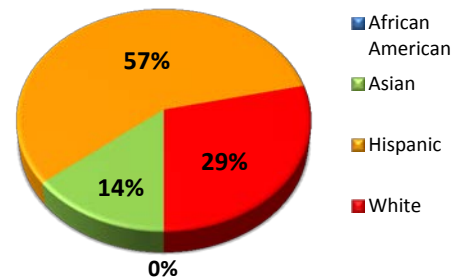
See: <http://portal.utpa.edu/railwaysafety/newsmedia/photos>



2015 UTCRS Summer Camp  
Gender Distribution



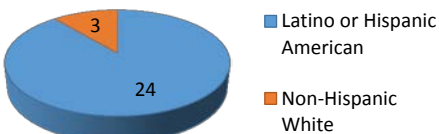
2015 UTCRS Summer Camp  
Diversity Distribution



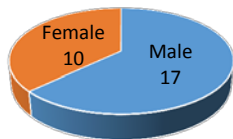
UTCRS in collaboration with the Texas Higher Education Coordinating Board (THECB) hosted its second annual Transportation Engineering Summer Enrichment Program (TESEP) from July 6-10, 2015. The **27 high school students** were pre-selected to participate in TESEP due to their interest in engineering careers. Students were exposed to research intensive activities involving conceptualization of physics laws, sensors, actuators, and data collection systems related to transportation engineering and railway safety. Demographics again show the success of UTCRS in promoting interest in transportation engineering careers among underrepresented groups.

See: [http://portal.utpa.edu/railwaysafety/newsmedia/photos\\_slideshow?setid=72157655373176808](http://portal.utpa.edu/railwaysafety/newsmedia/photos_slideshow?setid=72157655373176808)

By Ethnicity



By Gender



**Twelve** undergraduate students from UTRGV participated in the 2015 Research Experience for Undergraduates (REU) Program. During the ten-week REU Program (5/26 – 7/31), students worked alongside consortium faculty, staff, and students from Texas A&M University and the University of Nebraska-Lincoln on research-intensive projects directly related to UTCRS strategic research goals. This year's REUs also conducted professional field visits, mentored high school students, and presented their research to professionals in the railroad industry. Moreover, the 2015 REU participants will be presenting their final research findings to UTCRS consortium directors during the annual symposium scheduled at UTRGV on November 13<sup>th</sup>, 2015.

See: [http://portal.utpa.edu/railwaysafety/newsmedia/photos\\_slideshow?setid=72157651292164354](http://portal.utpa.edu/railwaysafety/newsmedia/photos_slideshow?setid=72157651292164354)  
[http://portal.utpa.edu/railwaysafety/newsmedia/photos\\_slideshow?setid=72157652056597752](http://portal.utpa.edu/railwaysafety/newsmedia/photos_slideshow?setid=72157652056597752)



Following the successful implementation of the Research Experience for Teachers (RET) Program in the summer of 2014, **eight** local STEM teachers, selected from a pool of 33 applicants, were funded to participate in the 2015 UTCRS Summer Camps. The RET participants assisted in optimizing the developed UTCRS Curricula for elementary, middle school, and high school. The Curricula focuses on STEM concepts related to transportation engineering with an emphasis on railway safety. The plan is to have the RET participants implement and promote UTCRS STEM Curricula in their home school districts and classrooms as part of their commitment to raise awareness of the transportation engineering and railway safety field.



**400 high school students** from the Texas Pre-Freshman Engineering Program (TexPREP) attended a 4-hour engineering workshop related to railway safety research. The workshop was run by UTCRS faculty and undergraduate and graduate research assistants aided by members of both the Society of Automotive Engineers (SAE) and the MiniBaja SAE team at UTRGV.

**Twelve** interns from the UTRGV College of Education, funded by the **Uteach** Program, and **thirteen** members of the student organizations (SAE, ASME, SWE, and SHPE) within the College of Engineering and Computer Science assisted in mentoring the K-12 students during the 2015 UTCRS Summer Camps. Interns had the opportunity to experience teaching STEM in a real classroom scenario, as well as conducting research to develop STEM instructional best practices and teaching methodology.

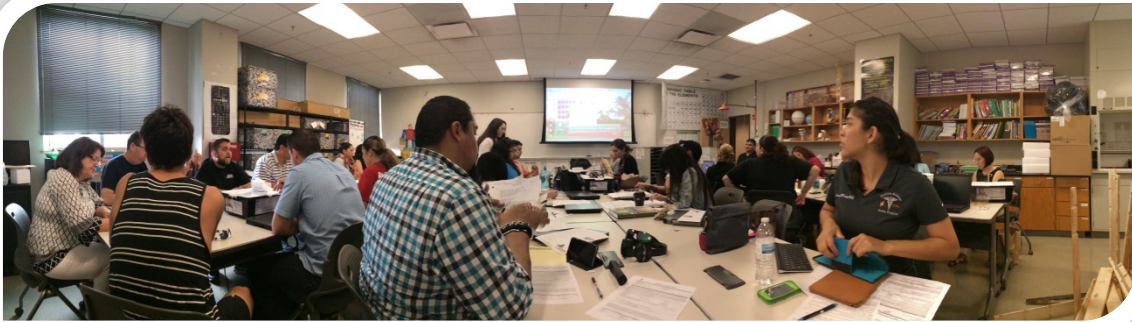


**40 K-12** STEM teachers and volunteers took part in the UTCRS Teacher Professional Development Workshop before the start of the 2015 UTCRS Summer Camps. Participants learned concepts of physics, magnetic



levitation, robotics, and engineering outlined in the developed UTCRS Curricula. These STEM teachers and volunteers applied what they learned in their 2015 UTCRS Summer Camp classrooms.

See: [http://portal.utpa.edu/railwaysafety/newsmedia/photos\\_slideshow?setid=72157655041934985](http://portal.utpa.edu/railwaysafety/newsmedia/photos_slideshow?setid=72157655041934985)



**Twelve** research assistants directed **nine** guided tours of the UTCRS research facilities for K-12 students attending the 2015 UTCRS Summer Camps. Over **1000** students learned about the various ongoing railway safety research projects from UTCRS students conducting the research. These tours helped UTCRS research assistants develop their professional presentation skills while providing the camp students the opportunity to visualize and relate the transportation engineering concepts they learned in the classroom to real-life research applications.



#### UTCRS HIGHLIGHTS for period (April 1, 2015 - September 30, 2015)

On July 13<sup>th</sup>, 2015, UTCRS hosted its Second Annual UTCRS Summer Camps Closing Ceremony. This year's ceremony was highlighted by our USDOT distinguished guests; USDOT Director of Research and Technology, Kevin Womack, and USDOT Grant Managers Amy Stearns and Dawn Tucker-Thomas. More than **1200** people attended this celebration including family members, students, faculty, staff, and UTRGV Upper Administration. The ceremony featured talks by USDOT Director of Research and Technology, Kevin Womack, UTPA President and Interim/UTRGV Provost, Havidán Rodríguez, UTRGV Senior Vice President for Research, Innovation and Economic Development, Teresa Maldonado, Interim Dean of UTRGV College of Engineering and Computer Science, Miguel Gonzalez, and UTCRS Director, Constantine Tarawneh. A video highlighting the student accomplishments and activities during the 2015 UTCRS Summer Camps was shown, followed by the selection of the Transportation Engineering Challenge Competition winners for Elementary, Middle School, and High School (see <http://portal.utpa.edu/railwaysafety>). The 2015 UTCRS Summer Camp Closing Ceremony was also featured in the local news paper "The Monitor". The article, posted August 7<sup>th</sup>, 2015, emphasized U.S. Department of Transportation (DOT) support toward local research, as well as UTCRS consortium universities role in supporting the initiatives and goals of the USDOT.

Link to Article: [http://www.themonitor.com/life/utpa-celebrates-second-railway-camp-with-usdot-and-utrgv-officials/article\\_729b7dd4-3c7c-11e5-b3e3-eb1b32815861.html#.VcUpwjh2V7E.email](http://www.themonitor.com/life/utpa-celebrates-second-railway-camp-with-usdot-and-utrgv-officials/article_729b7dd4-3c7c-11e5-b3e3-eb1b32815861.html#.VcUpwjh2V7E.email)





### UTCRS Welcomes USDOT to 2015 Summer Camps Programs Closing Ceremony!

The USDOT celebrated with the UTCRS the completion of the 2015 Summer Camps Programs on Monday, July 13th at the University of Texas-Pan American. High school overall winners pictured during the 2015 UTCRS Summer Camp Closing Ceremony with (from left to right): USDOT Grant Manager, Dawn Tucker-Thomas; UTCRS Director, Constantine Tarawneh; UTPA President ad Interim/UTRGV EVP, Havidan Rodriguez; USDOT Grant Manager, Amy Stearns; and DOT Director of Research, Development and Technology, Kevin Womack.



### 2015 UTCRS Summer Camps Closing Ceremony Distinguished Guests

USDOT officials join members of the University leadership and the UTCRS executive committee in celebrating the various educational activities of the 2015 UTCRS Summer Camps. For more details, [read the article featured in The Monitor.](#)



### The 2015 UTCRS Summer Camps Programs Were Featured in *The Monitor*

On Friday, August 7th, 2015, the University Transportation Center for Railway Safety's annual Summer Camps Programs were featured in *The Monitor*.

## What opportunities for training and professional development has the program provided?

UTCRS continued its strong commitment to develop a trained professional transportation workforce by focusing on graduating a highly-skilled and experienced cadre of graduate and undergraduate students. This reporting period, the UTCRS implemented a new practice of requiring students to present their

research findings and progress during the bi-weekly seminar series, where UTCRS Director, Constantine Tarawneh, and the faculty who have funded projects through the center give students feedback and discuss future tasks to be completed to ensure that the work stays on schedule. This new practice has contributed to much improved verbal communication skills, and has allowed the students to build confidence and gain much-needed professional presentation experience by fielding questions regarding their research work. In addition to scheduled presentations, students participated in a number of career-building activities such as: mock interviews, national railroad conferences, UTCRS laboratory tours, presenting to K-12 students, engaging high profile visitors during university and community engagement events, departmental seminars, UTCRS Symposiums, pre-college recruitment, and participating in the REU Program.

Undergraduate and graduate students involved in funded research are assigned leadership roles within research working groups, serving as primary mentors to new research assistants and as principal investigator assistants with oversight of research projects. In this way, students are expected to influence their professional supportive environment and create accountability in ensuring all UTCRS undergraduate and graduate students reach their fullest potential. Students with set graduation dates are also expected to train their position replacement to pass down knowledge, skills, and work habits before transitioning research responsibilities to a successor. While preparing for the 2015 UTCRS Summer Camps, students were given leadership roles to represent UTCRS in front of school district representatives, parents, and center partners to expose them to community engagement events.

In collaboration with the UTRGV Uteach program, which trains future educators, UTCRS provided the opportunity for **12** interns enrolled in Education and Curriculum degrees to take an active hands-on role in the 2015 UTCRS Summer Camps. During their internship, students assisted in teaching STEM lessons to K-12 students, they analyzed learning outcome data, and conducted surveys for applied STEM instructional methodology research. Overall, this collaboration proved very successful in giving students real-life teaching experience of transportation engineering and STEM concepts.



Curriculum and Instruction Interns presenting their research during the 2015 UTCRS Summer Symposium



### How have you disseminated your results?

The results of the 18 research projects funded through the UTCRS have been disseminated through professional presentations at local and national symposiums, national and international conferences, refereed journal and conference publications, technical reports, CUTC meetings, local community engagement and outreach events, and on the UTCRS website.

### What do you plan to do during the next reporting period to accomplish the goals and objectives?

- Implementation and completion of research activities as outlined in the table above for all research, education, workforce development, and technology transfer projects.
- Website will be updated to reflect new progress and upload the final reports of completed research projects. Additional tabs and resources are being added for outreach purposes.
- Increase UTCRS visibility and social media presence for greater dissemination, specifically to professional transportation workforce.
- Continue weekly conference calls with consortium Associate Directors and administrative staff to ensure an on-schedule and timely completion of all UTCRS planned activities.
- Continue the bi-weekly research meetings between faculty and student research assistants to address UTCRS goals and objectives, and identify tasks needed to meet project deliverables.
- Continue to develop student experience and leadership skills through mentoring and engagement in scholarly work with the UTCRS faculty.
- Initiate outreach activities to plan and organize the 2016 UTCR Summer Camps for elementary, middle school, and high school students.
- Promote UTCRS STEM Curricula to be implemented in local, state, and national classrooms.
- Sr. Program Coordinators from the partner institutions will continue to organize and work on key activities, such as maintenance of the UTCRS program projects onto the TRB database in preparation for the annual reporting.
- Devise a student tracking system to follow the academic and professional careers of students participating in UTCRS programs and activities in order to measure longitudinal impact.

## 2. PRODUCTS

### Publications, conference papers, and presentations:

The UTCRS sponsored projects have resulted in a number of journal, symposium, and conference publications and presentations in relevant national and international arenas, as follows:

1. Fleming, M., Kenyon, L., Upadhyay, B., Fortney, B., Kachur, R., Schinkten, O., **Chapman, A.**, Lewis, M., Baker, S., & Phelps, K., "Examining NGSS Practices through Cultural, Social, and Gender Perspectives," *Annual Meeting of National Association for Research in Science Teaching*, Chicago, IL, April 11-14, 2015.
2. **Chapman, A.**, and Walls, L., "Hispanic and White Students Perceptions of Scientists: Findings Using the Identify-a-Scientist (IAS) Instrument," *Annual Meeting of National Association for Research in Science Teaching (NARST)*, Chicago, IL, April 11-14, 2015.
3. Wilson, B. M., Fuller, A. J., **Tarawneh, C.**, and Turner, J. A., "Early Bearing Fatigue Initiation by the Identification and Selection of Bearings with Near Race Defects," *Proceeding of the 2015 International Heavy Haul Association Conference*, Perth, Australia, June 21-24, 2015. [Received Best Paper Award]
4. **Tarawneh, C.**, Maldonado, R., **Fuentes, A. A.**, and **Kypuros, J. A.**, "A vibration energy approach used to identify temperature trending in railroad tapered-roller bearings," *Int. J. Acoustics and Vibration*, Vol. 20, No. 2, pp. 69-80, 2015.



5. **Tarawneh, C., Sotelo, L., De Los Santos, N., Lechtenberg, R., Villarreal, A., and Jones, R.,** "Temperature Profiles of Railroad Tapered Bearings with Defective Inner and Outer Rings," Abstract submitted and accepted for the *2016 ASME Joint Rail Conference*, Columbia, South Carolina, USA, April 12-15, 2016.
6. **Rodriguez, O., Fuentes, A. A., Tarawneh, C., Jones, R., and Carbone, J.,** "Heat Generation in the Railroad Bearing Thermoplastic Elastomer Suspension Element," Abstract submitted and accepted for the *2016 ASME Joint Rail Conference*, Columbia, South Carolina, USA, April 12-15, 2016.
7. **Tarawneh, C.,** "Keys for a Successful University Transportation Center Operation," Invited Speaker, *US DOT OST-R Session for UTC Grantees*, New Brunswick, NJ, June 2-5, 2015.
8. **Tarawneh, C.,** "University Transportation Center for Railway Safety (UTCRS) Activities," Invited Speaker, *A Summit of University Transportation Centers for Safety*, Pittsburgh, PA, March 19-20, 2015.
9. **Perales, G.,** "Analysis of Empirical Side Friction Factors on Circular Horizontal Curves near Highway-Railway Grade Crossings," 57<sup>th</sup> Annual International Highway Engineering Exchange Program (IHEEP) Conference, Pittsburgh, PA, September 13, 2015.

UTCRS faculty participated in the following technical committees:

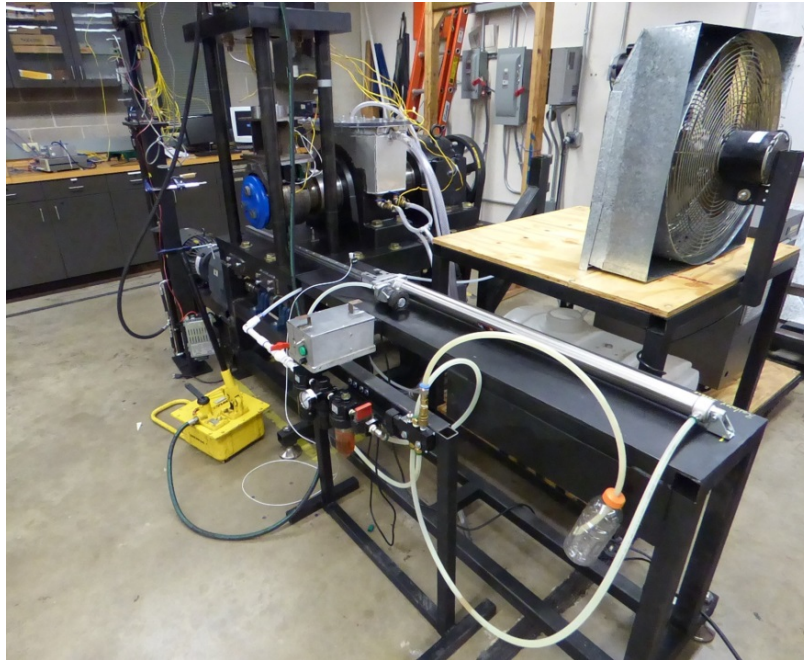
10. **Fry, G.** *Railway Working Technology Committee*. Technical Committee Member. June 6, 2015.
11. **Fry, G.** *Committee 7: Timber Structures (Acting Chair) AREMA*. Technical Committee Member. July 29-20, 2015.

#### **Website or other Internet Material:**

UTCRS Research, education, workforce development, technology transfer, and community engagement activities are primarily disseminated through our center website (<http://railwaysafety.utrgv.edu>). The UTCRS website received more than 1,300 page visits per month with an average of 1 minute 30 seconds view time per visit during this reporting period. The website is updated weekly and contains extensive photo galleries and videos of the various educational, research, workforce development, technology transfer, and outreach activities. A 'Resources' section under the 'Education' tab has been created to host the K-12 Curriculum Borrowing Agreement. Through this agreement, teachers, educators, coordinators, and other professionals are able to request the K-12 transportation engineering curriculum developed by UTCRS for use in their lesson plans, classrooms, STEM programs, or other related events. The agreement provides UTCRS with basic information about how the curriculum will be utilized as well as the intended audience. The agreement can be found at: <http://portal.utpa.edu/railwaysafety/education/resources>.

#### **Technologies or techniques:**

One of the unique products of the UTCRS is the **Single Bearing Tester** that provides specialized testing capabilities in which vertical, lateral, and impact loading can be applied simultaneously. This tester makes it possible to characterize the performance of railroad tapered-roller bearings in environments that closely mimic those of field service operation. There are currently no other test rig designs that can duplicate this tester's functionality. Over the summer, the Single Bearing Tester was equipped with a custom-built hydraulic motion controller that allows an infrared sensor to move at velocities up to 35 mph under the railroad bearing in order to mimic the field conditions where a bearing on a train passes over wayside hot-box-detector sites. This new technique, developed by UTCRS, allows researchers to analyze and characterize the performance of these widely used bearing condition monitoring devices in a laboratory setting, where it is very difficult to have the bearing travel at 35 mph over a stationary sensor, as is the case in field service. In other words, rather than have the bearing travel at 35 mph over the sensor, the sensor moves at 35 mph under the railroad bearing. This new technique is currently being utilized in two of the 2015 UTCRS funded projects.



UTCRS Single Bearing Tester Equipped with a Hydraulically-Operated Infrared Sensor Motion Controller

#### **Inventions, patent applications, and/or licenses:**

Nothing to report, all current research and workforce development activities are under implementation.

#### **Other products:**

The UTCRS Summer Camps have become one of the most popular programs in the lower Rio Grande Valley due to the overwhelming demand to deliver STEM field concepts to students at an early age in an engaging and exciting manner. The UTCRS Curricula were developed utilizing LEGO® MINDSTORMS® NXT 2.0, LEGO® MINDSTORMS® Education EV3, and MagLev educational toolkits, which can be implemented for K-12 students. The main goal is to inform and educate students on real-life transportation issues and opportunities, as well as, introduce them to railway safety applications and transportation engineering careers. UTCRS Curricula is now available for teachers, educators, and STEM program coordinators to borrow and implement at their own institutions.

### **3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS:**

#### **What individuals, organizations, or collaborators have worked on the program?**

During the current reporting period, the following individuals, organizations, and collaborators, listed hereafter, have been an integral part of the various educational, research, workforce development, and outreach activities of UTCRS.

| NAME                  | ORGANIZATION NAME                                      | RELATION     | GENDER |
|-----------------------|--|--------------|--------|
| <b>State</b>          |  |              |        |
| Acton, Jessica        | Texas Higher Education Coordinating Board (THECB)      | Education    | Female |
| Crown, Stephen, Ph.D. | Director of UTRGV Texas Pre-Freshman Program (TexPrep) | Education    | Male   |
| Nayeli Parra          | Texas Department of Transportation (TxDOT)             | Governmental | Female |

| Local                  |   |                |        |
|------------------------|---|----------------|--------|
| Dr. Esperanza Zendejas | Brownsville ISD   | Community      | Male   |
| David Cavazos          | La Joya ISD   | Community      | Male   |
| Kelly Watson           | Donna ISD   | Community      | Male   |
| Dr. Rene Gutierrez     | Edinburg CISD   | Community      | Female |
| Sandra Tovar           | Harlingen CISD  | Community      | Female |
| Cynthia Torres         | La Feria ISD  | Community      | Female |
| Wendy Grouler          | McAllen ISD   | Community      | Female |
| Dr. Sharon Roberts     | Mission CISD  | Community      | Female |
| Lisa Garcia            | Port Isabel ISD   | Community      | Female |
| Dr. Daniel Trevino     | Mercedes ISD  | Community      | Female |
| Dr. Daniel P. King     | PSJA ISD  | Community      | Male   |
| Mario Alvarado         | San Isidro ISD  | Community      | Male   |
| Heriberto Villarreal   | Santa Rosa ISD  | Community      | Male   |
| Dr. Maria Filomena Leo | Sharyland ISD   | Community      | Female |
| Dr. Marla M. Guerra    | South Texas ISD   | Community      | Female |
| Rolando Ramirez        | Valley View ISD   | Community      | Male   |
| Robert L. Olivarez     | Vanguard Academy  | Community      | Male   |
| Connie Sinoy           | Weslaco ISD   | Community      | Female |
| JoAnn Gama             | IDEA ISD  | Community      | Female |
| Barrera, Daniela       | Research Experience for Teachers (RET)<br>Mission C.I.S.D.            | District Level | Female |
| Barrera, Mariela       | Research Experience for Teachers (RET)<br>La Joya I.S.D.              | District Level | Female |
| Benitez, Andres        | Research Experience for Teachers (RET)<br>Sharyland I.S.D             | District Level | Male   |
| Camargo, Angela        | Research Experience for Teachers (RET)<br>McAllen I.S.D               | District Level | Female |
| Enriquez, Eric         | Research Experience for Teachers (RET)<br>Donna I.S.D                 | District Level | Male   |
| Garcia, Renee          | Research Experience for Teachers (RET)<br>Pharr San-Juan Alamo I.S.D. | District Level | Male   |
| Ochoa, Teresa          | Research Experience for Teachers (RET)<br>La Joya I.S.D.              | District Level | Female |
| Sanchez, Jose Jesus    | Research Experience for Teachers (RET)<br>Pharr San-Juan Alamo I.S.D. | District Level | Male   |
| Kurts, Jaime           | Co-director, Uteach   | Institutional  | Male   |
| Contreras, Robert      | Co-director, Uteach   | Institutional  | Male   |
| Mahmoud, Enad          | Assistant Professor, Civil Engineering, UTRGV                         | Institutional  | Male   |
| Garza, Barbara         | Director, Office of P-16 Initiatives, UTRGV                           | Institutional  | Female |
| Dove, Russell          | Web Designer II<br>Internet Services Department UTRGV                 | Institutional  | Male   |
| Aranda, James          | President of Society of Automotive Engineers (SAE)                    | Institutional  | Male   |
| Villarreal, Domingo    | MiniBaja Student Organization (SAE)                                   | Institutional  | Male   |
| Belmares, Milagros     | Society of Women Engineers (SWE)                                      | Institutional  | Female |
| Ortega, Gabby          | Society of Hispanic Professional Engineers (SHPE)                     | Institutional  | Female |
| Salazar, John          | American Society of Mechanical Engineers (ASME)                       | Institutional  | Male   |
| Pruneda, Ana           | American Society of Civil Engineers (ASCE)                            | Institutional  | Female |
| Private                |   |                |        |
| Wilson, Brent, Ph.D.   | Director of Research and Development Amsted Rail                      | Advisory       | Male   |

|                                  |  |                                       |        |
|----------------------------------|--|---------------------------------------|--------|
|                                  | Company, Inc. 1700 Walnut St., Granite City, IL 62040  | Board                                 |        |
| Connell, David                   | Vice President – Engineering Union Pacific Railroad Co.  | Advisory Board                        | Male   |
| Kalay, Semih                     | Vice President – Research and Development Transportation Technology Center, Inc.   | Advisory Board                        | Male   |
| Staplin, David                   | Deputy Chief Engineer – Amtrak   | Advisory Board                        | Male   |
| <b>Consortium</b>                |  |                                       |        |
| Tarawneh, Constantine, Ph.D.     | UTCRS – Director<br>Professor, Mechanical Engineering<br>University of Texas Rio Grande Valley<br>1201 West University Drive, Edinburg, TX 78539                             | Researcher/<br>Executive<br>Committee | Male   |
| Fry, Gary, Ph.D., P.E.           | UTCRS – Associate Director TAMU<br>Assoc. Professor, Civil Engineering<br>Texas A&M University<br>3135 TAMU, College Station, Texas 77843-3135                               | Researcher/<br>Executive<br>Committee | Male   |
| Rilett, Laurence, Ph.D., P.E.    | UTCRS – Associate Director UNL<br>Professor, Civil Engineering<br>University of Nebraska-Lincoln<br>262D Whittier Research Center<br>P.O. Box 830851, Lincoln, NE 68583-0851 | Researcher/<br>Executive<br>Committee | Male   |
| Freeman, Robert, Ph.D.           | UTCRS – Associate Director UTRGV<br>Professor and Chair, Mechanical Engineering  | Executive<br>Committee                | Male   |
| Lawrence-Fowler, Wendy, Ph.D.    | UTCRS – Diversity Coordinator - UTRGV<br>Professor, Computer Science   | Executive<br>Committee                | Female |
| Chapman, Angela, Ph.D.           | UTCRS – Education Coordinator - UTRGV<br>Assistant Professor, Curriculum & Instruction   | Researcher/<br>Executive<br>Committee | Female |
| Garcia, Citlalli, M.A.I.S.       | UTCRS – Sr. Program Coordinator - UTRGV  | Staff                                 | Female |
| Dove, Russell Web                | Dove, Russell Web Designer II, Internet Services,<br>UTRGV Institutional Male  | Institutional                         | Male   |
| Pena, Melissa Iliana             | UTCRS – Office Assistant III - UTRGV   | Staff                                 | Female |
| White, Amy                       | Program Coordinator<br>Center for Railway Research<br>Texas A&M Transportation Institute   | Staff                                 | Female |
| Thandayithabani, Lavania, M.B.A. | Assistant Director of Operations<br>University of Nebraska-Lincoln<br>262D Whittier Research Center<br>P.O. Box 830851, Lincoln, NE 68583-0851                               | Staff                                 | Female |
| Foltz, Heinrich, Ph.D., P.E.     | Professor and Department Chair,<br>Electrical Engineering, UTRGV   | Researcher                            | Male   |
| Fuentes, Arturo, Ph.D.           | Professor, Mechanical Engineering, UTRGV   | Researcher                            | Male   |
| Jones, Robert, Ph.D.             | Professor, Mechanical Engineering, UTRGV   | Researcher                            | Male   |
| Hurlebaus, Stefan, Ph.D.         | Texas A&M University - Civil Engineering   | Researcher                            | Male   |
| Briaud, Jean-Louis, Ph.D.        | Texas A&M University - Civil Engineering   | Researcher                            | Male   |
| Aemal Khattak, Ph.D.             | University of Nebraska-Lincoln - Civil Engineering   | Researcher                            | Male   |
| Villalobos, Cristina, Ph.D.      | Director – UTRGV C-STEM Center   | Center                                | Female |
| Lozano, Karen, Ph.D.             | Director – UTRGV Nano Materials Center   | Center                                | Female |
| Ben Ghalia, Mounir, Ph.D.        | NSF RET/ENET Grant PI - UTRGV  | Collaborator                          | Male   |



#### **4. IMPACT:**

##### **What is the impact on the development of the principal discipline(s) of the program?**

Via research projects currently underway, UTCRS is able to report various indicators of impact, including:

- UTCRS researchers have established a vital track record in the area of experimentally validated finite element analysis in the railway safety area. The research results from the latest UTCRS funded project titled “The Effect of Heat Generation in the Railroad Bearing Thermoplastic Elastomer Suspension Element on the Thermal Behavior of Railroad Bearing Assembly” will be presented at different local, national, and international conferences with different audiences that include science and engineering students and faculty, railroad industry representatives, and researchers in the private and public sectors.
- A new innovative technique for analyzing and characterizing the performance of wayside hot-box-detection bearing condition monitoring systems in a laboratory setting has been devised and is currently being utilized in various projects.
- A clear pathway to graduate studies between the three consortium institutions has been established and has resulted in five students who participated in the 2014 REU Program enrolling in graduate school in the three consortium institutions pursuing their Master’s degree. These five students were not planning on pursuing their graduate studies prior to participating in the UTCRS REU Program. Note that the lead institution (UTRGV) does not have a Master’s program in Civil Engineering.
- Training of a critical mass of engineering students in the use of finite element analysis (FEA) techniques and methodologies, while attracting other students to the transportation field through the presentation of several research case studies in the Introduction to Finite Element Methods course offered at UTRGV.
- UTCRS has been successful in attracting a large percentage of women and minorities, typically underrepresented in the transportation engineering fields, to the discipline. These groups are receiving rigorous hands-on training through active engagement in railway safety research applications that are vital for the railroad industry.

##### **What is the impact on other disciplines?**

UTCRS brought together faculty and students from six different departments and colleges with the purpose of exemplifying the interdisciplinary nature of the transportation industry. The various UTCRS activities involve collaborative efforts between mechanical, electrical, civil, and manufacturing engineering fields as well as computer science and curriculum and instruction. Faculty and students from these different disciplines are working in unison towards promoting transportation engineering and improving railway safety.

In the field of curriculum and instruction, the UTCRS has brought STEM pedagogical research opportunities to the College of Education and P-16 Integration at The University of Texas Rio Grande Valley (UTRGV). These opportunities have resulted in the establishment of a research group within the College of Education that is investigating how to improve retention of underrepresented groups in the Rio Grande Valley in STEM fields and careers. The findings from the inaugural 2014 UTCRS Summer Camps were presented at the National Association for Research in Science Teaching (NARST) and have resulted in two manuscripts that will be submitted to the Journal of STEM Education. In addition, the 2015 UTCRS Summer Camps provided the opportunity for **12** undergraduate students (10 female and 2 male) sponsored by the Uteach program at UTRGV to conduct educational studies related to the statistics and surveys collected from the **1000+** camp participants. These students are continuing the

work they started in the summer during the Fall 2015 semester. One of the main objectives of the aforementioned studies is to analyze student participant perceptions on the various aspects of instruction, including developing an engaging curriculum and teaching tools for K-12 students.

The workforce development efforts of the Center are led by a dedicated group of faculty comprised of members from the department of curriculum and instruction (College of Education) in collaboration with the various engineering programs involved in the Center (mechanical, civil, electrical, manufacturing, and computer science). Through this collaboration, a number of hands-on STEM Workshops for educators have been offered to develop the skill-sets required to teach transportation engineering concepts in their classroom and to expose educators to use appropriate pedagogy to engage students and expose them to all areas of the STEM fields. Teachers unable to attend the STEM Workshops can now benefit by borrowing the developed UTCRS STEM Curricula and available toolkits, which comprise complete lesson plans based on national and state science standards.

The UTCRS continued its partnership with TexPREP and the The Higher Education Coordinating Board (THECB) to extend STEM camp opportunities to high school students who do not qualify for TexPREP. For the second consecutive year, UTCRS partnering with TexPREP offered the Transportation Engineering Summer Enrichment Program (TESEP) that was funded by the THECB. TESEP exposed high school students interested in engineering careers to transportation engineering concepts emphasizing railway safety. As a transportation center committed to addressing the overwhelming interest in STEM camps, forming a partnership with a well-established program like TexPREP is a noteworthy success for UTCRS. The significant increase in the number of students exposed to STEM camps in 2015 as compared to 2014 is another indicator of the success of the education efforts of UTCRS.

### **What is the impact on the development of transportation workforce development?**

UTCRS had a number of contributions to workforce development this reporting period. The training of a critical mass of K-12 STEM teachers and providing them with learning modules and teaching tools that will aid in raising awareness of transportation engineering fields and railway safety among K-12 students. Additionally, the UTCRS continued its mission to develop the graduate and undergraduate student talent working on the various research projects on transportation engineering issues pertaining to railway safety in terms of mechanical, infrastructure, and operations research. Through their involvement in these research projects, students are acquiring advanced engineering skills in materials development, manufacturing, design and fabrication of mechanical systems, structural design, operations management, and instrumentation and controls. Furthermore, the students are cross-trained to use mechanical and electrical equipment in order to build efficient systems. Having mechanical engineering students working alongside electrical and civil engineering students and faculty from across consortium universities also provides students valuable expertise and transferable skills they will apply to their future professional careers in the transportation engineering fields.

One great success story that highlights the contribution of UTCRS in terms of workforce development is that of Ms. Gabriela Perales. Ms. Perales was one of the students that were selected to participate in the inaugural 2014 REU Program. As a result of her participation, she decided to pursue her graduate studies at one of the consortium institutions working on a railway safety project funded by the UTCRS. She was admitted to the Civil Engineering graduate program at the University of Nebraska-Lincoln in December of 2014 and started her Master's work in January of 2015. In her first year as a graduate student, she presented her research, "Analysis of Empirical Side Friction Factors on Circular Horizontal Curves near Highway-Railway Grade Crossings," at the annual International Highway Engineering Exchange Program

(IHEEP) Conference in Pittsburgh, PA. Given the exceptional quality of her work, Perales' presentation won in Area III of the Education Scholarship Presentations (ESP) Program competition and advanced to the International IHEEP Conference ESP Competition. The ESP program is intended to introduce young engineers who are training in transportation-related disciplines to IHEEP and potential DOT or sponsor employers. Her accomplishments and success in such a short period have earned her the 2015 Student of the Year (SOY) honors where she will be representing the UTCRS in the winter CUTC meeting.

### **What is the impact on physical, institutional, and information resources at the university or other partner institutions?**

The UTCRS continues to expand its collaborations among the departments and colleges involved in the various center activities. The different departments involved with the UTCRS have made their resources available to the students working on center activities, which resulted in increased productivity and efficiency. The cross-training of students in the engineering fields working alongside the curriculum and instruction students has been beneficial to these students and the workforce development efforts of the center. The University of Texas Rio Grande Valley (UTRGV) is striving to become a Tier 1 Research Institution. The advanced research conducted by the UTCRS which is generating high-caliber publications that are being presented at national and international conferences are in line with the overall institutional research goals. Furthermore, the effective collaboration among the consortium institutions is providing students superior research opportunities since they have access to the resources available at the three institutions.

The community outreach activities of the UTCRS have strengthened the institutional collaborations between UTRGV and the local Rio Grande Valley School Districts. More than **26** school districts have collaborated with the UTCRS to help organize the 2015 Summer Camps that benefited more than **1000** K-12 students. These collaborative efforts are ongoing as local teachers borrow the UTCRS STEM curricula and toolkits to implement in their classrooms. This mutually beneficial relationship provides resources for K-12 science teachers and, in return, UTRGV and UTCRS meet their educational goals of encouraging students to learn and consider careers in STEM, transportation, and railway safety fields.

The REU Program sponsored by the UTCRS generates tremendous benefits to all three consortium institutions. The UTRGV College of Engineering and Computer Science does not have a doctoral graduate program, or a Master's Program in Civil Engineering; hence, the REU Program has facilitated pathways for undergraduate and graduate students from UTRGV to enroll in doctoral granting graduate programs at TAMU and UNL. **Five** of the **eight** students that participated in the 2014 REU Program have joined graduate programs in the three consortium universities. UTCRS expects for this trend to grow as more students participate in the annual REU program.

### **What is the impact on technology transfer?**

In terms of research, the UTCRS has published nine papers in national and international journals and conferences and presented the findings to professionals in the railroad industry and the education community. Moreover, the developed UTCRS STEM curricula are being shared with the school districts for use in their classrooms in an effort to raise awareness of transportation fields among K-12 students.

The Single Bearing Test Rig capable of applying simultaneous vertical, lateral, and impact loading has been equipped with a custom-built hydraulic motion controller that allows an infrared sensor to move at velocities up to 35 mph under the railroad bearing in order to mimic the field conditions where a bearing on a train passes over wayside hot-box-detector sites. This new technique, developed by UTCRS,

allows researchers to analyze and characterize the performance of these widely used bearing condition monitoring devices in a laboratory setting, where it is very difficult to have the bearing travel at 35 mph over a stationary sensor, as is the case in field service.

### **What is the impact on society beyond science and technology?**

The University Transportation Center for Railway Safety (UTCRS) has had a noticeable impact on society through the various research, educational, workforce development, technology transfer, and outreach activities. The UTCRS programs are focused on closing the gap between theory and application of transportation engineering concepts by giving all participants (K-12 Summer Camps, REU, RET, TESEP, and student research assistants) a hands-on experience from which to gain transportation engineering and railways safety concepts and expertise. The significant increase in the number of participants in all UTCRS led programs during this reporting period is a clear indicator that UTCRS is offering the necessary teaching tools, experiences, trainings, and professional development opportunities. Research projects have yielded results and products which have been disseminated in various national and international rail conferences and journals. Products developed through collaborations, such as in education, have also been disseminated and accepted in several national conferences and journals. The UTCRS has engaged to date more than 63 graduate and undergraduate students, seventeen faculty, and seven staff members in its various educational, research, workforce development, technology transfer, and outreach activities, not counting the volunteers from the student engineering societies that have assisted the center during the 2015 UTCRS Summer Camps. The UTCRS activities are aimed at increasing awareness of transportation fields, transportation workforce diversification, and enhancing railway safety across the nation, which demonstrates the strong commitment to USDOT initiatives and goals.

The impact on the Rio Grande Valley has been tremendous given the fact that prior to the UTCRS, people in this region of the country did not know or hear of the USDOT UTC Program and its benefits. The graduate and undergraduate students involved in the Center presented their work as part of the Center's community outreach activities to more than **1450** K-12 students participating in both the UTCRS Summer Camps and the Texas Pre-freshman Engineering Program (TexPREP). Additionally, the UTCRS staff presented information to school districts, super-intendents, coordinators, teachers, volunteers and parents about the USDOT UTC Program and the UTCRS in UTRGV through its numerous 2015 Summer Camp meetings and orientations. Upwards of **2500** community members have been made aware of the work and the importance of USDOT and transportation fields in their society. These informative sessions have helped highlight the initiatives and goals of the USDOT UTC Programs across the nation, and the need to keep developing the talent that will feed into the various transportation fields, especially among underrepresented groups. A video highlighting the UTCRS activities during this reporting period can be found at <https://vimeo.com/134233245>.

### **5. CHANGES/PROBLEMS:**

A Sr. Program Coordinator for UTCRS in UTRGV was hired on May 28<sup>th</sup>, 2015 in accordance with all internal university and US DOT requirements for the position. Information and CV for this new staff member has been uploaded to the UTCRS website.

### **6. SPECIAL REPORTING REQUIREMENTS:**

Nothing to Report.