



## 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:** April 30, 2017
- **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:** March 31, 2017
- **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



**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, leadership activities, education and outreach activities, and technology transfer and implementation, the following was accomplished for this reporting period:

Research Activities	Status	% Complete
Call for Problem Statements for 3 <sup>rd</sup> Round of 2015-2016 Call for Proposals	Complete	100%
External Review for 3 <sup>rd</sup> Round of 2015-2016 Call for Proposals	Complete	100%
Proposals Reviewed by Executive Committee for 3 <sup>rd</sup> Round of 2015-2016 Call for Proposals	Complete	100%
Review Budgets for 3 <sup>rd</sup> Round of 2015-2016 Call for Proposals	Complete	100%
Final Ranking & Selection of Proposals for 3 <sup>rd</sup> Round of 2015-2016 Call for Proposals (UNL and UTRGV Projects)	Complete	100%
Finalize Project Selection Process Under UTCRS for All Consortium Members	Complete	100%
2014CY Selected Research Projects Completion	Complete	100%
2014CY Final Reports Due	Complete	100%
2015-2016CY Research Projects Under Contract for All Consortium Members	On Schedule	40%
Technology Transfer Briefs, Webinars, Symposiums, and Presentations on Research Results	On Schedule	60%
Applicable Slides, Handouts, Videos, Pictures Posted	Complete	100%
Final Reports Due & All Research Projects Completed	On Schedule	50%
Leadership Activities		
Coordination between UTCRS Director and Leadership Team	Complete	100%
Commit Remaining UTCRS Budget Funds and Finalize All Subcontracts with Consortium Members	Complete	100%
UTCRS Leadership Team Update	Complete	100%
2016 UTCRS Student of the Year Selection	Complete	100%
Education & Outreach Activities		
Call for 2017 Research Experience for Teachers (RET) Program	Complete	100%
Selection of 2017 Research Experience for Teachers (RET) Program Participants	Complete	100%
Meetings with the Lower Rio Grande Valley Independent School District Superintendents and their Representatives	Complete	100%
Parent Orientation Sessions for 2017 UTCRS K-12 Summer Camps	In progress	60%
Preparations for 2017 UTCRS K-12 Summer Camps	On Schedule	80%

Technology Transfer Activities		
Preparations for 2017 UTCRS K-12 STEM Teacher National Workshop	On Schedule	80%
Development of Elementary, Middle, 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	Complete	100%
UTCRS Spring 2017 Newsletter Describing Center Activities	Complete	100%
UTCRS Supported Journal and Conference Publications and Presentations	On Schedule	70%
UTCRS Supported Presentations, Symposiums, Workshops, and Short Courses	On Schedule	70%
USDOT OST-R: Reporting		
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%
Update UTCRS-UTRGV Website Research Repository	Complete	100%
Posting of Newly Funded Research Projects & Descriptions (Exhibit Fs)	Complete	100%

**What was accomplished under these goals?**

The UTCRS continues its timely delivery of comprehensive research, education, workforce development, technology transfer, and community outreach programs in support of the USDOT mission to train and develop the next transportation workforce that is prepared to design, deploy, operate, and maintain the complex transportation systems of the future. In particular, the UTCRS offered its annual Research Experience for Undergraduates (REU) Program Fall Symposium in which the 14 students that participated in the 2016 REU Program, along with other UTRGV undergraduate and graduate research assistants, presented their research projects through oral and poster presentations. Furthermore, the UTCRS continued its Research Experience for Teachers (RET) Program, which will feature 7 STEM teacher participants in summer of 2017, funded by the school districts who have come to depend on the UTCRS Summer Programs for teacher professional development, and to serve their students’ needs in terms of STEM Summer Camps. For the fourth consecutive year, the UTCRS Summer Camps will be hosting more than 1000 K-12 students who will be exposed to STEM curricula focused on transportation engineering with an emphasis on railway safety. The 2017 UTCRS K-12 STEM Teacher National Workshop is also expected to attract more than 70 STEM teachers that will undergo a full-day workshop on the use of the UTCRS developed curricula focused on transportation engineering. Recognizing the benefits and impact of the educational programs offered by the UTCRS, community collaborations have widely expanded, which is evident by the generous financial support (~\$100K) of the Independent School Districts in the Lower Rio Grande Valley (LRGV) for the 2017 UTCRS K-12 Summer Camps and STEM Teacher National Workshop. Currently, the UTCRS offers the *only* transportation related STEM summer camp for elementary students in the Rio Grande Valley (RGV).

To date, the UTCRS has funded **36** research projects aligned with the UTCRS strategic research goals in the three consortium institutions (11 at UTRGV-Lead Institution, 12 at UNL, and 13 at TAMU). The fourteen research projects initially funded as part of the inaugural 2014CY Call for Proposals have all been completed on-schedule, and the final reports have been posted on the UTCRS website and indexed on the TRID database. The twenty projects selected for funding at the three consortium institutions as part of the 2015CY Call for Proposals are progressing on schedule. UTRGV had a final 2017CY Call for Proposals to

commit the remainder of the allotted Federal funds, and two new projects were selected for funding starting February 2017 with an end date of August 2018. External reviewers from federal, state, and local agencies whose areas of expertise align with the subject matter of the proposed research projects were involved in the proposal peer-review process. Hence, as of January 2017, all Federal Funds allotted to the UTCRS have been fully committed, and all ongoing projects are progressing on schedule and are expected to complete by no later than August 2018. The following table provides a list of all the research projects that are/were funded by the UTCRS including links to the web pages that contain full project descriptions:

<b>RESEARCH AREAS: Addressed in Prospectus: 2014CY Call for Proposals</b>	
<b>Completed Projects</b>	
<b>1.</b>	<b>Structural Integrity of Railroad Bearing Adapters with Modifications for Onboard Monitoring Applications.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2014/modified-railroad-bearing-adapter-for-onboard-monitoring/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2014/modified-railroad-bearing-adapter-for-onboard-monitoring/index.htm</a>
<b>2.</b>	<b>Effects of Vapor Grown Carbon Nanofibers on Electrical and Mechanical Properties of a Thermoplastic Elastomer.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2014/conductive-railroad-bearing-suspension-element/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2014/conductive-railroad-bearing-suspension-element/index.htm</a>
<b>3.</b>	<b>Modeling the Residual Useful Life of Bearing Grease.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2014/life-of-bearing-grease/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2014/life-of-bearing-grease/index.htm</a>
<b>4.</b>	<b>Applications of Magnetostrictive Materials for Real-Time Monitoring of Vehicle Suspension Components.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2014/applications-of-magnetostrictive-materials/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2014/applications-of-magnetostrictive-materials/index.htm</a>
<b>5.</b>	<b>Single Bearing Test Rig with Vertical, Lateral, and Impact Load Capabilities.</b> The UTCRS test rig has been fully instrumented and operational. It 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 TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2014/single-bearing-test-rig/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2014/single-bearing-test-rig/index.htm</a>
<b>6.</b>	<b>Improving Safety at Rural Highway-Rail Grade Crossings by Utilizing Light Detection and Ranging (LiDAR) Technology.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/operations/improving-safety-at-hrgc-by-using-lidar-technology/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/improving-safety-at-hrgc-by-using-lidar-technology/index.htm</a>
<b>7.</b>	<b>High Speed Train Geotechnics.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/high-speed-train-geotechnics/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/high-speed-train-geotechnics/index.htm</a>
<b>8.</b>	<b>Development of Corridor-based Traffic Signal Preemption Strategies at Signalized Intersections near Highway Railway Grade Crossings.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/operations/traffic-signal-preemption-strategies-near-hrgc/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/traffic-signal-preemption-strategies-near-hrgc/index.htm</a>
<b>9.</b>	<b>Drivers' Perceptions of Highway-Rail Grade Crossing Safety and Their Behavior.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/operations/drivers-perceptions-of-hrgc/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/drivers-perceptions-of-hrgc/index.htm</a>
<b>10.</b>	<b>Safety Modeling of Highway Railway Grade Crossings using Intelligent Transportation System Data.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/operations/modeling-of-hrgc-using-its/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/modeling-of-hrgc-using-its/index.htm</a>
<b>11.</b>	<b>Rail Neutral Temperature In-Situ Evaluation.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/evaluation-of-rail-neutral-temperature/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/evaluation-of-rail-neutral-temperature/index.htm</a>
<b>12.</b>	<b>Ultrasonic Tomography for Infrastructure Inspection.</b> A final report has been indexed by TRID and posted on the UTCRS website at

<a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/ultrasonic-tomography-for-infrastructure-inspection/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/ultrasonic-tomography-for-infrastructure-inspection/index.htm</a>
13. <b>Optimizing Performance of Railroad Rail through Artificial Wear.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/railroad-rail-performance/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/railroad-rail-performance/index.htm</a>
14. <b>Vehicle-Borne Autonomous Railroad Bridge Impairment Detection Systems.</b> A final report has been indexed by TRID and posted on the UTCRS website at <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/railroad-bridge-impairment-detection-systems/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/railroad-bridge-impairment-detection-systems/index.htm</a>
<b>RESEARCH AREAS: Addressed in Prospectus: 2015CY Call for Proposals</b>
<b>On-going 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> <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2015/heat-generation-in-the-railroad-bearing-suspension-element/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2015/heat-generation-in-the-railroad-bearing-suspension-element/index.htm</a>
16. <b>Development of Predictive Models for Spall Growth in Railroad Bearing Rolling Elements.</b> <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2015/predictive-models-for-spall-growth-in-railroad-bearings/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2015/predictive-models-for-spall-growth-in-railroad-bearings/index.htm</a>
17. <b>Radiative Heat Transfer Analysis of Railroad Bearings Using a Single Bearing Test Rig for Wayside Thermal Detector Optimization.</b> <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2015/radiative-heat-transfer-analysis-of-railroad-bearings/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2015/radiative-heat-transfer-analysis-of-railroad-bearings/index.htm</a>
18. <b>Demonstration of Magnetostrictive Materials for Self-Powered Monitoring of Rail Vehicle Suspension Components.</b> <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2015/energy-harvesting-applications/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2015/energy-harvesting-applications/index.htm</a>
19. <b>A Mechanistic Investigation of Concrete Tie Degradation in the Rail Seat.</b> <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/investigation-concrete-tie-degradation/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/investigation-concrete-tie-degradation/index.htm</a>
20. <b>Bumps in High Speed Rails: What is Tolerable?</b> <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/bumps-in-high-speed-rails/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/bumps-in-high-speed-rails/index.htm</a>
21. <b>Dynamic Live Load Effects of Railroad on Retaining Walls and Temporary Shoring.</b> <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/dynamic-live-load-effects-of-railroads-on-retaining-walls/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/dynamic-live-load-effects-of-railroads-on-retaining-walls/index.htm</a>
22. <b>Estimating Bridge Span Deflections Using Data Streams from Rolling Stock.</b> <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/bridge-span-deflection-estimation/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/bridge-span-deflection-estimation/index.htm</a>
23. <b>Fatigue and Service Analysis of Railroad Eyebars Members.</b> <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/service-analysis-of-eyebars-members/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/service-analysis-of-eyebars-members/index.htm</a>
24. <b>Method for Predicting Thermal Buckling in Rails.</b> All phases of this project are progressing on schedule. <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/thermal-buckling-in-rails/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/thermal-buckling-in-rails/index.htm</a>
25. <b>Multi-scale Fatigue Damage Life Assessment of Railroad Wheels.</b> <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/wheel-fatigue-damage-life-assessment/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/wheel-fatigue-damage-life-assessment/index.htm</a>
26. <b>Strength and Fracture Toughness of Railroad Eyebars Members.</b> <a href="http://www.utrgv.edu/railwaysafety/research/infrastructure/fracture-of-eyebars-members/index.htm">http://www.utrgv.edu/railwaysafety/research/infrastructure/fracture-of-eyebars-members/index.htm</a>
27. <b>Anti-Icing LED Light Covers for Railroad Safety.</b> <a href="http://www.utrgv.edu/railwaysafety/research/operations/anti-icing-led-light-covers-for-railroad-safety/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/anti-icing-led-light-covers-for-railroad-safety/index.htm</a>
28. <b>Heavy Truck and Bus Traversability at Highway-Rail Grade Crossings.</b> <a href="http://www.utrgv.edu/railwaysafety/research/operations/heavy-truck-traversability-at-hrgc/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/heavy-truck-traversability-at-hrgc/index.htm</a>



29. <b>Improving Crash Prediction - A More Relevant Exposure Measure than AADT for Highway-Rail Crossing Safety Models.</b> <a href="http://www.utrgv.edu/railwaysafety/research/operations/improving-crash-predictions-at-hrgc/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/improving-crash-predictions-at-hrgc/index.htm</a>
30. <b>Best Practices for Modeling Light Rail at Intersections.</b> <a href="http://www.utrgv.edu/railwaysafety/research/operations/modeling-light-rail-intersections/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/modeling-light-rail-intersections/index.htm</a>
31. <b>Unifying Railcar Monitoring Sensor Data, Maintenance Records, and Railcar Usage Information through Big Data Processing for Optimizing Railcar Maintenance and Safety.</b> <a href="http://www.utrgv.edu/railwaysafety/research/operations/rail-equipment-safety/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/rail-equipment-safety/index.htm</a>
32. <b>Shipments of Oil By Rail: Economic Implications for Safety and Safety-Related Investments.</b> <a href="http://www.utrgv.edu/railwaysafety/research/operations/shipments-of-oil-by-rail/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/shipments-of-oil-by-rail/index.htm</a>
33. <b>Highway-Rail Crossing Safety Improvement by Diverting Motorists to Alternate Routes.</b> <a href="http://www.utrgv.edu/railwaysafety/research/operations/highway-rail-crossing-safety-diverting-motorists/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/highway-rail-crossing-safety-diverting-motorists/index.htm</a>
34. <b>Railyard Worker Safety through innovative Mobile Active Train Detection and Risk Localization.</b> <a href="http://www.utrgv.edu/railwaysafety/research/operations/railyard-worker-safety-mobile-active-train-detection/index.htm">http://www.utrgv.edu/railwaysafety/research/operations/railyard-worker-safety-mobile-active-train-detection/index.htm</a>
<b>RESEARCH AREAS: Addressed in Prospectus: 2017CY Call for Proposals</b>
<b>New Projects</b>
35. <b>Prototyping and Testing of Electrically Conductive Thermoplastic Polyurethane (TPU) Railroad Suspension Pad.</b> <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2017/prototyping-conductive-tpu-railroad-suspension-pad/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2017/prototyping-conductive-tpu-railroad-suspension-pad/index.htm</a>
36. <b>Low Power Wireless Sensors for Railroad Bearing Health Monitoring.</b> <a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2017/wireless-sensors-for-railroad-bearing-health-monitoring/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2017/wireless-sensors-for-railroad-bearing-health-monitoring/index.htm</a>

During this reporting period, the UTCRS financially supported 62 undergraduate, master’s, and doctoral students actively involved in the various UTCRS funded research projects and educational programs. As part of our commitment to transportation industry workforce development, a substantial number of research positions at the UTCRS are exclusively available for undergraduate students to experience working in a professional and research-intensive environment early in their academic careers. The majority of the UTCRS undergraduate students pursue master’s degrees upon graduation, and remain actively engaged in research, workforce development, and technology transfer activities.

<b>Student Researcher Classification</b>	<b>Number</b>	<b>Male</b>	<b>Female</b>
Undergraduate Research Assistants	33	17	16
Masters’ Research Assistants	16	12	4
Doctoral Research Assistants	13	8	5
Totals	62	37	25

Students funded by the UTCRS are also actively involved in education and outreach efforts through on-campus and off-campus community events where they present about the different transportation careers and opportunities available to students, and talk about railway safety issues and ongoing research projects being conducted at the UTCRS. These students facilitate, on a regular basis, presentations, tours, and symposiums, and attend various community events and K-12 science fairs representing the UTCRS. This reporting period, the UTCRS experienced a significant increase in requests for tours of the UTCRS laboratory facilities. This has proven exceptionally successful in giving students professional outreach

experience to promote and provide visitors with an accurate representation of the scope of railway safety research being performed at the UTCRS. The UTCRS outreach efforts reached more than 2000 community members through numerous information sessions and tours, and hosted an additional 1000 local K-12 students for tours of the UTCRS research facilities at UTRGV. The success of the aforementioned outreach efforts is evident in terms of participants' recruitment for education, workforce development, and outreach programs for summer of 2017. The UTCRS received 30 applications and selected 7 STEM teachers for the 2017 Research Experience for Teachers (RET) Program, and recruited, for the third consecutive year, over 1000 elementary, middle, and high school students, from Lower Rio Grande Valley (LRGV) school district partners, to attend the 2017 UTCRS Summer Camps. Additionally, more than 60 teachers have already registered for the 2017 UTCRS STEM Teacher National Workshop that is planned for June 3, 2017. The following is a summary of the educational, workforce development, and outreach activities carried out over the period from October 1, 2016 to March 31, 2017:

**EDUCATION & OUTREACH ACTIVITIES for period (October 1<sup>st</sup>, 2016 – March 31<sup>st</sup>, 2017)**  
 Outreach and Educational Activities aimed at Increasing Awareness of Transportation Engineering and Railway Safety Careers



The UTCRS hosted its Third Annual Research Experience for Undergraduates (REU) Symposium at UTRGV on December 2, 2016. The event served as a research forum for the **14 UTRGV REU students** who participated in the 2016 REU Program, as well as the rest of the UTCRS undergraduate and graduate research assistants. Students presented their railway safety research projects through a poster session and an oral presentation, in front of faculty and students in the College of Engineering and Computer Science and members of the community. The event demonstrated the wide range of research topics investigated by the UTCRS. The symposium was also a great opportunity for students to receive feedback and advice from faculty and peers on the future direction of their research efforts.

See: <https://www.flickr.com/photos/131769328@N02/sets/72157677456549865/with/31324619561/>



Following the successful implementation of the Research Experience for Teachers (RET) Program over the last three years through which 26 teachers were trained and provided the required tools to implement the UTCRS developed modules to introduce students to STEM concepts using transportation engineering and railway safety applications, the UTCRS solicited and received **30** applications for the 2017 RET Program. The UTCRS Leadership Team selected 7 teachers to participate in the 2017 RET Program. The program will begin on June 3<sup>rd</sup> and end on July 6<sup>th</sup>, 2017. The participants will actively engage in a variety of UTCRS research and education activities.

See: <http://www.utrgv.edu/railwaysafety/education/summer-exp/ret/index.htm>



## APPLICATIONS ARE NOW AVAILABLE

Contact your School Principal or District Program Coordinator for more information

## 2017 RAILWAY SAFETY Summer Camps

The University Transportation Center for Railway Safety (UTCRS) Summer Camps introduce students to STEM concepts related to Transportation Engineering with an emphasis on Railway Safety using:

LEGO Mindstorm/Robotics Kits  
Magnetic Levitation Train Kits

### Available Dates

Week 1: June 5 - 9, 2017  
Week 2: June 12 - 16, 2017  
Week 3: June 19 - 23, 2017  
Week 4: June 26 - 30, 2017

### Grade Levels

Elementary Grades 3 - 5  
Middle School Grades 6 - 8  
High School Grades 9 - 12

Final Competitions & Closing Ceremony  
July 6, 2017

Following three successful years of implementation of the UTCRS Summer Camps in 2014 (700 participants - 300 elementary, 300 middle school, and 100 high school), in 2015 (1000 participants - 450 elementary, 425 middle school, and 125 high school), in 2016 (1300 participants - 585 elementary, 515 middle school, and 200 high school), the 2016 UTCRS Summer Camps, to be held at UTRGV from June 5<sup>th</sup> to June 30<sup>th</sup>, will host over 1000 K-12 students (482 elementary, 417 middle school, and 116 high school) from the local school districts in the Lower Rio Grande Valley (LRGV). The UTCRS Summer Camps, acknowledged as the largest transportation related summer camps in the nation, have become the main program to attend for K-12 RGV students who are interested in STEM activities. To improve the 2017 Summer Camps, the UTCRS coordinated with 26 school district superintendents and coordinators and met on several occasions since November 2016 to implement new processes that will enhance the benefits to the students and teachers. The school districts once again provided financial support to cover 'participant support' fees to cost share program expenses. RET program participants, chaperon teachers, and volunteer staff have been recruited from participating school districts to

facilitate activities during the 2017 UTCRS Summer Camps. Participating RET teachers and volunteers will be trained by the UTCRS faculty and staff on June 3, during the 2017 K-12 STEM Teacher National Workshop, where teachers will gain invaluable STEM knowledge and hands-on training to apply the UTCRS curricula. Teachers trained in this workshop can borrow the UTCRS educational kits free of charge and deliver the railway safety modules to students in their classroom.

See: <http://www.utrgv.edu/railwaysafety/education/summer-camps/utcrs/index.htm>

## 2017 STEM Teacher National Workshop



Saturday June 3, 2017



8:00 am to 12:00 pm

### Session 1

#### Exploring with MagLevs

- Explore STEM concepts with the developed Magnetic Levitation Kits curriculum.
- Make the connection between STEM concepts and hands-on experiences and ways to implement in the classroom, with emphasis on transportation-related engineering and technology applications.



1:00 to 5:00 pm

### Session 2

#### Exploring with Lego Robotics

- Explore STEM concepts with the developed Lego Mindstorm Robotics Kits curriculum.
- Make the connection between STEM concepts and hands-on experiences and ways to implement in the classroom, with emphasis on transportation-related engineering and technology applications.



12:00 to 1:00 pm  
Lunch Break



University of Texas Rio Grande Valley (UTRGV)  
1201 W. University Dr., Edinburg, Texas 78539  
EENGR 1.300 (Engineering Auditorium)



To register: <https://goo.gl/forms/nZmiQsKTMXwN4k702>  
Information: <http://utrgv.edu/railwaysafety/2017-stem-workshop>



[railwaysafety@utrgv.edu](mailto:railwaysafety@utrgv.edu)  
(956) 665-8878  
EENGR Portable 1.100



Over the past three years, the UTCRS STEM Teacher Professional Development Workshops have helped train more than 300 Rio Grande Valley teachers to implement in their classrooms transportation engineering curricula and modules with an emphasis on railway safety. This year, the UTCRS will again train over 70 educators and coordinators on the use of the UTCRS developed curricula in its 2017 STEM Teacher National Workshop (Transportation in the Classroom) planned for June 3, 2017. The Workshop will provide hands-on training on the use and implementation of all the UTCRS developed curricula. During the workshop, participants will be introduced to challenge-based instruction methodologies that they can utilize to create their own challenges and modules, and implement them in their classrooms. Upon completion of the workshop, teachers should be able to design lessons and challenges that are aligned with state and national STEM learning objectives using applications in transportation engineering with an emphasis on railway safety. For more information, go to:

<http://www.utrgv.edu/railwaysafety/workforce/professional-workshops/2017%20stem%20teacher%20workshop/index.htm>

Register at: <https://goo.gl/forms/nZmiQsKTMXwN4k702>

UTCRS-UTRGV collaborating faculty and research assistants led six tours for **120 junior and senior high school students** (identified by UTRGV as potential engineering students) in the "TSA Region One Leadership Conference" November 16<sup>th</sup>, 2016. The tours featured the UTRGV Hi-Bay facilities and the UTCRS laboratories and testing



facilities. The visiting students had the opportunity to observe the research conducted by the UTCRS faculty and students, and listen to the students describe their work and where it fits within the transportation engineering field and how it impacts railway safety. Tours through our laboratories and facilities have been an exceptionally successful outreach activity because they provide visitors an accurate visual representation of the scope of the railway safety research being conducted at the UTCRS.



Over the period from October 1, 2016 to March 31, 2017, the UTCRS faculty, staff, and research assistants led numerous tours through the UTCRS-UTRGV Hi-Bay laboratory facilities for close to **3000** K-12 students from several school districts, community members during HESTEC week, and several local industries. Visitors learned about the field of transportation engineering with an emphasis on railway safety from UTCRS faculty and student researchers, and witnessed firsthand the different research projects funded by the UTCRS.



### UTCRS Highlights for October 1<sup>st</sup>, 2016 – March 31<sup>st</sup>, 2017

#### New Design for a Four Railroad Bearing Test Rig

The UTCRS research group composed of faculty and students designed and fabricated an efficient and compact Four Bearing Tester that can be used to perform long-duration service life tests to characterize bearing performance and assess the quality of the bearing steel. This new dynamic test rig is housed in a specially designed environmental chamber that can mimic ambient conditions as low as -40°F and as high as 150°F, and can be used to carry out laboratory experiments for any railroad bearing class used in both the United States and Canada. It is capable of simultaneously testing four bearings mounted on a test axle, and can apply up to 50 kips of vertical load per bearing while running at train speeds up to 85 mph. The new tester design is meant to be a more compact, safer, and overall a more efficient design from other dynamic test rigs currently in use in the industry.



#### UTCRS Student Accomplishments and Awards

The UTCRS students continue to demonstrate great leadership and outstanding academic performance in their respective engineering fields. First, Mr. Oscar Rodriguez (UTRGV graduate student) was selected as the 2016

Student of the Year representing the UTCRS in The Council of University Transportation Centers (CUTC) Awards Banquet and reception held on January 9, 2017. Mr. Rodriguez has also been named the 2016-2017 most outstanding graduate student by the vote of the mechanical engineering faculty at UTRGV, and is the recipient of two consecutive ASME Scholarships for submitting and presenting two papers at the 2016 and 2017 ASME Joint Rail Conference. Second, Mr. James Aranda has been named the 2016-2017 most outstanding undergraduate student by the vote of the mechanical engineering faculty at UTRGV. Third, Mr. Dominic Lebron has been named the 2016-2017 most outstanding undergraduate student by the vote of the electrical engineering faculty at UTRGV.



Student of the Year representing the UTCRS in The Council of University Transportation Centers (CUTC) Awards Banquet and reception held on January 9, 2017. Mr. Rodriguez has also been named the 2016-2017 most outstanding graduate student by the vote of the mechanical engineering faculty at UTRGV, and is the recipient of two consecutive ASME Scholarships for submitting and presenting two papers at the 2016 and 2017 ASME Joint Rail Conference. Second, Mr. James Aranda has been named the 2016-2017 most outstanding undergraduate student by the vote of the mechanical engineering faculty at UTRGV. Third, Mr. Dominic Lebron has been named the 2016-2017 most outstanding undergraduate student by the vote of the electrical engineering faculty at UTRGV.

**UTCRS-UTRGV Research Group Receives “Best Paper” Honors at the 2017 ASME Joint Rail Conference**

The UTCRS Research Group attended the 2017 ASME Joint Rail Conference from April 5-7 where they presented five papers on work that is performed as part of the projects funded by the UTCRS under the USDOT Grant No. DTRT13-G-UTC59. The UTCRS group consisted of five faculty and four students from UTRGV (4 faculty and 3 students) and consortium partner UNL (1 faculty and 1 student). The presentations featured four of our graduate students who were first authors and presenters at the conference. The UTCRS Research Group was the largest academic group in attendance at this conference and during the banquet held on Thursday April 6, 2017, four of our graduate students received the ASME Graduate Scholarship (3 from UTRGV and 1 from UNL). In total, there were 8 ASME graduate scholarships awarded and the UTCRS Research Group captured half of those. Moreover, one of the UTRGV graduate students (Oscar Rodriguez) received the “Best Paper” Award, which is the highest honors given in this conference. We are very proud of the accomplishments of the UTCRS Research Group! This event provided an invaluable experience for our students to participate in a professional conference where they were able to showcase and discuss their work with their peers and other professionals in the field.



**Transportation Innovation Speaker Series**

U.S. Department of Transportation  
Office of the Secretary of Transportation

**TRANSPORTATION INNOVATION SERIES**  
A strategic outreach series hosted by the  
Office of the Assistant Secretary for Research and Technology

**Advanced On-Board Condition Monitoring System for Freight Railcar Applications**

Dr. Constantine Tarawneh, University of Texas Rio Grande Valley  
Wednesday, February 15, 2017 • 1:00pm – 2:00pm  
USDOT Headquarters West Building Conference Center – Rooms 8-9-10

Dr. Constantine Tarawneh, UTCRS Director, was invited to participate in the UTC Program Transportation Innovation Speaker Series. His talk entitled “Advanced On-Board Condition Monitoring System for Freight Railcar Applications” was held on February 15, 2017 at the USDOT Headquarters West Building Conference Center.

See Complete Presentation at:  
<https://www.transportation.gov/utc/transportation-innovation-series-archive>



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

UTCRC remains committed to developing a professionally trained transportation workforce by focusing on graduating a highly-skilled and experienced cadre of graduate and undergraduate students. Students hired as research assistants by the UTCRC are required to perform at the highest level of research competence and to develop and maintain a professional-level skill set required to succeed in day-to-day research operations. To ensure research assistants' responsibilities are being met, the UTRGV Railroad Research Group provides its research assistants with quarterly mandatory trainings in which the students learn to: (1) enforce safety operational protocols, (2) maintain testing equipment and facilities, (3) disassemble and assemble bearings and testing rigs, (4) design and fabricate testing fixtures, which includes machining, milling, welding, and constructing a variety of testing components, (5) perform periodic bearing teardowns and inspections, (6) troubleshoot mechanical systems, and (7) prepare technical progress update reports that summarize the work accomplished and provide the main conclusions and steps moving forward. During Spring 2017, the UTCRC conducted **five** mandatory trainings attended by all 2016-2017 UTCRC research assistants; namely: (1) Data Acquisition and Analysis Training, provided by Dr. Constantine Tarawneh; (2) Mechanical Sensors Training, provided by Dr. Constantine Tarawneh and Dr. Stephen Crown; (3) Bearing Test Rig Setup and Maintenance Procedures Training, provided by Dr. Constantine Tarawneh, (4) Preparing Well-Drafted Technical Briefs and Reports Training, provided by Dr. Constantine Tarawneh, and (5) Laboratory Safety Training, provided by the UTRGV Environmental Health, Safety and Risk Management Office.

The UTCRC also continued their practice of holding a bi-weekly seminar series in which students presented research findings and progress. UTCRC Director, Dr. Constantine Tarawneh, and the faculty who have research projects funded through the center give students feedback and discuss future tasks to be completed during these meetings. This practice guarantees that work stays on schedule and that progress and research needs are being met; improves verbal communication skills; builds confidence; and addresses issues before problems arise. At the same time, undergraduate and graduate students involved in funded research are expected to help create a professional and encouraging environment of support and accountability. To ensure that all UTCRC students reach their fullest potential, they are asked to serve as primary mentors for new research assistants. In this way, students are responsible for passing down knowledge, skills, and work habits before transitioning research responsibilities to a successor. While preparing for the 2017 UTCRC Summer Camps, students were given leadership roles to represent the UTCRC in front of school district representatives, parents, and center partners in order to expose them to community engagement events. The UTCRC students led numerous tours of the research facilities.

Several research assistants who have been funded by the UTCRC for more than two semesters have participated in national conferences alongside professors with whom they collaborate. Supervising professors provide support, guidance, knowledge, and wisdom allowing students the opportunity to develop a professional network, and become recognized by their future peers in the transportation industry. A recent success story in this area involves three UTRGV and one UNL graduate students who received ASME Scholarships, which were awarded during the 2017 ASME Joint Rail Conference, held in Philadelphia, PA. UTCRC students, Oscar Rodriguez, Arthur Mealer, Nancy De Los Santos of UTRGV, and Subharthi Banerjee of UNL, submitted papers summarizing their initial findings and results as part of the work performed under their UTCRC funded projects.

The UTCRC has placed student researchers in a leadership role by allowing them to represent the UTCRC in science fairs' judging panels, providing laboratory tours, presenting to K-12 students, mentoring high school students, and interacting with high profile visitors during university and community engagement events. One example of UTCRC students taking on leadership roles is a group of students from the UTRGV

Curriculum and Instruction Department who participated as interns through the UTeach program collaboration. After being trained by the UTCRS faculty to implement the K-12 STEM curricula during the 2016 UTCRS Summer Camps, the group of students applied the UTCRS-developed STEM lessons at local elementary and middle school classrooms. These interns also presented posters at national conferences.

### **How have you disseminated your results?**

The progress and results of the 36 research projects funded by the UTCRS are published in the UTCRS website (<http://railwaysafety.utrgv.edu>) with further dissemination including academic publications, national and international conference presentations, local and national symposiums, theses and dissertations, UTC meetings, local community engagement and outreach events, and project poster presentations. The UTCRS also released a semi-annual newsletter to further disseminate results, news, and highlights of the center. This newsletter was distributed by email to all collaborating faculty, students, UTC counterparts, industry contacts and K-12 educators and program coordinators, and has been posted on social media for the general public. The newsletter highlights specific project accomplishments, research and technology transfer achievements, and upcoming trainings and educational programs.

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

1. Implementation and completion of research activities as outlined in the table above for all research, education, workforce development, and technology transfer projects.
2. Continue to update the UTCRS website on a daily basis to reflect all new progress.
3. Increase the UTCRS visibility and social media presence for greater dissemination, specifically to the professional transportation workforce.
4. Continue to communicate with the consortium Associate Directors and their administrative assistants to ensure a timely completion of all the UTCRS planned activities.
5. 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.
6. Continue to develop student experience and leadership skills through mentoring and engagement in scholarly work with the UTCRS faculty.
7. Successfully run the 2017 UTCR Summer Camps for elementary, middle, and high school students.
8. Successfully run the 2017 Transportation in the Classroom K-12 STEM Teacher National Workshop.
9. Keep promoting UTCRS STEM Curricula to be implemented in local, state, and national classrooms.
10. Continue to track and follow the academic and professional careers of students that are participating/have participated in UTCRS programs and activities to measure longitudinal impact.
11. Continue to leverage the partnership with the local independent school districts and the community at large to grow our existing outreach and educational programs and develop new ones that are aimed at year-around community engagement efforts.

## **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:

#### Journal Publications:

1. Chen, Y. and Rilett, L., "A Train Data Collection and Arrival Time Prediction System for Highway-Rail Grade Crossings," *Transportation Research Records, Journal of the Transportation Research Board*, January 2017.

#### Conference Publications:



2. Kang, Y. and Khattak, A., "A Cluster-Based Approach to Analyze Crash Injury Severity at Highway-Rail Grade Crossings," *Proceedings of the Transportation Research Board 96th Annual Meeting*, paper 17-06202, Washington, D.C., January 9, 2017.
3. Liu, H. and Khattak, A., "Alternate Indicators for Crash Severity—Analysis of Multi-Vehicle Crashes Based on a Multi-Level Mixed-Effects Ordered Logit Model," *Proceedings of the Transportation Research Board 96th Annual Meeting*, paper 17-06412, Washington, D.C., January 9, 2017.
4. Chen, Y. and Rilett, L., "A Train Data Collection and Arrival Time Prediction System for Highway-Rail Grade Crossings," *Proceedings of the Transportation Research Board 96th Annual Meeting*, Washington, D.C., January 10, 2017.
5. Zhao, L. and Rilett, L., "Dynamic Model of Driver Approaching Behaviors at Highway-Rail Grade Crossings," *Proceedings of the Transportation Research Board 96th Annual Meeting*, Washington, D.C., January 10, 2017.
6. Somayeh, T., Briaud, J. L., and Fry, G., "High Speed Trains and Ground Mach 1," *Geo Institute of ASCE Congress*, Orlando, Florida, USA, March 12-15 2017.
7. Mealer, A., Tarawneh, C., and Crown, S. W., "Radiative Heat Transfer Analysis of Railroad Bearings for Wayside Hot-Box Detector Optimization," *Proceedings of the 2017 ASME Joint Rail Conference*, Philadelphia, Pennsylvania, USA, April 4-7, 2017.
8. De Los Santos, N., Jones, R., Tarawneh, C., Fuentes, A. A., and Villarreal, A., "Development of Prognostic Techniques for Surface Defect Growth in Railroad Bearing Rolling Elements," *Proceedings of the 2017 ASME Joint Rail Conference*, Philadelphia, Pennsylvania, USA, April 4-7, 2017.
9. Rodriguez, O., Fuentes, A. A., Tarawneh, C., and Jones, R., "Hysteresis Heating of Railroad Bearing Thermoplastic Elastomer Suspension Element," *Proceedings of the 2017 ASME Joint Rail Conference*, Philadelphia, Pennsylvania, USA, April 4-7, 2017. **[Received Best Paper Award]**
10. Timmer, D., Tarawneh, C. and Jones, R., "Models for the Residual Life of Railroad Bearing Grease in Laboratory and Industry Applications," *Proceedings of the 2017 ASME Joint Rail Conference*, Philadelphia, Pennsylvania, USA, April 4-7, 2017.
11. Fry, G., and Tangtragulwong, P., "Analysis of Rail Grinding as a Means to Optimize Rail Head Fatigue Life under Heavy Axle Loads," *Proceedings of the 11th International Heavy Haul Association Conference, Cape Town, South Africa*, September 2-6, 2017.

Theses and Dissertations:

12. Allard, A. J., "Vehicle Bourne Autonomous Railroad Bridge Impairment Detection Systems," Doctoral Dissertation, Zachry Department of Civil Engineering, Texas A&M University, May 2017.
13. Renteria, D., "Discrete Element Analysis of SCB Variability – Asphalt Mixtures," Master's Thesis, Department of Mechanical Engineering, The University of Texas Rio Grande Valley, in progress, expected date of completion: May 2017.
14. Brown, C., "Fatigue and Wear of Steel Eye Bars from Historic Railroad Truss Bridges," Master's Thesis, Zachry Department of Civil Engineering, Texas A&M University, January 2017.
15. Kiani, M., "Multi-Scale Fatigue Damage Life Assessment of a Railway Wheel Using a Critical-Plane Model," Doctoral Dissertation, Zachry Department of Civil Engineering, Texas A&M University, December 2016.
16. Blackwell, D., "Multivariate Calibration of a Load Sensor for Dynamic and Static Freight Railcar Applications," Master's Thesis, The University of Texas Rio Grande Valley, December 2016.

Professional Presentations, Technical Committees, and Editorial Boards:

17. Tarawneh, C. Advanced On-Board Condition Monitoring System for Freight Railcar Applications. Invited Speaker, Office of the Assistant Secretary for Research and Technology (OST-R) Transportation Innovation Series, Washington, D.C., February 15, 2017.

18. Tafti, S. High Speed Trains and Ground Mach 1. *Geo Institute of ASCE Congress*, Orlando, Florida, March 12-15, 2017.
19. Mohammadrajabi, M. and Fry. G., "Dynamic Live Load Effects of Railroads on Retaining Walls and Temporary Shoring," *22<sup>nd</sup> Annual Research Review*, Technology and Innovation to Improve the Safety of North American Railways, Poster Presentation, March 21-22, 2017.
20. Tarawneh, C. Radiative Heat Transfer Analysis of Railroad Bearings for Wayside Hot-Box Detector Optimization. 2017 ASME Joint Rail Conference, Philadelphia, Pennsylvania, April 4-7, 2017.
21. De Los Santos, N. Development of Prognostic Techniques for Surface Defect Growth in Railroad Bearing Rolling Elements. 2017 ASME Joint Rail Conference, Philadelphia, Pennsylvania, USA, April 4-7, 2017.
22. Rodriguez, O. Hysteresis Heating of Railroad Bearing Thermoplastic Elastomer Suspension Element. 2017 ASME Joint Rail Conference, Philadelphia, Pennsylvania, USA, April 4-7, 2017. [Received Best Paper Award]
23. Jones, R. Models for the Residual Life of Railroad Bearing Grease in Laboratory and Industry Applications. 2017 ASME Joint Rail Conference, Philadelphia, Pennsylvania, USA, April 4-7, 2017.
24. John Sangster, Assistant Professor, Committee Research Coordinator, Transportation Research Board – Conduct of Research Committee (ABG10)
25. IEEE Vehicular Technology Conference
26. IEEE International Conference on Communications
27. IEEE International Conference on Signal and Image Processing Applications (ICSIPA)
28. International Journal of Computing and Digital Systems (IJCDS)
29. International Workshop on Mobile Applications
30. Chair, Transportation Research Board (TRB) Standing Committee on Highway/Rail Grade Crossings (AHB60)
31. IEEE International Conference on Electro Information Technology (2017) Communication Track Chair
32. Presiding officer, Session 447 "Highway/Rail Grade Crossing Accident Analysis"
33. Presiding officer, Session 583 "Current Trends in Highway/Rail Grade Crossing Research"
34. Presiding officer, Session 734 "Current Highway/Rail Grade Crossing Research"
35. Presiding officer, AHB60 Committee Meeting
36. Journal of Intelligent Transportation Systems: Technology, Planning and Operations, Editorial Board, 2005 – Present.
37. Journal of Transportation Engineering, Managing Editor, 2007 – Present.
38. Journal of Transportation Engineering, Textbook Editor, 2010 – Present.
39. Co-Editor-in-Chief, Wiley Security and Communications Networks (SCN) Journal.
40. Editorial Board Member, Journal of Transportation Research Forum.

**Website or other Internet Material:**

The UTCRS website (<http://railwaysafety.utrgv.edu>), hosted by UTRGV, is being maintained on a daily basis to reflect the full spectrum of research, education, workforce development, technology transfer, outreach activities, trainings, and student opportunities and programs available at UTCRS. The UTCRS website received a total of 2,394 page visits per month with an average of 1 minute 57 seconds view time per visit during this reporting period. The goal is to have a complete repository of photo galleries, videos, and news articles that carefully document the UTCRS operations and activities over the past four years.

**Technologies or techniques:**

- a. One of the major goals of the University Transportation Center for Railway Safety (UTCRS) is to increase the railway reliability by, among other things, developing advanced technology for infrastructure monitoring and developing innovative safety assessments and decision-making tools.

One of the UTCRS research teams is continuing the process of developing a novel fisheye camera-based object detection algorithm used to detect moving objects in railyard environments and gauge their distance. The team is also developing mobile and wearable solutions to directly protect workers, alert them of imminent danger, and track accidents to transmit alerts to other railyard workers. These technologies will enable railroads to track potential threats to railyard workers in real-time.

- b. Since it is not economical or practical to sample bearing grease in service operations, experimentally-derived models have been developed to permit the estimation of the residual life of grease in bearings used in either a laboratory setting or in an industrial (rail service operations) setting. This grease oxidation induction time predictor model is available for anyone to use and can be accessed at the following link: <http://quality.engr.utrgv.edu:8080/RailwayGreaseOIT-Predictor/>

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

Nothing to report at this time.

**Other products:**

The new design for the four railroad bearing test rig that has been fabricated at UTRGV and is in use performing testing for the various UTCRS funded projects was shown earlier in this report.

**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 below have been an integral part of the various research, education, workforce development, technology transfer, and outreach activities of the UTCRS.

NAME	ORGANIZATION NAME	RELATION	GENDER
<b>State</b>			
Acton, Jessica	Texas Higher Education Coordinating Board (THECB)	Education	Female
Crown, Stephen, PhD	Director of UTRGV Texas Pre-Freshman Program (TexPrep)	Education	Male
Mahmoud, Enad	Texas Department of Transportation (TxDOT)	Governmental	Male
Parra, Nayeli	Texas Department of Transportation (TxDOT)	Governmental	Female
<b>Local</b>			
Dr. Roni Rentfro	Brownsville ISD	Community	Female
Dr. Alda Benavides	La Joya ISD	Community	Female
Kelly Watson	Donna ISD	Community	Male
Sandra Tovar	Harlingen CISD	Community	Female
Cynthia Torres	La Feria ISD	Community	Female
Rey Villarreal	La Feria ISD	Community	Male
Dr. Jose A. Gonzalez	McAllen ISD	Community	Male
Dr. Sharon Roberts	Mission CISD	Community	Female
Dr. Daniel P. King	Pharr-San Juan-Alamo ISD	Community	Male
Dr. Robert O’Conner	Sharyland ISD	Community	Male
Dr. Richard Rivera	Edcouch Elsa ISD	Community	Male
Dr. Rene Gutierrez	Edinburg CISD	Community	Male
Ramiro Balderas	Valley View ISD	Community	Male
Robert L. Olivarez	Vanguard Academy	Community	Male
Jorge Chipres	IDEA ISD	Community	Male
Jimmy McDonough	Los Fresnos ISD	Community	Male
Brenda DeHoyos	Hidalgo ISD	Community	Female

Olivia Almanza	Monte Alto ISD	Community	Female
Dr. Adrian Vega	San Benito CISD	Community	Male
Maria J. Chavez	Santa Maria ISD	Community	Female
Martin Cuellar	Progreso ISD	Community	Male
Yulia Molina	Progreso ISD	Community	Female
Dr. Priscilla Canales	Weslaco ISD	Community	Female
Scott Amdahl	Weslaco ISD	Community	Male
Sister Cindy Mello	Catholic Diocese of Brownsville	Community	Female
Sarah Leal-Mendez	RGV Homeschool Cooperative Resource	Community	Female
Andres Benitez	2014-2016 RET Program Participant - Sharyland ISD	District Level	Male
Rene Garcia	2014-2016 RET Program Participant - PSJA ISD	District Level	Male
Teresa Ochoa	2015-2016 RET Program Participant - La Joya ISD	District Level	Female
<b>Private</b>			
Wilson, Brent, PhD	Director of Research and Development, Amsted Rail	Advisory Board	Male
Connell, David	Vice President – Engineering Union Pacific Railroad Co.	Advisory Board	Male
Kalay, Semih	Vice President – Research and Development, Transportation Technology Center, Inc. (TTCI)	Advisory Board	Male
Staplin, David	Deputy Chief Engineer – Amtrak	Advisory Board	Male
<b>Consortium</b>			
Tarawneh, Constantine, PhD	UTCRS – Director Professor, Mechanical Engineering, UTRGV 1201 West University Drive, Edinburg, TX 78539-2999	Researcher/ Executive Committee	Male
Allen, David, PhD, PE	UTCRS – TAMU Associate Director Professor, Civil Engineering, TAMU 3135 TAMU, College Station, TX 77843-3135	Researcher/ Executive Committee	Male
Rilett, Laurence, PhD, PE	UTCRS – UNL Associate Director Professor, Civil Engineering, UNL 262D Whittier Research Center P.O. Box 830851, Lincoln, NE 68583-0851	Researcher/ Executive Committee	Male
Freeman, Robert, PhD	UTCRS – UTRGV Associate Director Professor and Chair, Mechanical Engineering, UTRGV	Executive Committee	Male
Lawrence-Fowler, Wendy, PhD	UTCRS – Diversity Coordinator Professor, Computer Science, UTRGV	Executive Committee	Female
Chapman, Angela, PhD	UTCRS – Education Coordinator Assistant Professor, Curriculum & Instruction, UTRGV	Researcher/ Executive Committee	Female
Pena, Melissa Iliana	UTCRS – UTRGV Program Assistant	Staff	Female
Dove, Russell	Web Designer II, Internet Services, UTRGV	Institutional	Male
Pelton, Amanda	Program Coordinator, Center for Railway Research, Texas A&M Transportation Institute (TTI)	Staff	Female
Cutsor, Shelly	NTC Program Coordinator, UNL 262D Whittier Research Center, Lincoln, NE 68583-0851	Staff	Female
Foltz, Heinrich, PhD, PE	Professor, Electrical Engineering, UTRGV	Researcher	Male
Fuentes, Arturo, PhD	Professor, Mechanical Engineering, UTRGV	Researcher	Male
Jones, Robert, PhD	Professor, Mechanical Engineering, UTRGV	Researcher	Male
Fry, Gary, PhD, PE	Associate Professor, Civil Engineering, TAMU	Researcher	Male
Hurlebaus, Stefan, PhD	Assistant Professor, Civil Engineering, TAMU	Researcher	Male
Briaud, Jean-Louis, PhD	Assistant Professor, Civil Engineering, TAMU	Researcher	Male
Aubeny, Charles, PhD	Professor, Civil Engineering, TAMU	Researcher	Male
Keating, Peter, PhD	Associate Professor, Civil Engineering, TAMU	Researcher	Male



Grasley, Zachary, PhD	Associate Professor, Civil Engineering, TAMU	Researcher	Male
Alexander, Dennis, PhD	Professor, Kingery Engineering, UNL	Researcher	Male
Zuhlke, Craig, PhD	Research Assistant Professor, UNL	Researcher	Male
Schmidt, Jennifer, PhD	Research Assistant Professor, MWRSF, UNL	Researcher	Female
Stolle, Cody, PhD	Research Assistant Professor, MME, UNL	Researcher	Male
Faller, Ronald, PhD	Associate Research Professor, Civil Engineering, UNL	Researcher	Male
Sangster, John, PhD, PE	Assistant Professor, Civil Engineering, UNL	Researcher	Male
Khattak, Aemal, PhD	Associate Professor, Civil Engineering, UNL	Researcher	Male
Sharif, Hamid, PhD	Professor, Telecommunication and Computer Engr., UNL	Researcher	Male
Hempel, Michael, PhD	Research Assistant Professor, Elect. and Comp. Eng., UNL	Researcher	Male
Thompson, Eric, PhD	Associate Professor, Economics, UNL	Researcher	Male
Contreras, Roger, PhD	Co-director, UTRGV UTeach Program	Institutional	Male
Gonzales, Veronica	VP for Governmental and Community Relations, UTRGV	Institutional	Female
Garza, Barbara	Director, Office of P-16 Initiatives, UTRGV	Institutional	Female
De Los Santos, Nancy	Society of Automotive Engineers (SAE)	Institutional	Female
Villarreal, Domingo	MiniBaja Student Organization (SAE)	Institutional	Male
Capitanachi, Dulce	Society of Women Engineers (SWE)	Institutional	Female
Mendoza, Atilano	Society of Hispanic Professional Engineers (SHPE)	Institutional	Male
Gutierrez, Jacob	American Society of Mechanical Engineers (ASME)	Institutional	Male
Resendez, Erika	American Society of Civil Engineers (ASCE)	Institutional	Female

#### 4. IMPACT:

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

The UTCRS is able to report various indicators of impact, including:

- A clear pathway to graduate studies between the three consortium institutions has been established providing students with several options to pursue their postgraduate studies on mechanical, operations, and infrastructure railway research. To date, 25 of the 35 REU students are either already enrolled or have been accepted into graduate programs at the three consortium institutions pursuing Master's degrees in transportation-related fields. The UTCRS 71% admission to graduate programs as a result of participation in an REU Program is well above the national average of these programs. This percentage is expected to slightly increase as some of the remaining REU student participants are still completing their undergraduate degrees. More importantly, these students come from mechanical, civil, electrical, manufacturing, and computer engineering; a fact that demonstrates the impact of the UTCRS on several engineering programs.
- The UTCRS has been successful in attracting a large percentage of minorities, typically underrepresented in 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.
- Training of a critical mass of engineering students on hands-on skills that include welding, machining, design specifications, assembly, testing fixtures, and the use of hydraulic machinery.
- Sixteen graduate and fifteen undergraduate students have gained invaluable technical writing and oral presentation experience by co-authoring paper publications, writing and defending theses, and presenting at national and international conferences relevant to the rail transportation industry.
- Students also gained experience in using complex mathematical and statistical modeling and state-of-art engineering software tools and packages such as SolidWorks, Algor, MatLab and Labview.
- The success of the UTCRS REU Program has highlighted the need for a Master's Program in Civil Engineering at UTRGV. Based on that, the Civil Engineering Department at UTRGV put together a proposal to establish a Master's of Science in Civil Engineering Program with an emphasis on

transportation. This proposal has already been approved by the University of Texas System and is awaiting final approval by The Higher Education Coordinating Board (THECB) in July 2017. The department has already hired one faculty with expertise in transportation systems, and will be requesting two more faculty this upcoming fall.

- The new transportation systems faculty that has been hired in the Civil Engineering Department at UTRGV has set up a new Smart-Grid Traffic Simulation Laboratory that will be used to devise and develop efficient traffic flow models for cities and municipalities.

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

The UTCRS continues to emphasize the interdisciplinary nature of the transportation industry in all research and educational programs the center develops. To this end, the UTCRS activities are developed as college and university wide initiatives rather than a single department or unit. Hence, the UTCRS activities span across the mechanical, electrical, civil, manufacturing, computer engineering, and computer science from the college of engineering and computer science, as well as the department of curriculum and instruction from the college of education and P-16 integration. Faculty, staff, and students from these different disciplines are working in unison towards promoting transportation engineering, improving railway safety, and raising awareness and interest in the transportation field.

One of the most significant impacts the UTCRS had on other disciplines has been in the field of STEM education. The UTCRS and the College of Education and P-16 Integration at UTRGV have been working on researching techniques to improve retention of underrepresented groups, in the Rio Grande Valley, in STEM fields and careers. Findings of this ongoing study have been presented at the National Association for Research in Science Teaching (NARST), and particular approaches resulting from the research were introduced in the UTCRS STEM Curricula. UTRGV UTeach program interns, who have benefitted immensely from this synergistic partnership with the UTCRS, are now implementing the UTCRS curricula, testing the different methods for teaching STEM in classroom settings, and collecting data on the effectiveness of teaching techniques being proposed by their research to improve retention of underrepresented groups in STEM fields and careers. The benefits of the pedagogical approaches being studied have already been observed in classrooms and school districts of former RET participants who implemented the UTCRS curricula. The teaching approaches utilized in the UTCRS STEM Curricula have demonstrated promise in influencing underrepresented minority populations of students to consider careers in engineering and the transportation industry. For the fourth year in a row, the UTCRS Summer Camps will be serving more than 1000 K-12 students from over 26 different school districts in the lower Rio Grande Valley, which demonstrates continued interest and engagement.

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

Since its inception in the fall of 2013, the UTCRS has engaged over 200 undergraduate and graduate students in its various research, education, technology transfer, professional development, and community outreach activities. These students are mentored by a team of highly qualified and dedicated faculty who are committed to providing a well-rounded education and research experience in the transportation engineering field. Students develop valuable skill-sets through hands-on projects relevant to the railroad industry, preparing technical reports and briefs on work accomplished, co-authorship of journal and conference papers, presentation at local and national symposiums and conferences, and writing and defending theses and dissertations, making these students workforce ready upon graduation.

In addition to developing well-rounded transportation engineering workforce skills in research students, the UTCRS educates and provides development opportunities for a largely Hispanic student population that is statistically underrepresented in the professional transportation field (as reported by the

Department of Labor Statistics of 2014). Moreover, of the 200 UTCRS students that were engaged in the various center activities, more than 35% of them are female, which more than doubles the national average of 15.7% female in Professional Transportation and Materials Moving Occupations. In fact, 14 of the 25 UTCRS REU participants who are now pursuing their master's degrees in transportation engineering fields are females who were not previously considering pursuing their graduate education.

The UTCRS K-12 education outreach and workforce development efforts are led by a dedicated group of faculty comprised of members from the UTRGV College of Education and P-16 Integration, in collaboration with the various engineering programs involved in the Center (mechanical, civil, electrical, manufacturing, computer engineering, and computer science). This group has facilitated a number of hands-on STEM workshops for educators, offered to develop the skill-sets required to teach transportation engineering concepts in their classroom, and to expose educators to the use of appropriate pedagogy to engage students in STEM fields. The UTCRS has been diligently working on planning and recruitment of attendees for its Third Annual Transportation in the STEM Classroom K-12 Teacher National Workshop. This K-12 STEM Teaching Workshop will take place on June 3, 2017 at UTRGV, and will provide hands-on training to 75+ teachers, program coordinators, counselors, and administrators on how to implement the UTCRS Curricula in diverse educational settings. The UTCRS STEM Curricula offered in this workshop contains complete lesson plans based on state and national science standards. Attendees will learn how to implement all levels (elementary, middle, and high school) of the UTCRS curricula to enable them to deliver age-appropriate STEM concepts, related to transportation engineering with an emphasis on railway safety, in their classrooms.

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

The community outreach activities of the UTCRS have strengthened institutional collaborations between UTRGV and more than **26** school districts that collaborated with the UTCRS in the organization of the 2017 Railway Safety Summer Camps. Of particular importance is the establishment of interlocal cooperation contract agreements between UTRGV and the school districts that will facilitate the partnership on current and future education and workforce development initiatives. In fact, the school districts are funding the majority of the expenses incurred for the 2017 UTCRS Summer Camps as these school districts have come to depend on the UTCRS for their STEM camps at the elementary level, since they are the only STEM camps offered at that level in the lower Rio Grande Valley. These community collaborations have brought recognition in the community, and guaranteed the participation of over 1000 K-12 students and 75+ teachers for the fourth year in a row. More importantly, the UTCRS outreach efforts and educational programs are very well-aligned with UTRGV's institutional mission and educational goals of encouraging K-12 students to attend college and pursue degrees and careers in STEM fields.

The advanced research conducted by the UTCRS has generated national and international institutional visibility for the three consortium universities. In particular, UTRGV has benefited from the high-caliber publications produced by the UTCRS, as well as the national and international exposure of its research in conferences. The aforementioned is in-line with the overall institutional research goal of becoming a Tier 1 Research Institution. Furthermore, the effective collaboration among the consortium institutions has provided students accessibility to resources available at all three institutions. Through the UTCRS REU Program, the consortium has facilitated pathways for undergraduate and graduate students from UTRGV to enroll in graduate and doctoral programs with strong emphasis on transportation engineering. This reporting period, six more REU participants have enrolled in graduate programs at all three consortium institutions, with more expected to follow suit once they complete their undergraduate degrees.

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

Technology transfer activities include publication of theses and research papers, presentations at national conferences and symposiums, trainings, field testing, and deployment. For this reporting period, the UTCRS technology transfer activities included three doctoral dissertations, four Master's theses, nine conference papers, one journal article, two research symposiums, and twelve professional presentations including one presentation that was part of the UTC Program Transportation Innovation Speaker Series. Moreover, the remaining seven projects that were initially funded through the inaugural 2014CY call for proposals have completed during this reporting period. As part of the grant reporting requirements, final project reports have been posted on the UTCRS web site and are available for download. Exhibit F forms have been completed and posted on the UTCRS web site and are available for immediate download. The work performed on the ongoing projects has also resulted in some products. These products include a Grease Oxidation Induction Time Predictor Models that are available on the UTCRS web site for anyone to utilize. Another product is an efficient design for a four railroad bearing test rig that can be used to characterize bearing performance and qualify the steel used for railroad bearing fabrication.

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

The UTCRS serves a population that is 90% Hispanic, of which approximately 85% are of Mexican descent, and 50% earn incomes that are significantly below the state average. The UTCRS outreach efforts in the Rio Grande Valley (RGV) have facilitated many opportunities for the community that will otherwise not be possible. The UTCRS Summer Camps are the only elementary camps in the RGV that promote and raise awareness about the need to go to college and pursue careers in STEM. Through the strong collaborative partnership that has been established between the UTCRS and the local school districts, these educational summer camps are available to students at no charge to them, thus, affording them the same opportunities as those available to students whose parents are not financially challenged. The impact of these camps becomes apparent when considering that more than 60% of parents in the RGV did not attend college, and that these camps are the first exposure to a university setting for their kids. Moreover, the UTCRS offers the necessary teaching tools, experiences, trainings, and professional development opportunities to K-12 students and teachers at no cost to them, which, in some cases, is the only way that some of the poorer school districts can afford these experiences for their students and teachers. Most teachers involved in the UTCRS RET Program have been able to advance their professional careers through the work experience they gained by working with UTCRS faculty and Staff.

Finally, over 3,000 community members have been made aware of the work and importance of the USDOT and the transportation fields in their society. The UTCRS has highlighted the initiatives and goals of the USDOT UTC Program, and the need to keep developing the talent that will feed into the various transportation fields, especially among underrepresented groups. Videos and photographs highlighting the various UTCRS activities during this reporting period can be found at:

Community Outreach: <http://www.utrgv.edu/railwaysafety/education/community/index.htm>

News and Events: <http://www.utrgv.edu/railwaysafety/news/index.htm>

Visitor Information: <http://www.utrgv.edu/railwaysafety/about/visitor/index.htm>

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

Dr. Gary Fry, UTCRS Associate Director, TAMU, has accepted a job offer at the Transportation Technology Center, Inc. as of Sept. 2016. Dr. David Allen has replaced him as the UTCRS Associate Director at TAMU. This change was voted on and approved by the UTCRS Executive Committee.

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

Nothing to report.