FEDERAL RAILROAD ADMINISTRATION

RAIL
MOVING AMERICA FORWARD

FRA OFFICE OF RESEARCH, DEVELOPMENT, and TECHNOLOGY

CURRENT RESEARCH PROJECTS

U.S. Department of Transportation
Federal Railroad Administration

2020 TRB Annual Conference

RESEARCH SECTIONS

1. Track
2. Rolling Stock
3. Train Control and Communications
4. Human Factors

SECTION ONE

TRACK

Quantification and Evaluation of Rail Flaw Inspection Practices and Technologies

PROJECT DESCRIPTION

Rail Flaw Library of Associated Defects (RF-LOAD)

- Continued collecting naturally occurring flaws from revenue service operations. These rail flaw samples will be used for the training of inspectors using hand-held non-destructive evaluation (NDE) instruments, probability of detection method development, and initial development of advanced inspection technologies.

Phased Array UT Modeling/Simulation for Rail Thermite Welds

- Conducting ultrasonic testing (UT) simulations to better understand ultrasonic beam interaction and responses in rail welds as well as for different realistic internal rail weld defects.

Flash/Infrared Thermography Approach for Rail Base Defects

- Assessing the feasibility of using this technology at moving speed for non-contact in motion rail base inspection.

Feasibility of Special Trackwork Inspection using NDE Methods

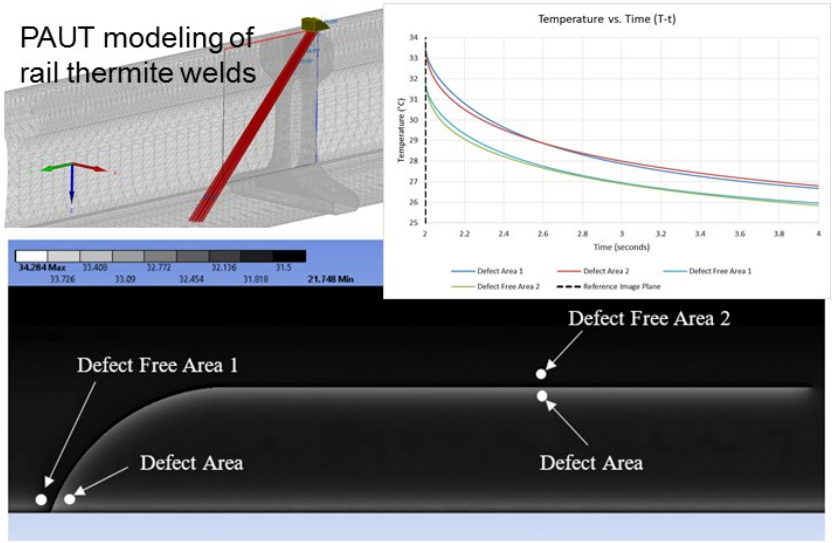
- Assess the feasibility of using advanced NDE methods on the frog test samples

PROJECT PARTNER

- Transportation Technology Center, Inc.

COST & SCHEDULE

- Funding: $549,594 (to date)
- Project Duration: July 2016 – July 2020



RAILROAD IMPACT

- Support future research on evaluating and improving the performance of current and future rail inspection technologies for use in detecting rail flaws as well as the methods for quantifying them.
- Rail flaw library will serve other researchers, allowing them direct access to the realistic rail flaw samples for validating their work on rail inspection technologies.
- Optimized ultrasonic parameters and inspection angles will improve detection of missed flaws in revenue service.
- Explore innovative advanced NDE technologies capable of inspecting the rail base, rail welds, and special trackwork for critical internal defects.

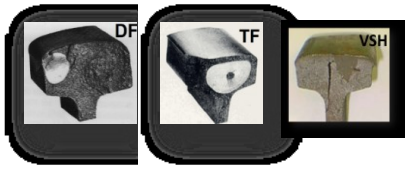
FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

From Rail Flaw Imaging to Remaining Life Estimation

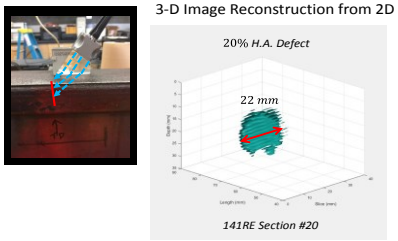
PROJECT DESCRIPTION

- Project will complete UCSD's work in ultrasonic imaging and add fracture mechanics to close the gap between the "diagnosis" and the "prognosis" steps of rail inspection and maintenance.
- UCSD's SAFT rail flaw imaging prototype will be advanced to the stage of field deployment and automatic reconstruction of 3D images of the rail's interior.
- A fracture mechanics model based on Paris' law will be applied and validated to estimate a rail's remaining life, based on initial crack size, crack growth parameters, and expected loads.
- Remaining life estimations will be calibrated and validated through accelerated fatigue tests at UCSD's Powell Structural Laboratories.

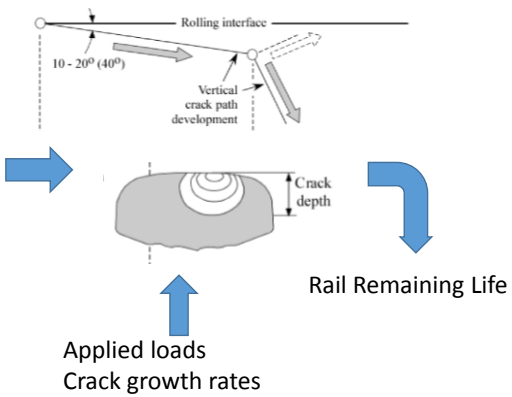
SAFT Rail Flaw Imaging



3-D Image Reconstruction from 2D



Fracture Mechanics model



RAILROAD IMPACT

- Advanced rail inspection technologies and advanced rail flaw modeling are high priorities of FRA's R&D program.
- The ultimate goal of an effective and safe rail inspection program is to enable maintenance decisions based on the actual severity of a flaw.
- An ability to (a) quantitatively image an internal flaw and (b) determine from the flaw imaging data the remaining life of the rail will be an invaluable tool in the hands of railroad maintenance personnel.

PROJECT PARTNERS

- University of California, San Diego (prime contractor)
- Participating railroads (BNSF committed, UP & NS potential)

COST & SCHEDULE

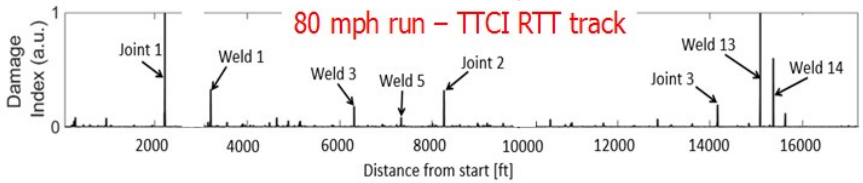
- Total Project duration: 3 years (07/01/2019-06/30/2022)
- Initial phase (07/2019-07/2020 – FUNDED): $138,965 (FRA), $50,000 (UCSD equipment cost share)
- Option 1 (07/2020-07/2021 – NOT FUNDED): $144,187
- Option 2 (07/2021-07/2022 – NOT FUNDED): $213,393

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Non-Contact Rail Inspection Prototype (Passive-Only System for High-Speed Rail Inspection)

PROJECT DESCRIPTION

- Evaluate a new technique that uses non-contact acoustic sensors and special signal processing algorithms to detect internal defects in rails by exploiting the acoustic excitations naturally induced in the rail by the wheels of a running train.
- Apply special signal processing algorithms to extract a "stable" acoustic transfer function between two points of the rail despite the "random" acoustic excitation by the rolling train wheels.
- Already performed two field tests at TTC at speeds up to 80 mph with good feasibility results for the detection of joints, welds, and internal flaws.
- Continuing the technology development with additional field tests at TTC to be scheduled in the fall 2019/winter2020.



PROJECT PARTNERS

- University of California, San Diego – grantee
- ENSCO, Inc. – test support
- Transportation Technology Center, Inc. – test support

COST & SCHEDULE

- Funding: $424,418
- Period of Performance: February 2018-May 2020

RAILROAD IMPACT

- Passive rail inspection technology would enable extremely high testing speeds, well beyond the ~ 25 mph maximum speed currently allowed by conventional (e.g., RSU-based) rail inspection cars.
- Inspecting the rail at regular train speeds would simplify scheduling of rail inspections around normal traffic.
- "Smart train" approach: this technology could be used on regular trains to enable multiple, redundant inspections of the same track, thereby improving the inspection reliability and, ultimately, the safety of transportation.

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

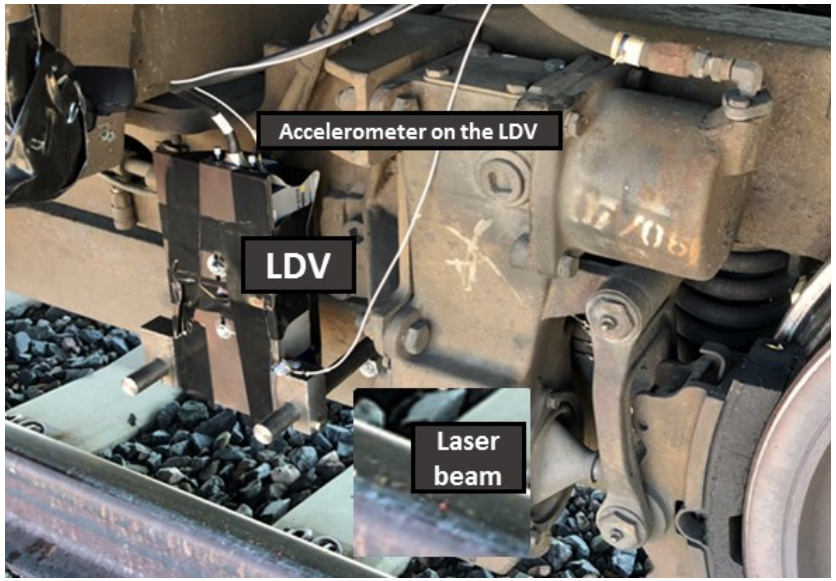
Rail Defect Detection by Non-Contact Vibration Measurements

PROJECT DESCRIPTION

- Develop a non-contact technology for the identification of defects in railroad tracks.
- A laser Doppler vibrometer (LDV) is proposed to record the dynamic vibrations induced by the wheel-rail contact from a moving platform.
- Advanced modal system identification techniques will be evaluated to characterize the vibrations of rails induced by a moving railcar.

RAILROAD IMPACT

- A non-contact rail integrity inspection system to detect rail flaws including internal flaws using rail vibrations induced by railcar wheels.
- Implementation of new generation a laser Doppler vibrometer in order to enhance the signal-to-noise ratio.
- Ability to carry out inspections at operation rail car speeds.



PROJECT PARTNERS

- University of Texas at Austin – grantee
- Transportation Technology Center, Inc. – test support

COST & SCHEDULE

- Funded: $150,000
- Additional $300,000 possible for additional phases
- Project Duration: May 2019 – May 2022

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

High-Speed Broken Rail Detection

PROJECT DESCRIPTION

- Demonstrate a second-generation prototype detection system.
- Automated detection of broken rails.
- Real-time imaging of rail morphology will allow breaks to be differentiated from rail joints.
- Novel high-speed detector will enable detection of broken rails from trains at normal operational speeds (does not require dedicated metrology/inspection).
- Initial field testing on Vermont Rail System track demonstrated extremely accurate detection of rail joints from moving platform.
- Preparing to test over additional sections of revenue service track.

RAILROAD IMPACT

- Broken rails or welds are a common cause of Class I mainline derailments. Rails often break under trains but do not cause immediate derailment until further damage leads to catastrophic failure.
- Current inspection methods are periodic and may miss the critical period during which initial damage progresses to complete failure.
- Detection of early-stage rail defects from normal service revenue trains enables repair before catastrophic failure and derailment.

PROJECT PARTNERS

- Creare, LLC
- Vermont Rail System

COST & SCHEDULE

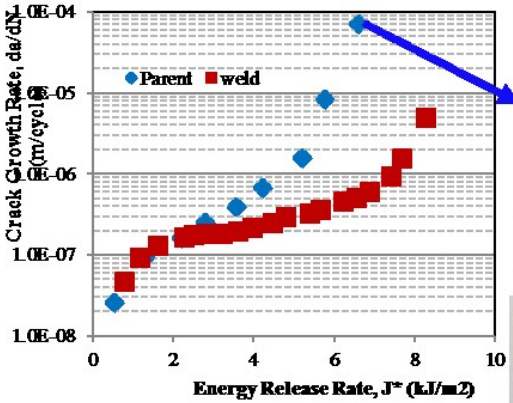
- Funding: $450,000
- Project Duration: May 2017 – May 2020

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Pre-Heating Optimization and Field Testing of Railhead Defect Repair

PROJECT DESCRIPTION

- **Task 1:** Optimization of pre-heating conditions that include computational heat transfer analysis on a simulated railhead defect (slot) under uniform preheating applied to the web and lab experiments to assist with the computational heat transfer analysis.
- **Task 2 :** Perform multiple (5) head repair welds based on the patented technology by Tuskegee University (TU) using an AREMA 136 RE rail section length.
- **Task 3:** Perform multiple metallurgical lab testing on three weld samples provided by TU. These tests will be performed by Transportation Technology Center, Inc. (TTCI). TU will also perform similar tests for comparing results with TTCI.
- **Task 4:** Perform six slow bend tests similar to AREMA requirement for electric-flash butt welding. This will be performed by an independent laboratory approved by both TU and TTCI.



Slot-welded pearlitic railhead shows better fatigue performance than the parent rail steel.

Parent pearlitic rail head before repair

Slot welded railhead

RAILROAD IMPACT

- Improve the quality of railhead defect weld repair.
- Provide a more efficient and consistent field repair method for railhead defects.
- Enhance the fatigue damage tolerance of weld repaired rail.

PROJECT PARTNERS

- Tuskegee University
- Transportation Technology Center, Inc.
- EWI
- Nucor Steel

COST & SCHEDULE

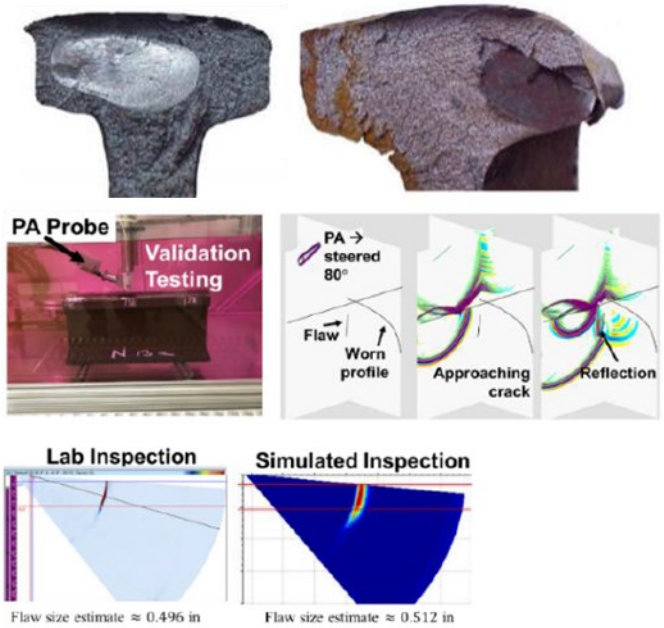
- Funded: $123,895
- Additional $160,223 possible for later phases
- Period of Performance: October 2017 – September 2020

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Automated Railhead Flaw Characterization and Rail Remaining Life Prediction Technology

PROJECT DESCRIPTION

- Automated railhead flaw characterization and rail remaining life prediction technology.
- Experimental track inspection data from Sperry.
- Machine learning and computer vision data-driven models to classify and characterize rail head flaws.
- Rail life remaining and remedial action planning.
- Uncertainty quantification of flaw estimates and remaining service life predictions.



RAILROAD IMPACT

- Current rail NDE technology relies on human interpretation to characterize and classify rail head flaws.
- Increased flaw sizing reliability and inspection speed enabled by pre-training data-driven models.
- Shifts flaw sizing burden from inspector and on to analysis and software development.
- Increased flaw sizing (e.g., % rail head area) reliability will decrease chance of derailments.
- Building on the most recent research of the fail integrity and fatigue life prediction for modern rails.
- Delayed remedial action plan based on remaining life.

PROJECT PARTNERS

- Thornton Tomasetti, Inc.
- Siemens
- Sperry
- Harvard University

COST & SCHEDULE

- Funding: $225,002
- Project Duration: October 2019 – September 2021

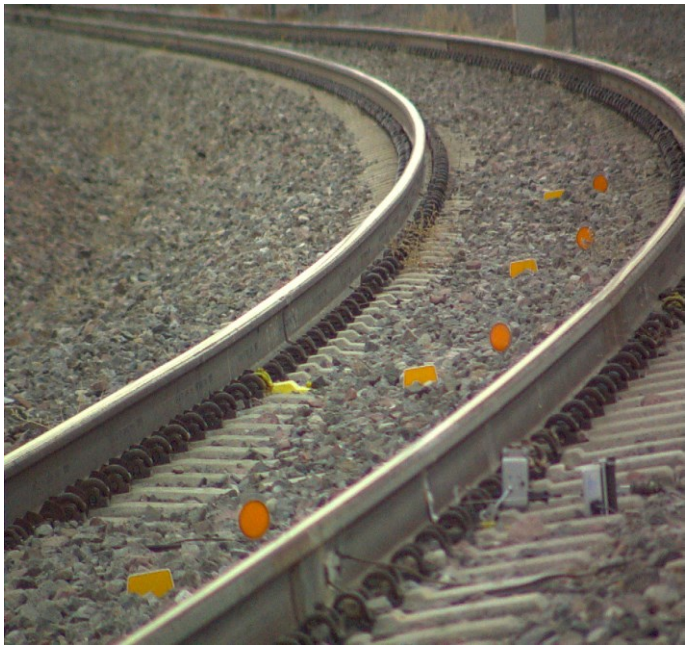
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Rail Neutral Temperature (RNT) and Longitudinal Force Management

PROJECT DESCRIPTION

- **RNT Data Mining and Analysis**
- **Monitoring RNT and Curve Movement under Heavy Axle Loads**
- **Evaluation of Potential Curve Monitoring Technologies**
- **RNT Workshops:**
  - Develop a workshop to document the best RNT management practices from industry and FRA.
  - Workshop to develop more buckling resistant track.
- **RNT Test Bed Design:**
  - This task will develop an RNT and track buckling test bed design concept and performance requirements. The potential exists for installation of a track segment that can have independent rail force loading capability while still being part of an operating track, such as the High Tonnage Loop at the Transportation Technology Center.
- **Track Maintenance Effects on RNT**



RAILROAD IMPACT

- Characterization of RNT changes in revenue service track:
  - Documenting initial RNT loss after rail installation.
- Evaluation of new methods to monitor curve movement.
- Understand how curves breathe with and without train traffic.
- Measure rail movement and RNT changes simultaneously in curves at the FAST facility.

PROJECT PARTNER

- Transportation Technology Center, Inc.

COST & SCHEDULE

- Funding: Approx. $630,784
- Project Duration: August 2016 – March 2021

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

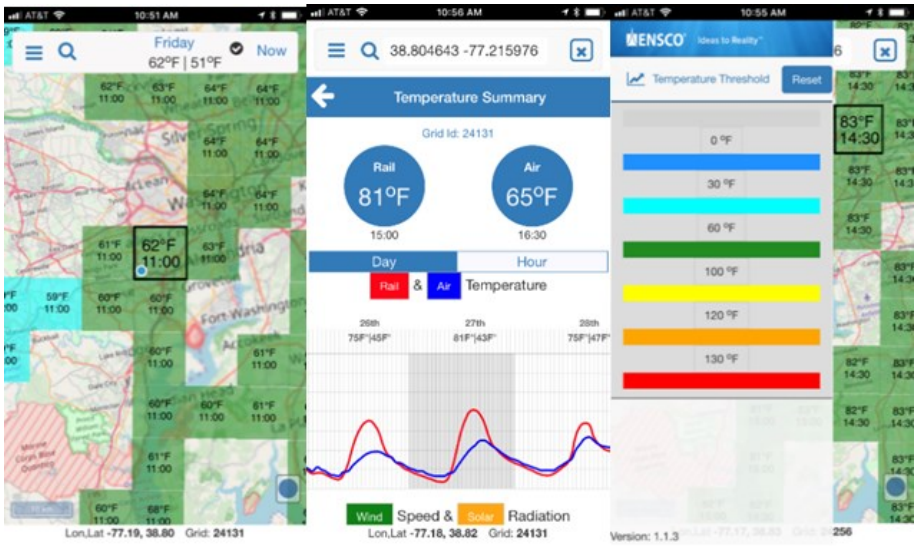
Rail Temperature and Buckling Risk Prediction

PROJECT DESCRIPTION

- Expand the functionality of FRA's existing Rail Temperature and Buckling Risk Prediction web-mobile application.
- Implement CWR readjustment methodology into the application.
- Support training for use of the application, including user documentation and training webinars.

RAILROAD IMPACT

- Provide industry with a tool to issue heat slow orders in a more effective and targeted way.
- Prevent or minimize consequences of track buckling-related derailments by improved heat slow order management process and rail stress adjustment guidance.
- Establish better awareness of rail temperature for track personnel through use of a utility that provides information in near-real time.



PROJECT PARTNERS

- ENSCO, Inc.
- Amtrak

COST & SCHEDULE

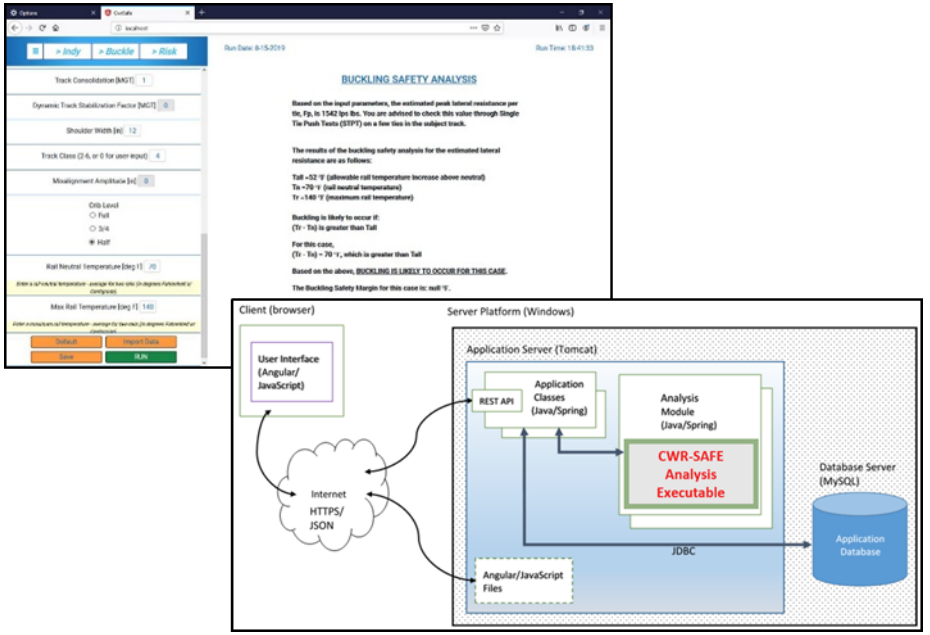
- Funding: $144,941
- Project Duration: September 2018 – February 2021

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Upgrade of CWR-SAFE Software

PROJECT DESCRIPTION

- Upgrade CWR-SAFE, a computational model for track buckling safety analyses, to run on modern computer operating systems and mobile platforms.
- Implement improvements to user interface with focus on data visualization.
- Promote FRA and industry use of the CWR-SAFE application through provision of the utility via secure website.



RAILROAD IMPACT

- Provide industry with a tool for a deterministic evaluation of buckling strength and safety.
- Prevent or minimize consequences of track buckling-related derailments.
- Establish better awareness of buckling danger for track personnel.

PROJECT PARTNER

- ENSCO, Inc.

COST & SCHEDULE

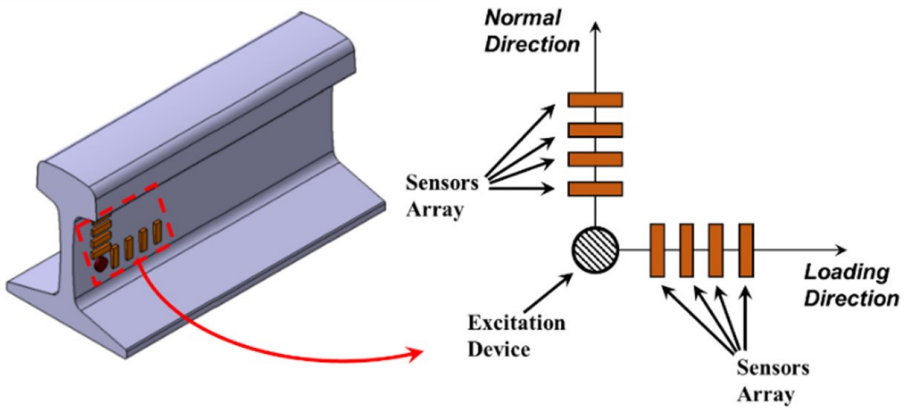
- Funding: $304,983
- Project Duration: September 2018 – February 2021

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Rail Neutral Temperature (RNT) Measurement by Virginia Tech

PROJECT DESCRIPTION

- Develop, validate, and implement a novel acoustoelastic-based approach for longitudinal rail stress and neutral temperature measurement.
- The proposed approach has two fundamentally distinctive features compared to current ultrasonic practices:
    1. The utilization of *low-frequency* flexural waves to calculate the state-of-stress, which offers enhanced sensitivity and robustness.
    2. The utilization of the vertical (normal-to-loading) direction as a reference, which further enhances the robustness of the technique and allows compensating for uncertainties in rail characteristics.



RAILROAD IMPACT

- Potential to provide reliable, *reference-free* measurements of longitudinal rail stress and neutral temperature.
- Better understanding and management of RNT through regular measurements.
- Ability to spot-check RNT on any given rail.
- Potential to reduce track buckles and pull-aparts.

PROJECT PARTNERS

- Virginia Tech
- Norfolk Southern
- Tennessee Tech

COST & SCHEDULE

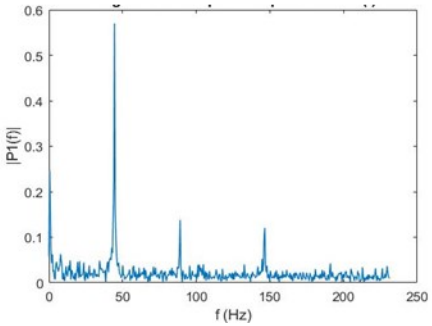
- Funding: $284,190
- Project Duration: July 2018 – July 2020

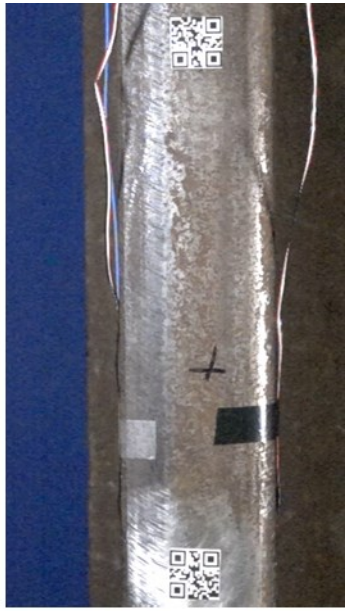
FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Image Processing and Machine Learning Algorithms to Measure Axial Stress in Rails

PROJECT DESCRIPTION

- Investigate a new technology able to determine the absolute stress of continuous welded rails (CWRs) without disturbing the track structure, without prior knowledge of the rail neutral temperature (RNT), and with a single measurement.
- Develop new inspection concept based on the non-contact detection of rail vibrations using cameras operating at ~1,000 fps, and on image processing algorithms able to extract characteristics such as mode-shapes and frequencies of the vibrating rail. These characteristics are then used to infer the axial stress using existing models and advanced machine learning algorithms.
- Perform feasibility laboratory tests on a rail segment under compressive load.
- Perform the first field test in spring 2020 at the Transportation Technology Center High Tonnage Loop.





RAILROAD IMPACT

- Reliable technology, able to determine axial stress and neutral temperature, would reduce drastically the risk of buckling during warm days or rail fracture during the cold season.
- The proposed technology is conceived to be minimally invasive, cost-effective, and practical. It is minimally invasive and practical because it would require only a very few measurements to be conducted at any time of the day and at any time of the year.

PROJECT PARTNERS

- University of Pittsburgh – grantee
- Northeastern University - grantee
- Transportation Technology Center, Inc. – test support

COST & SCHEDULE

- Funding: $156,152
- Project Duration: August 2019 – January 2022

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

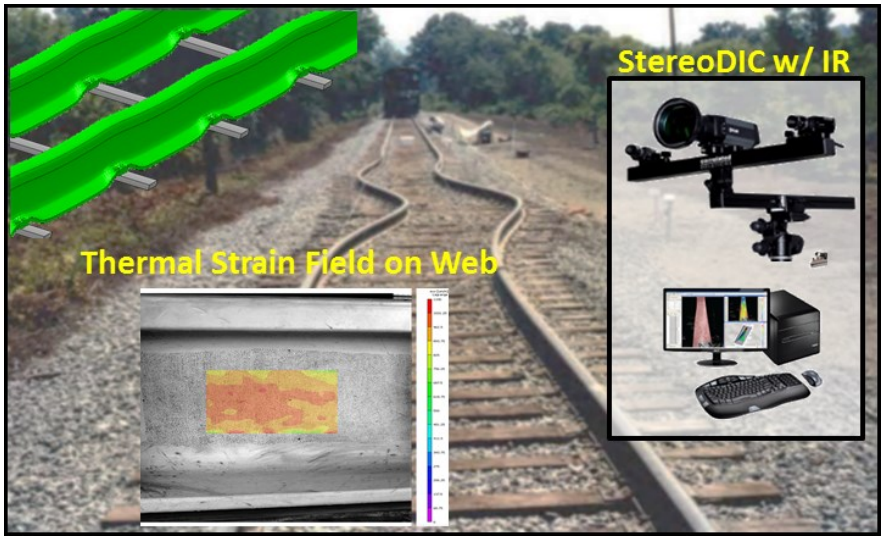
Longitudinal Stress Measurements in Rail Using a Non-Contacting Reference-Free Vision-Based Approach

PROJECT DESCRIPTION

A non-contacting vision-based method is proposed to estimate the rail neutral temperature and quantify the stress in the rail. This study will demonstrate the viability of the proposed technique in a laboratory environment.

Tasks – Phase I:

- 1. Design and Build the Prototype System
- 2. Method Verification
- 3. Method assessment on Physical Track Section in the Laboratory



RAILROAD IMPACT

- Improve safety through early detection of potential rail failure.
- Facilitate effective management of thermal stresses.
- In-situ, non-destructive, reference-free testing; does not disrupt service.
- Simple, easy to use, accurate and cost-effective technology deployed on a routine basis or on demand.
- Ability to integrate data with information acquired by other track-sensing technologies.

PROJECT PARTNER

- University of South Carolina, Columbia

COST & SCHEDULE

- Funding: $57,004 (Phase I)
  $142,544 (Phase II – Optional)
  Total: $199,548
- Project Duration: June 2019 – July 2020 (Phase I)

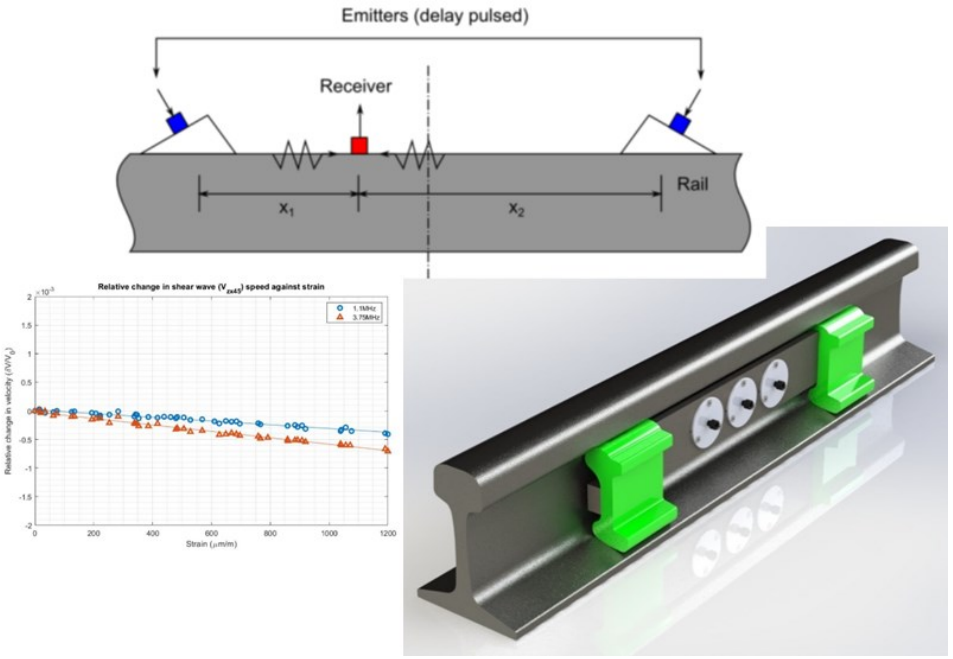
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Longitudinal Stress Measurement Using Ultrasound

PROJECT DESCRIPTION

- Demonstrate a measurement of the induced longitudinal stress in continuously welded rail using an ultrasonic system.
- Use sensors aligned in multiple planes to return measurements without reference to a calibration curve.
- Relate the stress value to neutral rail temperature (NRT).
- Return a measurement for rail longitudinal stress without un-pinning rail.



RAILROAD IMPACT

- Extension of rail lifetime.
- Lower track downtime, resulting in less service disruption.
- Simplification and cost reduction of rail NRT maintenance.
- Increase accuracy of rail NRT monitoring.
- Increase railroad safety by reducing the occurrence of bucking/pull-apart failures.
- The outcome of this project could be further developed into a fast, hand-held device for determining NRT – to be used by a non-specialist operator.
- Develop a tool for better condition monitoring and pre-emptive maintenance.

PROJECT PARTNERS

- University of Sheffield, UK
- Transportation Technology Center, Inc.

COST & SCHEDULE

- Funding: $150,009
- Project Duration: November 2018 – September 2020

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Enhanced Acoustic Birefringence Method for Measuring Longitudinal Rail Stress

PROJECT DESCRIPTION

Develop a portable prototype for measuring rail stress allowing rail neutral temperature (RNT) to be estimated within 5° F. The completed feasibility study demonstrated a highly linear relationship ($r^2 > 99.9\%$) between longitudinal rail stress (LRS) and acoustic birefringence (AB), as well as a technique for overcoming the influence of residual stress and texture.
Year 1 goals of this project are:

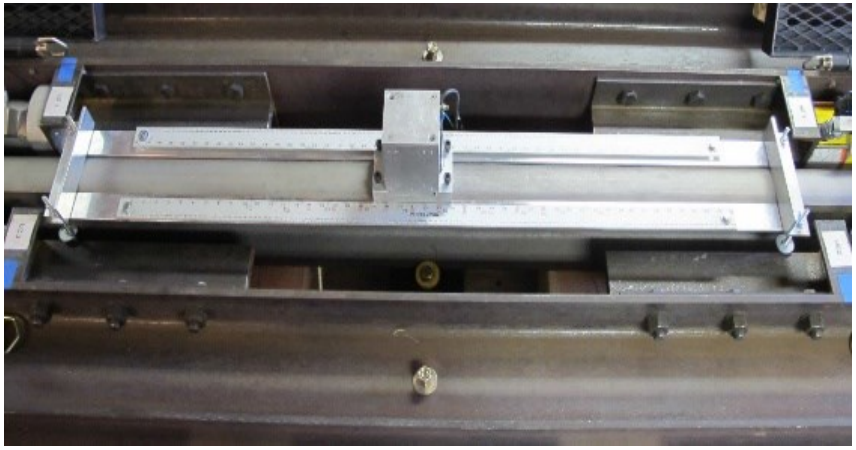
- Verify that AB measurements are accurate in field conditions.
- Determine factors influencing the AB/stress relationship.

If results justify proceeding, Year 2 goals will be:

- Develop a portable field version of the lab equipment.
- Determine if similar rails (related by weight, manufacturer, year batch, etc.) have similar AB/stress relationships.
- Final assessment of stress and RNT measurement accuracy in field conditions (supervised blind test at TTCI)

RAILROAD IMPACT

- Potential to provide reliable, *reference-free* measurements of LRS and RNT.
- Capability to regularly spot-check and monitor trends in RNT.
- Adjust RNT after defect removal, curve realignment, etc.
- Determine when slow orders are necessary and justified.
- Target proactive adjustments of RNT to mitigate risk of winter pull-apart and summertime heat buckles.



PROJECT PARTNER

- Analogic Engineering, Inc.
- Dr. Robert Erikson, University of Wyoming College of Engineering and Applied Science
- Transportation Technology Center, Inc. (TTCI)

COST & SCHEDULE

- Funding: $121,608 (Year 1; Year 2 funding pending results)
- Project Duration: September 2019 – September 2021

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Technical Support for FRA Office of Railroad Safety

PROJECT DESCRIPTION

- Assist FRA Office of Research, Development and Technology in conducting tests, detailed analyses and technical reviews on behalf of the Office of Railroad Safety to ensure the safety of the United States railroad network;
- Efforts can include analyses to ensure appropriate and justifiable regulations as well as support for efforts focused on railway infrastructure, passenger safety and freight accident prevention.
- Provide support and training for safety-related issues including Continuously Welded Rail maintenance practices.

RAILROAD IMPACT

- Task provides for quick response instrumentation, test, and analysis support to resolve safety-related problems and emergencies, determine causal factors, and reduce future problems.
- Supports data gathering for high speed/high cant deficiency qualification and revised safety standards reflecting sound science and engineering expertise.
- Facilitates ongoing technical evaluation required for demonstration and deployment of new technologies for improved safety and operational efficiency.
- Training material for CWR management developed in 2020 will serve as a resource for the rail industry.

PROJECT PARTNERS

- ENSCO Inc.
- Kandrew Consulting, Inc.

COST & SCHEDULE

- Funding: $250,000
- Project Duration: September 2018 – June 2021

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 494-2265 • robert.wilson@dot.gov

Ballast Waiver Support

PROJECT DESCRIPTION

- Better define the performance, degradation, variability, and safety of “reduced performance” ballast through a better understanding of its long-term behavior.
- Collect and analyze pertinent information using track inspection vehicles, long-term track instrumentation, ground-penetrating radar, and other available data.
- Continue stakeholder support for the operations under the fouled ballast waiver and the activities related to concurrent, joint Association of American Railroads (AAR)-FRA research effort.

RAILROAD IMPACT

- Better understanding of reduced performance or “fouled” ballast under a range of weather conditions, and its effect on track performance and safety-critical conditions.
- Development of objective criteria for both railroads and FRA inspectors to use for identifying and managing fouled ballast conditions.
- Production of information for potential data-driven recommendations related to enforcement of Track Safety Standards §213.103 .
- Improved railroad safety and maintenance operations

PROJECT PARTNERS

- ENSCO, Inc.
- AAR
- BNSF
- University of Illinois, Urbana-Champaign
- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $604,433
- Project Duration: August 2018 – Dec 2019

FRA PROJECT MANAGER: Hugh Thompson • (202) 493-6383 • hugh.thompson@dot.gov

Quantification of Track Instabilities Due to Ballast Movement at Special Locations Using Integrated Sensor Networks

PROJECT DESCRIPTION

- Develop a platform of hardware and software to: (1) quantify in the field ballast failure mechanism and criteria, and (2) offer a platform for the future real-time ballast stability evaluation and monitoring program.
- Develop advanced sensors with: (1) onboard programmable ballast failure mechanism and criteria algorithm, and (2) advanced communication protocols such as iBeacon.
- Install field instrumentation of the advanced sensor networks at different locations under different traffic and maintenance conditions.
- Initiate the real-time ballast stability evaluation and monitoring program based on validated ballast failure mechanism and criteria.

RAILROAD IMPACT

- Real-time data collection and integrated analysis systems allow railroads to more accurately identify the instantaneous condition of their ballast and track bed and proactively assign maintenance windows to ensure safe and efficient train operation with the least amount of train delay due to maintenance outages.
- Allow railroads to identify an objective threshold by which they can establish a window or opportunity for ideal track maintenance.
- Technology is “moving platform ready” with iBeacon technology because sensor data can not only be sent to the engineers in real time but can also be stored and “picked up” by geometry cars passing by, with which track engineers will have significant higher resolution and real-time images of their track in terms of safety and serviceability.

PROJECT PARTNERS

- Penn State
- HyGround
- Amtrak
- Railroad Technology & Services (RTS)

COST & SCHEDULE

- FRA BAA Funding: $322,842 – scheduled for 24 months (two phases)
- Granted In-kind support from:
  - RTS – 50 “SmartRocks” free of charge and other technical support (equivalent cash value of $48,600)
  - Amtrak – site access and protection, technical support, etc.
- Project Duration: September 2018– August 2020

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Hugh Thompson • (202) 493-6383 • hugh.thompson@dot.gov

Innovative Track Inspection Technologies

PROJECT DESCRIPTION

- Support for the introduction of new track inspection approaches and advancement of existing track inspection technologies, with a focus on data interpretation and analysis
- Research into assessment of FRA's Vertical Track Deflection Measurement System (VTDMS) and alternative approaches to directly measure vertical defection under given loads.
- Provide engineering and data analysis support for gage restraint measurement system, ground-penetrating radar, VTDMS, and similar track evaluation technologies.
- Support field activities for FRA track research.

RAILROAD IMPACT

- Broaden the application of innovative technologies to detect degraded track conditions.
- Improve the understanding of track behavior through characterization of various track components and parameters.
- Provide practical uses of technology to improve railroad safety and maintenance practices.

PROJECT PARTNER

- ENSCO, Inc.

COST & SCHEDULE

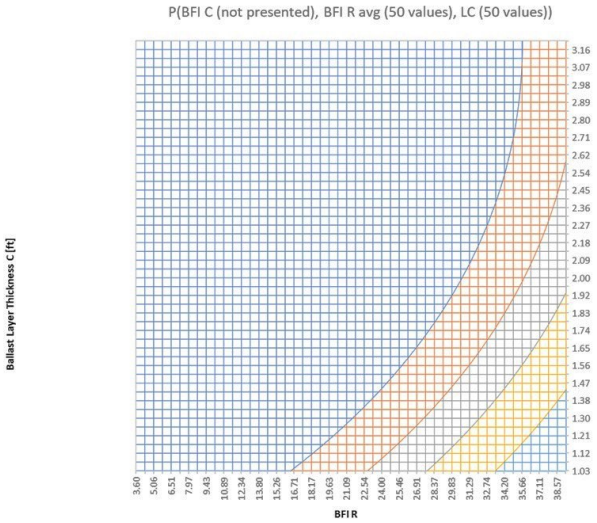
- Funding: $242,453
- Project Duration: August 2018 – June 2020

FRA PROJECT MANAGER: Hugh Thompson • (202) 493-6383 • hugh.thompson@dot.gov

Relationship between Track Geometry Defects and Measured Track Subsurface Conditions

PROJECT DESCRIPTION

- Develop improved and expanded data analytics-based relationships between track substructure inspection parameters and track geometry defect occurrence.
- Focus on GPR data but can include M-rail data as available from FRA DOTX 218/220 consist.
- Provide for identification of track locations with potential for development of track geometry defects that will grow to unsafe levels, considering acceptable inspection intervals.
- Develop analysis algorithm(s) to correlate multiple inspection parameters with track geometry defects.
- Implement framework on suitable dataset with broad range of results.



RAILROAD IMPACT

- Track geometry cars are being equipped with additional inspection technologies to supplement the basic track geometry measurements.
- The ability to use these substructure inspection tools to identify potential track geometry defect initiation sites would be a valuable tool for railroads.
- Provide additional information on where high-risk track geometry defects could develop.
- Improved track safety
- Lower cost of maintenance

PROJECT PARTNER

- University of Delaware (Railroad Engineering and Safety Program)

COST & SCHEDULE

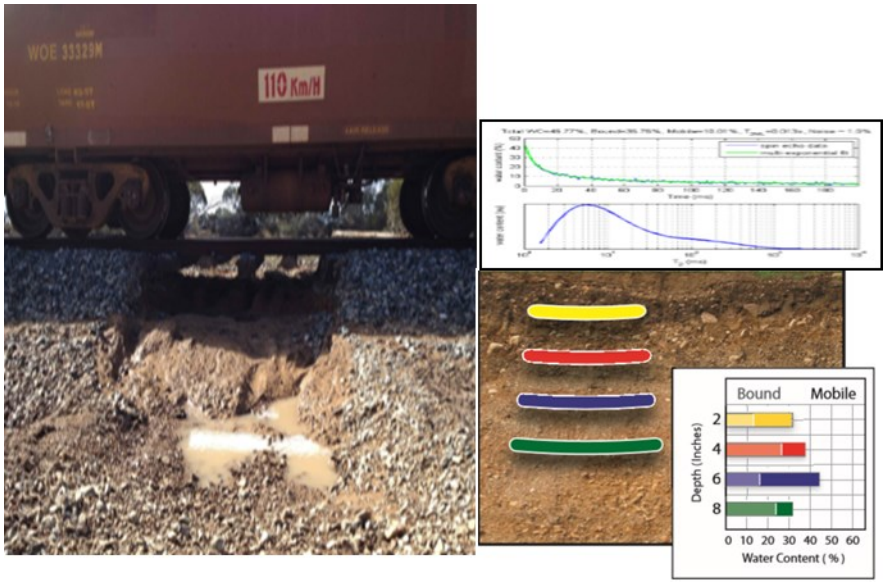
- Funding: $304,000
- Project Duration: September 2019 – September 2021
  - 24-month schedule includes data collection and preparation, development of engineering relationships, statistical analysis, and development of analysis algorithms.

FRA PROJECT MANAGER: Hugh Thompson • (202) 493-6383 • hugh.thompson@dot.gov

Trackbed Moisture Monitoring System (TMMS)

PROJECT DESCRIPTION

- The proposed Trackbed Moisture Monitoring System (TMMS) is based on a novel adaptation and implementation of existing nuclear magnetic resonance soil moisture measurement technology.
- The outcome will be a rail-mounted system to measure bound and mobile water content to depths of about 20” between the rails.
- Measurements will be obtainable in static and slow-speed transit modes.
- The TMMS will give railroad inspectors a unique tool to remotely measure trackbed water content.
- Results will be directly viewable in the field.



RAILROAD IMPACT

- Fouling materials in ballast absorb moisture and can lead to failure of the formation and pumping of mud from the subgrade. At an advanced stage, this requires expensive rehabilitation of the track.
- Saturated fouled material decreases the resistance to shear deformation, decreases track support, and affects geometry.
- If fouled materials are allowed to dry, the ballast bed can bind, and the resulting lack of elasticity can damage sleepers and rolling stock.
- Saturated fouled ballast can significantly reduce effectiveness and productivity of ballast cleaning.
- TMMS will provide a direct means of measuring mobile and bound water content of the trackbed in areas targeted by GPR to have fouled BFIs.

PROJECT PARTNERS

- Vista Clara, Inc.
- Zetica Ltd.

COST & SCHEDULE

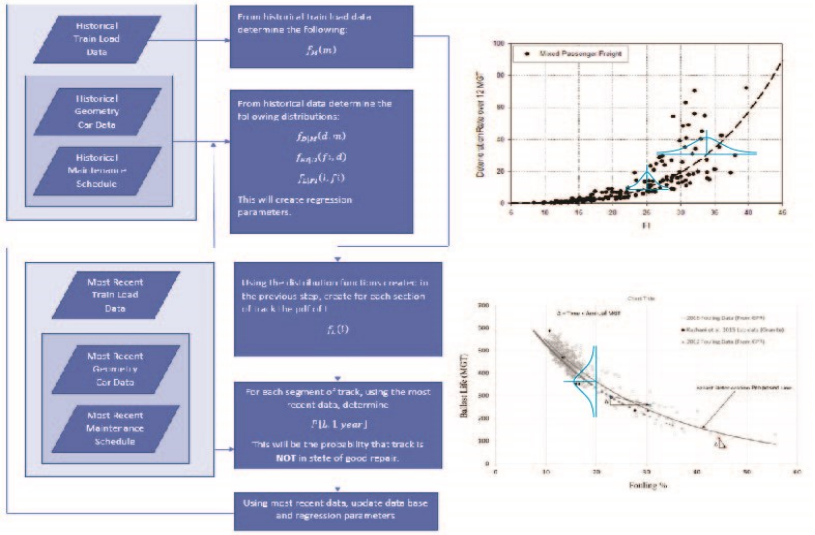
- Funding: FY19/20 – $330,000
- Project Duration: September 2018 – September 2020

FRA PROJECT MANAGER: Hugh Thompson • (202) 493-6383 • hugh.thompson@dot.gov

Probabilistic Approach to Evaluate Ballast Life Using Large Datasets

PROJECT DESCRIPTION

- Develop a probabilistic methodology based on the large datasets being collected by the railroads.
- Assess the availability of data collected from regular geometry car measurements and develop a means to utilize both the large historical data and the most recent data to produce an assessment of the need to conduct remedial measures (maintenance, repair, replacement).
- Identify section of track on which to apply the proposed methodology. This will require the development of a means to automatically assign the data and probability distribution parameters to each of the track sections in the GIS-based system, and to conduct the appropriate analysis.



RAILROAD IMPACT

- Improved safety, as 33 percent of all rail accident fatalities are the result of substructure failure.
- Ballast fouling was a contributing factor in recent rail accidents that resulted in oil fires.
- Probabilistic approach accounts for uncertainty associated with determining maintenance needs of ballasted track.
- Model will be able to predict ballast life, potentially reducing the need for remediation or catching a problematic section of track prior to an immanent need to remediate.

PROJECT PARTNERS

- University of Massachusetts (lead)
- Loram/HyGround Geotechnical Services

COST & SCHEDULE

- Funding: FY19/20 – $315,000
- Project Duration: September 2019 – September 2021

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Hugh Thompson • (202) 493-6383 • hugh.thompson@dot.gov

Near-Real-Time Processing of Targeted Ground-Penetrating Radar Data for Ballast Condition

PROJECT DESCRIPTION

- Support introduction of new track inspection approaches and advancement of existing track inspection technologies with focus on data interpretation and analysis.
- Research into assessment of FRA's Vertical Track Deflection Measurement System (VTDMS) and alternative approaches to directly measure vertical defection under given loads.
- Provide engineering and data analysis support for gage restraint measurement system, ground-penetrating radar, VTDMS, and similar track evaluation technologies.
- Support field activities for FRA track research.

RAILROAD IMPACT

- Broaden the application of innovative technologies to detect degraded track conditions.
- Improve understanding of track behavior through characterization of various track components and parameters.
- Provide practical uses of technology to improve railroad safety and maintenance practices.

PROJECT PARTNERS

- Balfour Beatty
- Zetica Rail

COST & SCHEDULE

- Funding: $607,362
- Project Duration: September 2018 – December 2019

FRA PROJECT MANAGER: Hugh Thompson • (202) 493-6383 • hugh.thompson@dot.gov

Automated Frog Repair Technology

PROJECT DESCRIPTION

- Phase 2 project includes field testing of repaired frogs on Class I railroads.
- Development of metal-cored electrode to reduce weld slag and eliminate inter-pass cleaning.
- Develop conceptual framework for fully automated repair system.

RAILROAD IMPACT

- Automated, improved repair process for austenitic manganese steel (AMS) frogs.
- Eliminates errors and inconsistencies in field repairs.
- Controlled process ensures high quality and extended life for repaired frogs.
- Automated process allows for off-track rehabilitation, thus reducing time on track.

PROJECT PARTNERS

- Edison Welding Institute
- CSX
- Norfolk Southern

COST & SCHEDULE

- Funding: $540,000
- Project Duration: March 2016 – March 2020

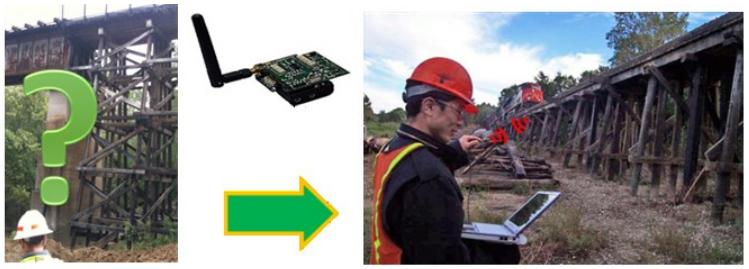
FRA PROJECT MANAGER: Cameron Stuart • (202) 493-6384 • cameron.stuart@dot.gov

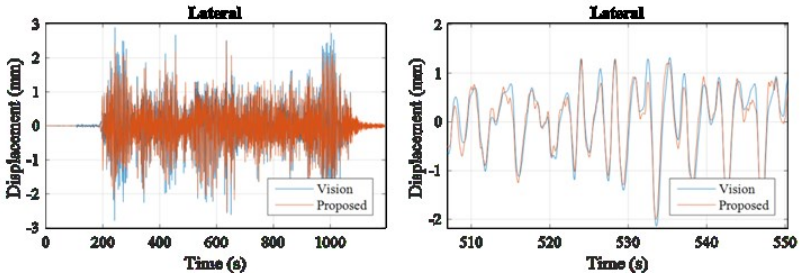
Bridge Condition Assessment Using Smart Sensors

PROJECT DESCRIPTION

Phase 2 development effort:

- Field trials of equipment on multiple bridges in U.S. Midwest.
- Establish service limit thresholds based on measured data.
- Test the reference-free displacement estimation algorithms and user interface.





RAILROAD IMPACT

- Accurate, reference-free bridge displacement estimations under revenue traffic.
- Dynamic bridge safety limit thresholds.
- Wireless technology – no fixed installation required.
- Quantitative data for railroad use in prioritization of bridge maintenance and replacement.

PROJECT PARTNERS

- University of Illinois at Urbana-Champaign (UIUC)
- FRA Office of Railroad Safety
- Class I – CN, multiple short line railroads

COST & SCHEDULE

- Funding: $650,000
- Project Duration: Feb 2013 – January 2020

FRA PROJECT MANAGER: Cameron Stuart • (202) 493-6384 • cameron.stuart@dot.gov

Investigation of Timber Crosstie Spike Fastener Failures

PROJECT DESCRIPTION

- Identify and quantify the extent of spike failures in the field.
- Collect data on operating conditions, environmental characteristics, track construction, maintenance, and age.
- Develop and test failure cause hypotheses.
- Make recommendations to eliminate failures.
- Conduct laboratory and field experiments to characterize the dynamic load environment in areas of spike failures.
- Develop numeric models to describe load conditions and predict failures.
- Isolate root cause(s) of spike failures.
- Conduct accelerated testing of new fastener system designs at Transportation Test Center.

RAILROAD IMPACT

- Improve system safety and reliability, and reduce life cycle infrastructure costs.
- Improve spike design and system arrangements.
- Reduce risk of derailments due to fastener failures.

PROJECT PARTNERS

- University of Illinois at Urbana-Champaign (UIUC)
- Volpe National Transportation Systems Center
- Class I railroads: Norfolk Southern, BNSF, CSX, UP, CN
- Suppliers: Pandrol, Vossloh

COST & SCHEDULE

- Funding: $410,000
- Project Duration: April 2018 – Dec 2020

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Cameron Stuart • (202) 493-6384 • cameron.stuart@dot.gov

US – China Railway Technology Exchange

PROJECT DESCRIPTION

- Support FRA effort in arrange and participate of the US–China Transportation Forum and its associated rail group meetings and communications.
- Facilitate technical exchanges with China institutions in various areas of FRA interests.
- Organize rail technology and standards exchange meetings and technical visits.

RAILROAD IMPACT

- Enable technical exchanges especially on high-speed rail infrastructure and equipment inspection and maintenance.
- Enhance FRA presence at the US–China Transportation Forum — an effort led by U.S. Department of Transportation.

PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Volpe National Transportation Systems Center

COST & SCHEDULE

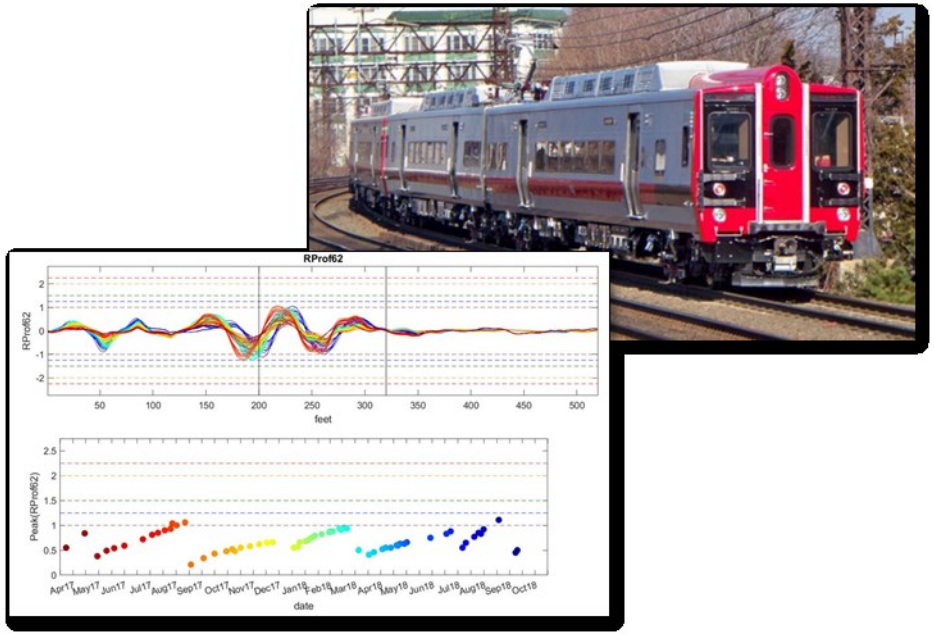
- Funding: $203,000 (2012 – 2019)

FRA PROJECT MANAGER: Luis Maal • (719) 584-0551 • luis.maal@dot.gov

Development of Predictive Analytics Using ATGMS Data

PROJECT DESCRIPTION

- Autonomous track geometry measurement systems (ATGMS) provide for routine, frequent, track-related data to allow railroads to better monitor track conditions and facilitate predictive approaches to preventive maintenance.
- This project leverages large volumes of these recursive track geometry measurements to develop and implement automated processes for analyzing, predicting, and reporting track locations of concern, including those with significant rates of degradation.
- This project will also focus on the identification of root causes of excessive degradation rates to guide corrective actions and extend maintenance cycles.



RAILROAD IMPACT

- This project demonstrates to the railroad industry of the utility of the continual assessment of frequently collected track condition data.
- Processes to be developed will provide the basis for timely preventive maintenance to address safety-related issues long before they become problematic, improving safety and reliability for the entire network.
- As part of a long-term strategy, this information can also be used to identify the cause of deterioration and to guide corrective action choices to improve track performance and safety.

PROJECT PARTNERS

- ENSCO, Inc.
- Metro-North Railroad

COST & SCHEDULE

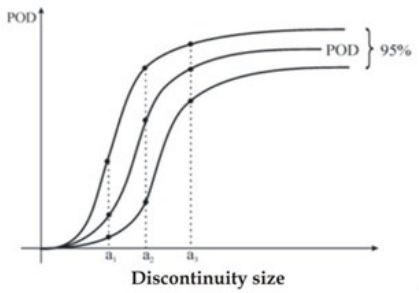
- Funding: $558,950
- Project Duration:
  - Phase I: October 2018 – June 2019
  - Phase II: July 2019 – June 2020
  - Phase III: July 2020 – December 2020

FRA PROJECT MANAGER: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov

Evaluation Procedures for Track Inspection Technologies

PROJECT DESCRIPTION

- Further develop procedures for quantifying the effectiveness of track inspection technology.
- Establish a uniform approach for design and execution of performance assessment testing for track inspection technologies.
- Investigate sample size requirements, repeatability, reproducibility procedures, and acceptance criteria as they relate to the evaluation of track inspection technology effectiveness.
- Demonstrate the feasibility of the model-assisted probability of detection methodology and its application in the railroad industry.



Actual Class \ Predicted class	P	N
P	True Positives (TP)	False Negatives (FN)
N	False Positives (FP)	True Negatives (TN)

RAILROAD IMPACT

- Develop an approach for standardizing the evaluation of effectiveness of existing and emerging track inspection technologies.
- Establish confidence in the effectiveness of new inspection technologies, thereby facilitating adoption for regular use in safety assurance.

PROJECT PARTNERS

- ENSCO, Inc.
- Transportation Technology Center, Inc.

COST & SCHEDULE

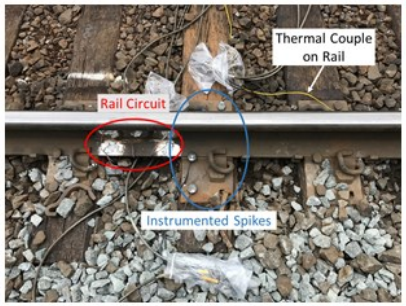
- Funding: $399,800
- Project Duration:
  - Phase I: September 2019 – July 2020
  - Phase II: July 2020 – March 2021
  - Phase III: March 2021 – September 2022

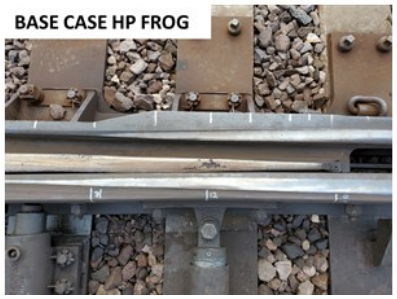
FRA PROJECT MANAGER: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov

Heavy-Axle-Load (HAL) Research and In-Track Testing

PROJECT DESCRIPTION

- Provide an opportunity to evaluate HAL track infrastructure subjected to a range of track, operational, and climatic conditions, under which to evaluate the performance of:
  - New and alternative component designs and materials
  - Improved track maintenance procedures
- Optimize the effectiveness of HAL testing by placing experiments in track segments with representative HAL operating environments.
- Current studies/experiments include:
  - **Demonstration of Railhead Repair Weld Technologies:**
    - Railhead Repair Weld Non-Destructive Technique Improvement Using Phased-Array Ultrasonic Testing
  - **Effects and Characterization of Moisture on Degraded Ballast:**
    - Effects of Light/Heavy Rain Events on Track Settlement Using TTC's "Rainy Section"
  - **Support of Vertical Track Deflection Research Efforts:**
    - Prototype Frog & Weld Repair Performance Evaluations
    - Investigation of Spike-Fastener Breakage under HAL
    - Engineered-Polymer Composite Grade Crossing Tie Study





RAILROAD IMPACT

- Better understanding of the effects of HAL on railway infrastructure and root causes of HAL-related problems.
- Mitigate adverse effects of HAL on track degradation and improve operational safety.
- Help reliably estimate track component life and reduce track-caused accidents.
- Safer and more and reliable infrastructure for heavy-haul freight transportation

PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Collaborative effort with Association of American Railroads
- Norfolk Southern Railway
- Union Pacific Railroad
- Canadian National Railway

COST & SCHEDULE

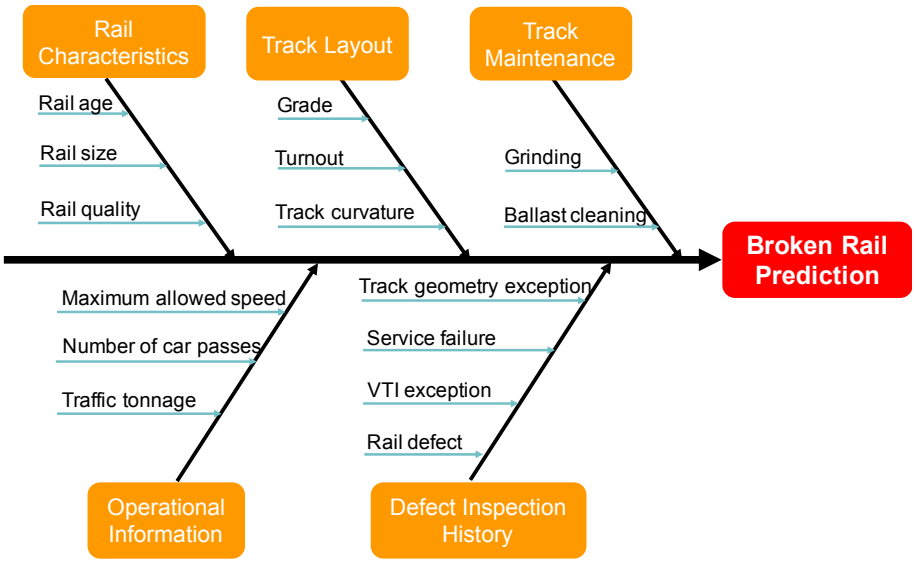
- Funding: $651,750
- Project Duration: May 2017 – May 2020

FRA PROJECT MANAGER: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov

Simulation-Based, Broken-Rail Derailment Risk Analysis

PROJECT DESCRIPTION

- Collect data related to rail defects, broken rails, track geometry exceptions, rail and track characteristics, maintenance, and operations from the partner railroad.
- Develop machine learning models for predicting the probability of broken rails by time and location.
- Estimate derailment consequence (e.g., number of cars derailed) using multivariate data analyses.
- Develop a broken rail derailment risk analysis model based on various track- and train-related factors.
- Evaluate segment-specific risk and identify high-risk locations on the network.



RAILROAD IMPACT

- Development of an integrated broken-rail derailment risk analysis and simulation framework, and, in turn, a flexible analytical tool to analyze the risk of broken rails.
- Creation of a new toolbox to aid in understanding the change in potential risk in response to changes in track condition, operations, maintenance, etc.
- New knowledge regarding the risk of track failure, particularly derailment risk associated with broken rails, as well as the potential for safety improvement and optimization of inspection/maintenance.

PROJECT PARTNERS

- Rutgers, The State University of New Jersey
- CSX Transportation

COST & SCHEDULE

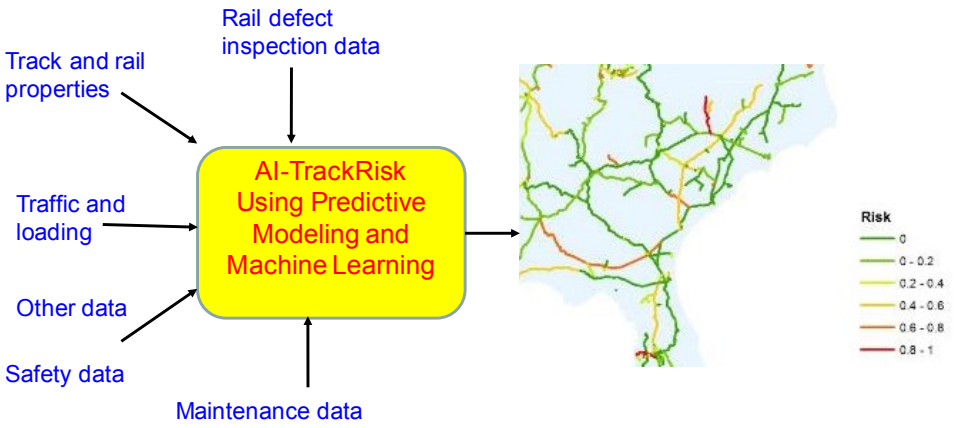
- Funding: $294,000
- Project Duration: January 2017 – October 2019

FRA PROJECT MANAGER: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov

Artificial Intelligence-Aided Track Risk Analysis

PROJECT DESCRIPTION

- Develop an Artificial Intelligence (AI)-Aided Track Risk Analysis (AI-TrackRisk) tool, focusing on rail failures at this stage.
- AI-TrackRisk is an intelligent computer system that can automate track data modeling, predictive analytics, and risk analysis and visualization, ultimately supporting optimal track inspection and maintenance decisions.
- AI-TrackRisk can be a "brain" of a "virtual risk analyst" to automatically turn volumes of railroad big data directly into risk predictions and decision making.



RAILROAD IMPACT

- Provide the industry with an innovative map-based, decision-making tool to perform track data integration, statistical modeling, and risk prediction and visualization automatically, enabled by AI techniques.
- Acquire new knowledge and tools pertaining to how AI can be used to support track data analysis and risk management.

PROJECT PARTNERS

- Rutgers, The State University of New Jersey
  - Civil & Environmental Engineering Department
  - Computer Science Department
- CSX Transportation

COST & SCHEDULE

- Funding: $345,651
- Project Duration: August 2018 – August 2020

FRA PROJECT MANAGER: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov

Field Test Support at Transportation Technology Center

PROJECT DESCRIPTION

- Provide multiple university- and third-party-led research initiatives with onsite testing services and equipment at the FRA's Transportation Technology Center (TTC) to support technology evaluation in a "real-world" setting.
- Recent activities under this task have included:
  - Continued support of non-contact acoustic internal rail flaw detection research conducted by the University of California, San Diego.
  - Support of optical and laser-based change detection research conducted by the Pavemetrics and the University of Illinois at Urbana-Champaign.
  - In-track evaluation of premium fastening systems aimed at mitigating the mechanisms associated with timber tie spike fastener failures as part of research conducted by the University of Illinois at Urbana-Champaign.

RAILROAD IMPACT

- Provide support for controlled testing at TTC, including opportunities for evaluation in a real-world environment, for new and emerging technologies.
- Develop critical prototype hardware/software for advanced rail inspection technology.
- Focus on the development and evaluation of advanced inspection technologies under revenue-service-like conditions.

PROJECT PARTNER

- Transportation Technology Center, Inc.

COST & SCHEDULE

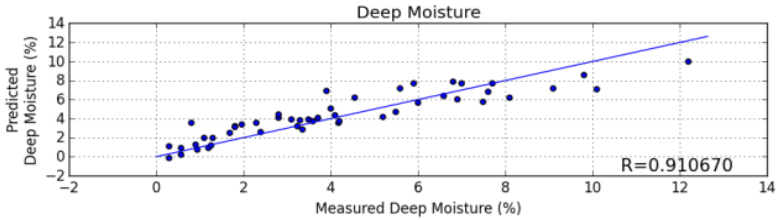
- Funding: $450,200
- Project Duration: April 2017 – October 2020

FRA PROJECT MANAGER: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov

Advanced Development and Field Verification of the RABIT

PROJECT DESCRIPTION

- Further refine a portable, automated instrument to non-invasively determine fouling condition (i.e., “RABIT”, or **RA**dar **B**allast **I**nspection **T**ool).
- Collect field data on outdoor test track and revenue service track.
- Compare ground-penetrating radar results with geotechnical laboratory analysis results to show validity of the technique.
- Investigate relationship between ballast condition and ballast performance (i.e., strength).



RAILROAD IMPACT

- Provide real-time fouling measurement; no post-processing required, which eliminates the need for highly trained personnel to interpret the results.
- Plan maintenance based on fouling measurement and relationship between ballast condition and ballast performance (i.e., strength).
- Provide railroad personnel with an automated solution that allows for track to be inspected on their schedule and to spot-check problem areas.

PROJECT PARTNERS

- Earth Science Systems, LLC
- BNSF
- University of Massachusetts at Amherst
- Volpe National Transportation Systems Center
- FRA Office of Railroad Safety (Region 7)

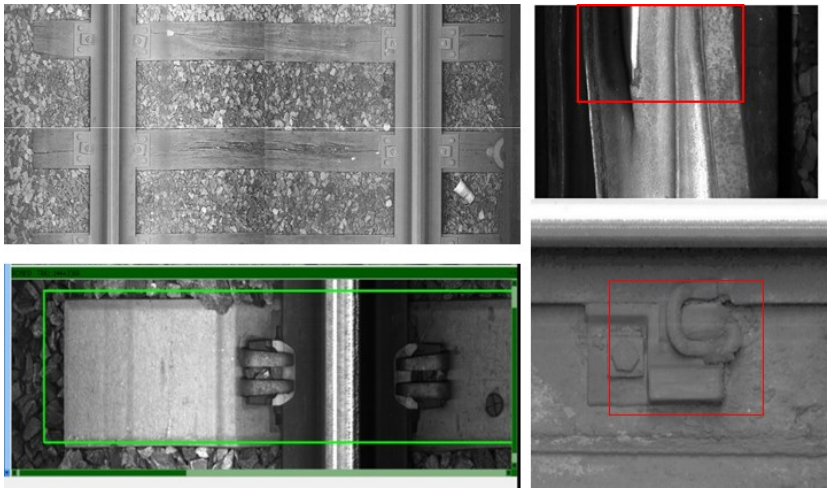
COST & SCHEDULE

- Funding: $252,211.32
- Project Duration: September 2019 – September 2020
  - Field Evaluation with FRA Track Inspector: Spring 2020
  - Final Report: 2020

Data Products for FRA's ATIP Imaging Systems

PROJECT DESCRIPTION

- Identify, develop, and integrate new information products from the data collected by the DOTX-220 Track Component Imaging System (TCIS) and Joint Bar Inspection System (JBIS) in support the FRA Automated Track Inspection Program (ATIP) safety mission and the Office of Research, Development, and Technology (RD&T) research objectives.
- Analyze TCIS and JBIS data outputs within the context of ATIP and RD&T mission profiles to create a plan for data product development that prioritizes each possible product relative to development effort and impact on FRA's safety assurance mission.
- Develop as many useful data products as possible within the constraints of the task. The goal is to produce data products early and often to encourage stakeholder feedback throughout the development phase.



RAILROAD IMPACT

- Further development of automated vision-based inspection technologies that can isolate areas of the track structure with potentially unsafe conditions.
- Improve track inspection quality and efficiency, allowing for safety-critical maintenance to be conducted in a more timely manner.
- Introduction of automated image analytics to traditional tools used to identify defect conditions by FRA's ATIP vehicles and expansion of the off-track inspection toolset for safer inspections.
- Higher level of understanding of track conditions that result in a geometry or other defect condition by adding context and automated analyses to two-dimensional data products.

PROJECT PARTNERS

- ENSCO, Inc.
- FRA Office of Railroad Safety (ATIP)

COST & SCHEDULE

- Funding: $150,000
- Project Duration: July 2019 – July 2020

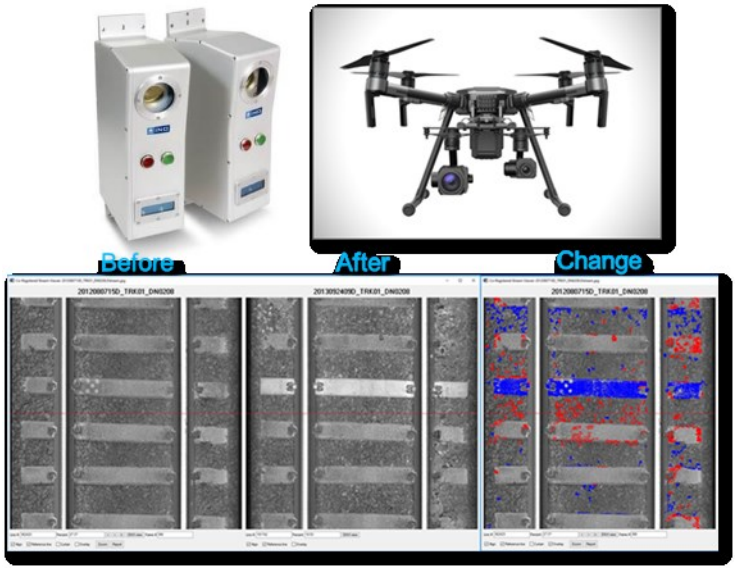
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGERS: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov
Cameron Stuart • (202) 493-6384 • cameron.stuart@dot.gov

Automated Change Detection Technology for Track Inspection

PROJECT DESCRIPTION

- Leverage commercial hardware and software to create an automated change detection system applicable to the railroad track environment, capable of evaluating images against a baseline for relevant changes in the track structure automatically.
- Develop the technological framework for advancing change detection technology to a practical application for track safety assurance inspections.
- Explore alternative data collection methods for change detection, including unmanned aircraft systems (UAS).
- Results will be compiled and presented in reports and presentations to industry at large.



RAILROAD IMPACT

- Further development of automated vision- and laser-based inspection technologies that can automatically isolate areas of the track structure that have changed since the previous inspection.
- Investigation into and implementation of deep learning and artificial intelligence techniques that can accurately process associated data and report on areas of relevant change to railroad decision makers.
- Development of technologies that will supplement traditional walking or hi-rail track inspection activities for safety assurance.

PROJECT PARTNERS

- Pavemetrics Systems, Inc.
- ENSCO, Inc.
- Harris Geospatial Solutions, Inc.
- Noble Drone Services, LLC
- Amtrak

COST & SCHEDULE

- Funding: $345,651
- Project Duration: August 2018 – August 2020

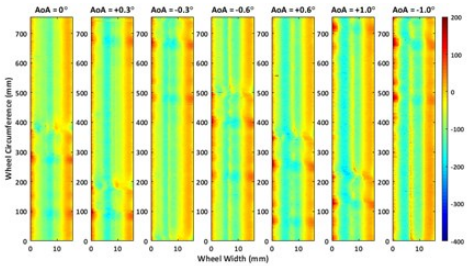
FRA PROJECT MANAGERS: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov
Cameron Stuart • (202) 493-6384 • cameron.stuart@dot.gov

U.S. Department of Transportation
Federal Railroad Administration

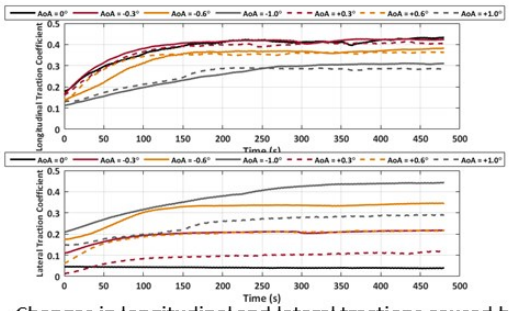
Experimental Evaluation of Wheel/Rail Contact, Third-Body Layer, and Surface Finish on Risk of Derailment

PROJECT DESCRIPTION

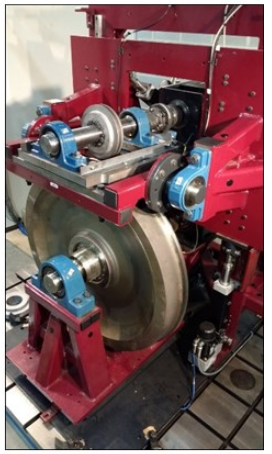
- Provide an experimental evaluation of numerical models widely used by the rail industry, such as CONTACT, for predicting derailment.
- Evaluate the effect of rolling stock operating conditions such as large angle-of-attack (AoA) and rail cant angle on contact dynamics and lateral-to- vertical force ratio, as a derailment indicator.
- Determine the effect of wheel surface finish and third-body layers occurring naturally or added to the track on longitudinal and lateral traction at the wheel/rail interface (WRI).
- Provide guidelines for corrective actions regarding wheel re-surfacing, operating newly-machined wheels, and possibly condemning of hollow-worn wheels, to assist FRA and the U.S. rail industry with safer operation of rolling stock.



Effect of AoA on wheel surface wear



Changes in longitudinal and lateral tractions caused by increased wheel surface wear with time



RAILROAD IMPACT

- Understanding the complex mechanics and dynamics that occur at the WRI is critical for improving railway operational safety and efficiency.
- Introducing a new level of accuracy for measuring a multitude of contact parameters critical in WRI modeling and technology advancement for both passenger and freight trains, far beyond the means currently available to FRA and rail industry.
- Scientifically evaluating parameters and conditions that affect wheel-rail wear, but cannot be evaluated accurately in the field due to naturally-varied conditions.
- Providing guidelines that can assist FRA in further improving U.S. railroads' safety.

PROJECT PARTNERS

- Virginia Tech
- Amtrak
- Standard Steel

COST & SCHEDULE

- Funding: $280,231
- Project Duration: September 20, 2019 to September 19, 2020

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

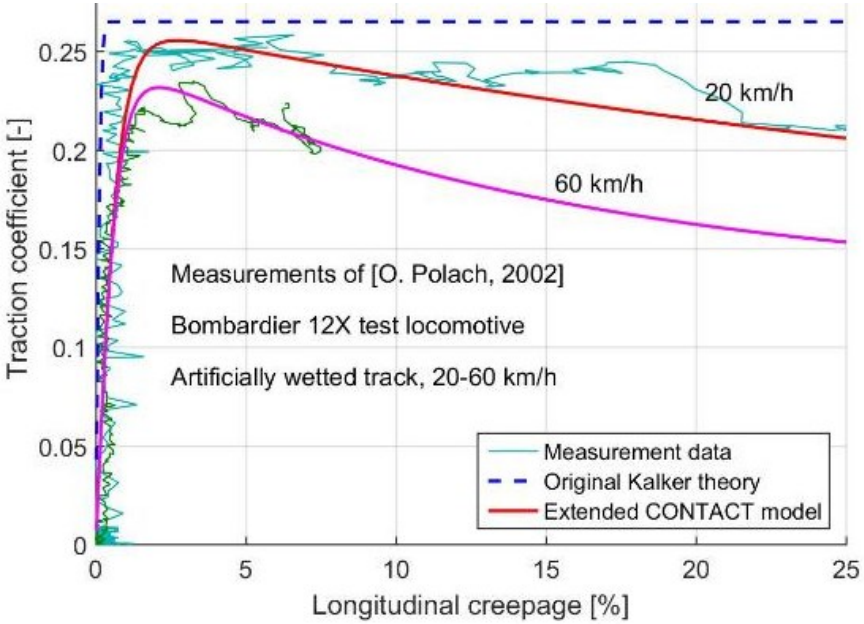
Advanced Modeling of Wheel/Rail Friction Phenomena

PROJECT DESCRIPTION

- Improve the friction modeling approach in the extended CONTACT model.
- Validate the model against available measurements.
- Improve physics-based modeling.
- Integrate the model in the main vehicle-track interaction (VTI) simulation packages.

RAILROAD IMPACT

- Our simulation technology will improve computer simulation:
  - Influence falling friction on flange climb derailment.
  - Influence the friction modifiers on curving behavior, traction control, and energy efficiency.
  - The loads exerted on the track, in a wide range of circumstances.



PROJECT PARTNER

- VORtech BV

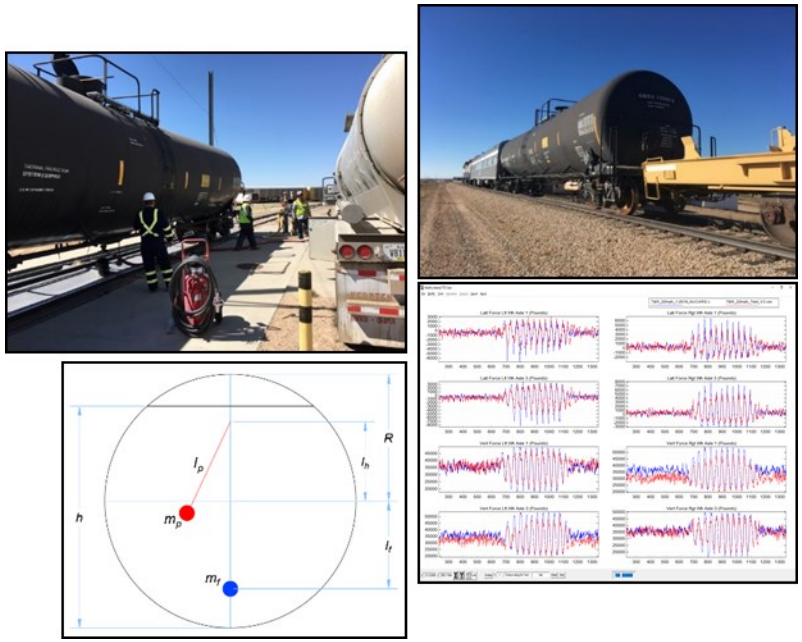
COST & SCHEDULE

- Funding: $225,000
- Project Duration: March 2017 –December 2019

Track Geometry and Vehicle Performance

PROJECT DESCRIPTION

- Phase II & III focus, as tasked by FRA, consists of evaluating tank car dynamic performance and improving the tank car model developed under Phase I of the project. To that end, FRA procured tank car DOT-117A100W1 for vehicle characterization and on-track tests.
- Conduct full-scale tank car tests on TTC test tracks, including the High Tonnage Loop, Precision Test Track, Wheel/Rail Mechanism loop, and Railroad Test Track. For the loaded condition, crude oil and water are to be used as lading. Data acquired from the various tests is utilized for developing a tank car pendulum and fixed-mass model designed to account for fluid-sloshing effects.



RAILROAD IMPACT

- Conducting on-track testing for empty and loaded conditions of a DOT-117 tank allows for the assessment of vehicle dynamic behavior and provides critical data for developing the pendulum and fixed-mass NUCARS® tank car model designed to account for fluid-sloshing.
- The use of crude oil and water as lading for the loaded condition duplicates the typical revenue service condition.
- The tank car model can be reliably deployed to enhance applicable track geometry limits for safer tank car performance.

PROJECT PARTNER

- Transportation Technology Center, Inc.

COST & SCHEDULE

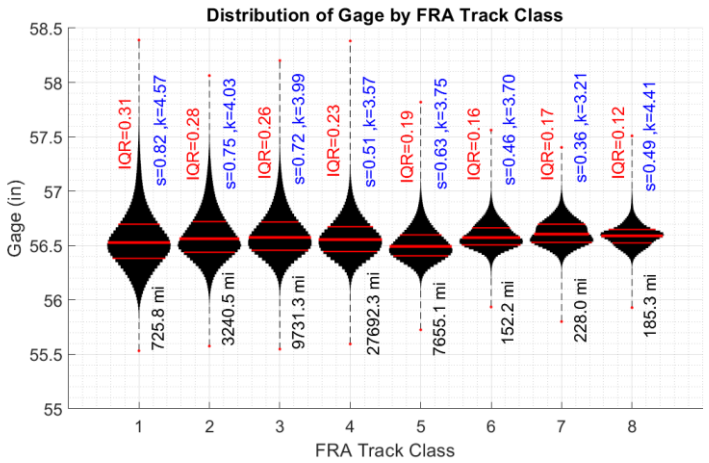
- Funding: FY19 – $346,874
- Project Duration: September 2016 – September 2021

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Characterization of Track Geometry for Various Operational Conditions

PROJECT DESCRIPTION

- Conduct a review of modern literature covering measurement and characterization of track geometry:
  - Measurement methods
  - Processing procedures and settings
  - Characterization and analysis methods
- Using state-of-the-art methodology, analyze track geometry data collected by FRA and Amtrak track geometry cars.
- Characterize the amplitude and wavelength content of the current track geometry environment of the U.S. rail system under various operational conditions, including:
  - Track Classes 1-8
  - Tangent vs. curved track
  - Traffic type (freight vs. passenger)
  - Crosstie type
- Examine the correlations between track geometry variables (gage, crosslevel, alignment, profile).



PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Volpe National Transportation Systems Center
- ENSCO, Inc.
- Amtrak

RAILROAD IMPACT

- Recommendations on best practices for track geometry measurement will be provided.
- Characterization results can be used to develop new analytical and empirical track geometry inputs for use in rail vehicle simulations and tests.

COST & SCHEDULE

- Funding: $314,512
- Project Duration: September 2018 – December 2021
  - Literature review and interim report: March 2019
  - Automated characterization: October 2019
  - Manual characterization: April 2020
  - Final Report: September 2020
  - Conference paper and presentation: 2021

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Steering Traction on Wheel and Rail Damage – Full Scale Testing with RCF Simulator (RCFS)

PROJECT DESCRIPTION

- The RCFS has been installed in the Rail Dynamics Laboratory at FRA's Transportation Technology Center in Pueblo, Colorado.
- This facility is capable of testing full scale, standard-gauge freight and passenger wheelsets and rails under current and anticipated load conditions with precisely controlled variables.
- Testing at varying traction forces under 36-ton axle load reveals plastic flow dominant, combination of RCF and wear and wear dominant damage modes.
- RCF and wear performance of different class wheels and rails are investigated.
- Wheel/rail contact forces, creep force – creepage characteristic measurement
- Lubrication and rail grinding effect on RCF
- Wheel/rail contact model validation and tribology study

RAILROAD IMPACT

- Results will lead to reduction of RCF through optimization of wheel and rail materials, profiles, and maintenance procedures.
- High-speed passenger train operations on rails with RCF may lead to derailment.
- RCF may contribute to shattered and vertical split rims; it may also mask deeper seated cracks in rail from ultrasonic detection.
- Implementation of results will lead to lowered stresses and crack growth in rail.
- Measured W/R contact creep characteristic may provide valuable information for maintenance strategy and safety regulations.

PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Association of American Railroads

COST & SCHEDULE

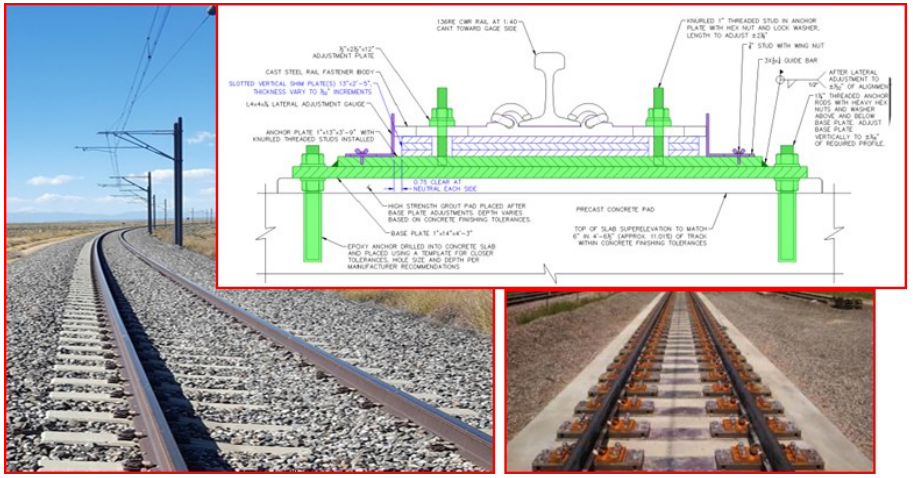
- FRA funding: $2,474,422 (2013~2021); AAR SRI funding: $4,449,459 (2011~2019); TTCI IR&D funding for RCFS design and construction: $3,2888,000 (2012~2015)
- Seasonal effect RCF tests completed in 2019.
- Lubrication testing and force measurement improvement will be continued in 2020.

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Adjustable Precision Curved Track Anomaly Test Section

PROJECT DESCRIPTION

- Track geometry measurement validation and vehicle-track interaction testing are critical functions for safety and operations of railroads, especially for high-speed passenger trains.
- This project will design a curved test track section on the high-speed test track at FRA's Transportation Technology Center (TTC), where geometric track anomalies can be installed and adjusted.
- A curved test track section will supplement the existing tangent high-speed adjustable perturbation slab track test section previously built at TTC.



RAILROAD IMPACT

- Track geometry testing is a critical function for safety and operations of railroads, especially for high-speed passenger trains.
- For high-speed passenger rail, the track anomaly test section will provide a unique testing platform where vehicle-track interaction modeling simulations can be validated and existing and new technologies can be tested.
- This track section can be used to validate a track geometry measurement system, especially for high-speed track inspection.

PROJECT PARTNERS

- Transportation Technology Center, Inc.
- David Evans and Associates, Inc.

COST & SCHEDULE

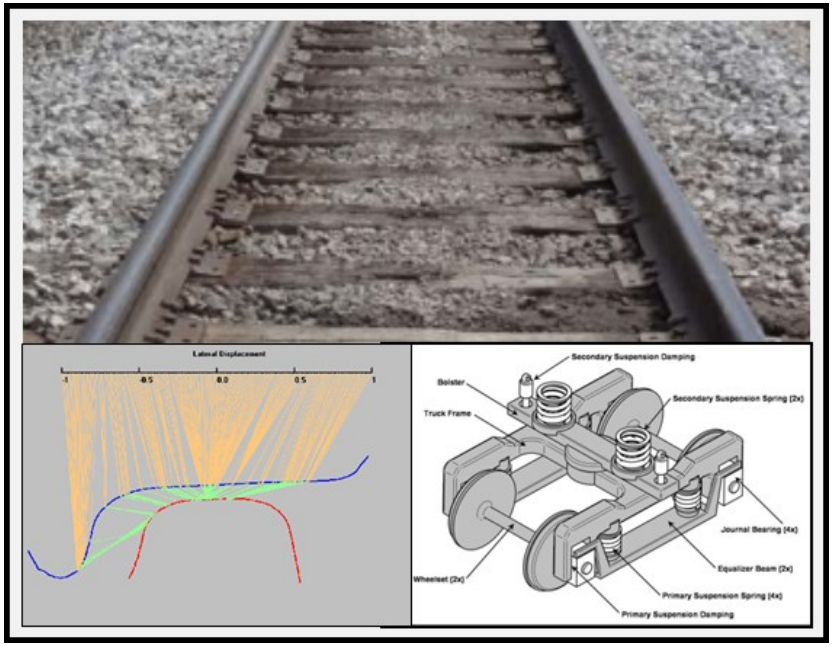
- Funding: $1,340,914
- Project Duration: September 2018 – March 2020
  - Conceptual design and 30% design plans
  - Geotechnical investigation of the site
  - 60% and 90% design and final construction bid document preparation

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Vehicle-Track Interaction Testing, Modeling and Analyses

PROJECT DESCRIPTION

- Assist FRA Office of Research, Development, and Technology in modeling, simulation, test, data collection, and analyses of vehicle-track interaction related issues.
- Efforts include evaluating current track geometry standards and exploring influence of track geometry characteristics and speeds on vehicle dynamic forces.
- Current activities focused on characterizing current condition of the nation's rail network for use in assessing derailment risks.



RAILROAD IMPACT

- Studies in this area lead directly to reduced derailment risk, track degradation, vehicle wear or damage, lading damage and passenger discomfort.
- Research here considers performance-based track geometry tolerances and vehicle design parameters that ensure safety and maximize effective and efficient use of maintenance resources.

PROJECT PARTNER

- ENSCO, Inc.

COST & SCHEDULE

- Funding: $351,000
- Project Duration: September 2018 – September 2020

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Ground-Truth Measurement of Track Geometry

PROJECT DESCRIPTION

- FRA has constructed a 500’ tangent test track with adjustable fasteners to allow the introduction of known geometry deviations for evaluation of TGMS systems and their accuracy.
- Efforts under this task will focus on developing a measurement device that can be used to measure the actual track geometry installed on the concrete slabs accurately and quickly identified as ground truth.
- These highly accurate measurements will be the baseline with which TGMS accuracy is compared.

RAILROAD IMPACT

- System will establish conditions of test track that will be used to verify the accuracy of track geometry measurement systems.
- Once the condition of the test track is precisely determined using this system, the track can be used as a benchmark for use in validating a wide range of measurement systems and dynamic modeling exercises.

PROJECT PARTNERS

- ENSCO, Inc.
- Volpe National Transportation Center

COST & SCHEDULE

- Funding: $480,248
- Project Duration: September 2018 – September 2020

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Track Geometry Measurement System (TGMS) Evaluations

PROJECT DESCRIPTION

- Develop procedures for testing and evaluating Track Geometry Measurement Systems (TGMS) under controlled conditions to verify accuracy and repeatability.
- Develop known vertical and lateral track perturbations on TTC's High-Speed Adjustable Perturbation Slab (HS-APS) track including "blind tests."
- Test DOTX 216 at speeds 15 to 105 mph in 2015 and 2016:
  - Combinations of perturbation vertical and lateral wavelengths and amplitudes
- FRA and Volpe Center: Develop procedures and analyze test data.
- TTCI: Assist with developing/reviewing procedures, install, measure perturbations; provide wayside measurements, operations support, and improvements to HS-APS based on testing experience.
- ENSCO: Test planning, operate DOTX 216, and collect TGMS data.

PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Volpe National Transportation Systems Center
- ENSCO, Inc.

RAILROAD IMPACT

- Consistent method for evaluating and benchmarking TGMS cars
- Reduce TGMS measurement error.
- Verify accuracy and repeatability, including effects of measurement speed and repeated/multiple deviations.
- Identify potential issues for measurement/analysis of certain types of track geometry (TG) perturbations.
- Increased confidence in TG data and exception reports
- Improved TG data for input to vehicle-track dynamic interaction computer simulation models

COST & SCHEDULE

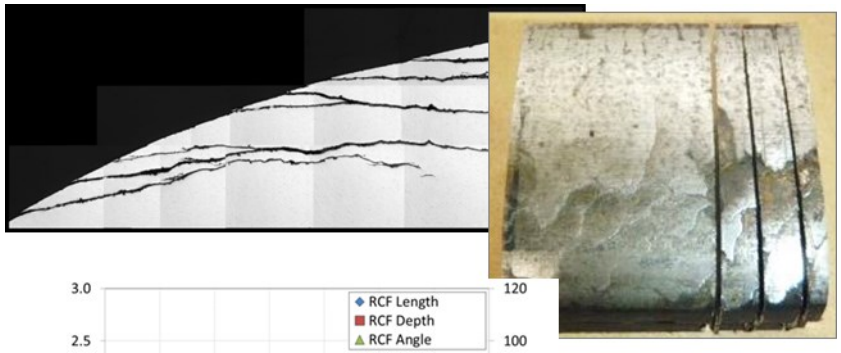
- Funding: $1,225,151
- Project Duration: May 2015 – December 2018
- Phase 1 and 2 testing completed in 2016, with test report delivered to FRA September 2017
- Report on improvements to HS-APS December 2018 including:
  - Track stiffness and damping characterization tests
  - Additional wayside strain gages & instrumentation shed
  - Improved lateral alignment and permanent benchmarks
  - Cost estimate for design and construction of curved HS-APS in 50-minute high-speed curve at TTC

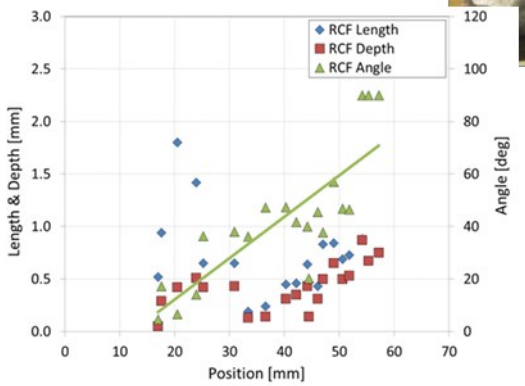
FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Rolling Contact Fatigue (RCF) Qualification

PROJECT DESCRIPTION

- Measuring RCF severity on rail to improve railroad safety and reliability.
- Over the last year, 15 rail samples were analyzed metallurgically to determine the extent of RCF and its correlation with visible surface damage.
- Relationships are being developed between surface damage appearance and subsurface crack propagation angles and depths using eddy current measurement techniques.
- These same relationships can be applied to surface photographs being collected by imaging systems.
- All inspection results are being placed in an “RCF Matrix” for public use, while many different combinations of steel type, curvature, and tonnage have yet to be analyzed.





RAILROAD IMPACT

- **Safety:** Understanding rail subsurface RCF damage as a function of track curvature and million gross ton accumulation will allow railroads to more safely manage RCF.
- **Economic competitiveness:** Accurate mapping of RCF is useful to railways for making grinding and rail replacement decisions and to RCF modelling experts for predicting rail life under variable conditions.

PROJECT PARTNER

- National Research Council, Government of Canada

COST & SCHEDULE

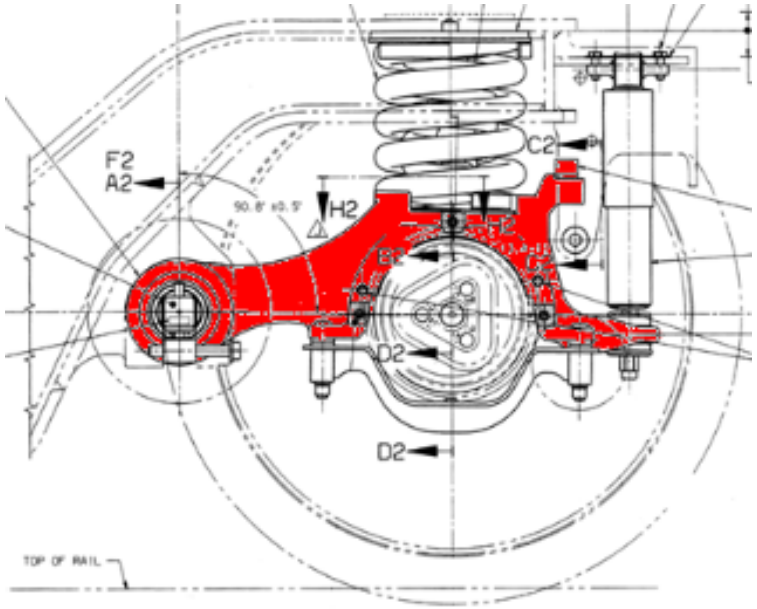
- Funding: $90,000 annually
- Project Duration: 2017 – 2021

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Coil Spring Characterization and Modeling

PROJECT DESCRIPTION

- Procure a multiaxial test machine to test suspension springs under various loading conditions.
- First phase is to procure the test machine.
- Measure the axial, shear, and torsional stiffness of the spring.
- Study the best practice for modeling suspension springs in the trucks.
- Investigate the need for modifications in the methods that the springs are modeled in multibody simulation programs.



RAILROAD IMPACT

- Provide best practices on how to measure spring properties.
- Provide information on how to model springs in multibody simulation program.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Zwick

COST & SCHEDULE

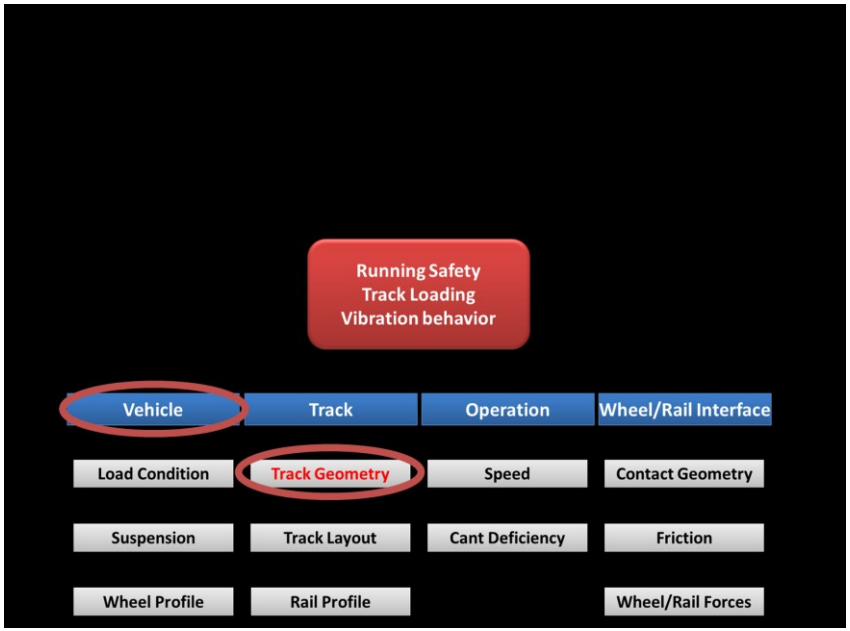
- Funding:
  - Phase I – Procure the test machine: $500,000
  - Phase II – Perform testing to characterize springs: $200,000
- Project Duration: 2014 – 2020

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Influence of Track Irregularities on Derailment Safety

PROJECT DESCRIPTION

- Develop validated computer models of freight and passenger rail vehicles to study dynamic response for speeds up to 220 mph.
- Currently working on developing validated tank car computer model including the effects of liquid slosh on vehicle dynamics on Track Classes 1 through 5.
- Perform parametric studies using computer modeling to study the relationship between vehicle performance, track geometry, and derailment safety.
- Use model results to identify safe operating speeds, maximum allowable track geometry deviations, and other operating conditions needed to minimize the risk of derailment.



RAILROAD IMPACT

- Help provide an infrastructure that supports a variety of vehicles for speeds up to 220 mph.
- Address derailment safety concerns and support industry's needs in terms of identifying safe track geometry limits and procedures used for assessing the performance of new rail vehicles from a derailment safety standpoint.
- Work with industry to develop a tank car model suitable for examining the response of tank cars to track geometry deviations with the inclusion of sloshing effects to examine effects of combined track geometry deviation on vehicle performance.

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

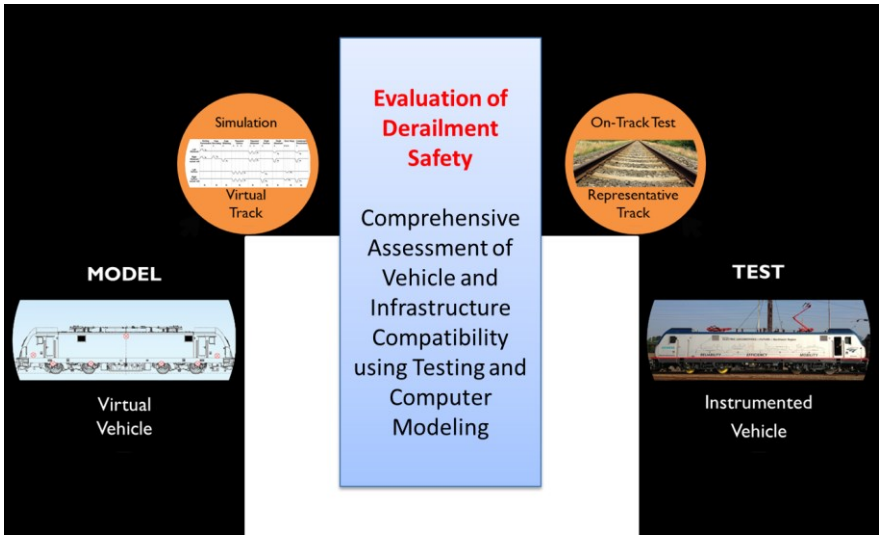
- Funding: $400,000
- Project Duration: June 2018 – May 2020

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Support of FRA Office of Railroad Safety

PROJECT DESCRIPTION

- Review test plans submitted for qualification testing and pre-revenue service acceptance testing.
- Develop and update new procedures for assessing safety of rail vehicles, including existing designs imported to North America, prior to usage in revenue service and taking advantage of state-of-the-art computer modeling and testing.
- Analyze data collected during physical testing as well as data from simulations from vehicle qualification process.
- Assist in derailment investigations.



RAILROAD IMPACT

- Review of qualification testing results identifies potential safety concerns which can be addressed before revenue service.
- Simulations included in qualification process provide a standardized procedure for vehicle manufacturers to examine the dynamics of a new design intended for the North American railroad operating environment.
- Derailment investigation can identify root causes of accident and potentially prevent future accidents.

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

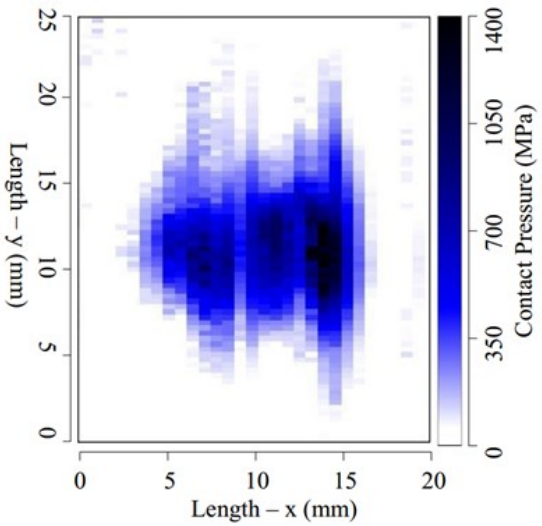
- Funding: $400,000
- Project Duration: June 2018 – May 2020

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

International Collaborative Research Initiative (ICRI) / Wear, Fatigue Rails and Wheels

PROJECT DESCRIPTION

- The ICRI was formed to undertake joint research on wear and fatigue of rails and wheels. Teams are collaborating on topics such as Friction Modelling, VTI Economics, Quantify Surface Fatigue, and Modeling Surface Damage initiatives. The most recent initiative is risk modeling to complement the economics modeling activity.
- The ICRI organizes an annual international workshop at which these and other topics are reviewed and revised. A publicly accessible web site (icri-rcf.org) makes all meetings and research available.



RAILROAD IMPACT

- RCF and wear cost the rail industry billions of dollars each year as result of associated rail and wheel replacement, derailments, work stoppage, inspection, and maintenance.
- This ICRI exists to identify and solve wheel/rail problems and advance technology developments that will improve the safety and maintenance of railways.
- The ICRI model is an efficient and economical way of undertaking research by pooling resources, leveraging work already underway, accessing test equipment, and sharing field results promptly.

PROJECT PARTNERS

- Transport Canada
- NRC Canada
- 27 suppliers, 24 universities

COST & SCHEDULE

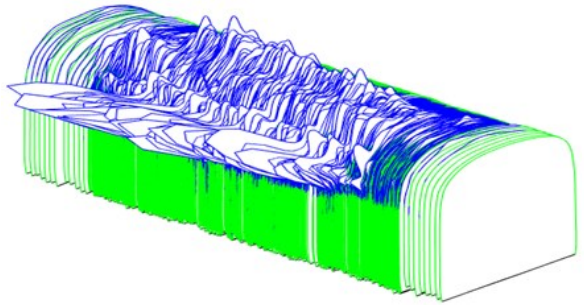
- Funding: FY19 $75,000 FRA, $75,000 Transport Canada and NRC
- Project Duration: September 2019 – September 2020
  - April 2020 Annual ICRI Workshop
  - July 2020 one day Workshop

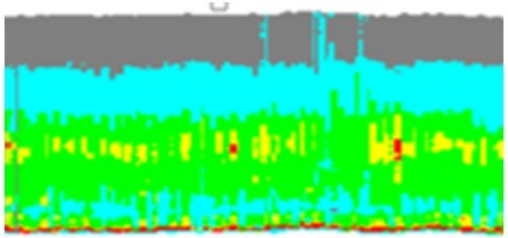
FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

Vehicle/Track Interaction, RCF, and Wear

PROJECT DESCRIPTION

- The first phase of the project is to conduct rail/vehicle simulations to quantify a loading environment for damage modelling. The goal is to develop and validate predictive algorithms for rail damage. Detailed predictions of a loading environment have been developed and are being related to rail damage experienced in the field.
- Using operating and geometry data obtained from a North American Class I railroad and with the support of several railroad suppliers, stochastic modelling and simulation of the loading environment over several curves and tangent track have been completed.





RAILROAD IMPACT

- RCF and wear cost the rail industry billions of dollars each year as result of associated rail and wheel replacement, derailments, inspection, maintenance, and lost capacity.
- Credible models of fatigue and wear will support predictive maintenance effort and justification (economic and safety) for new technology adaptations and process improvement
- This project complements other ICRI efforts related to quantifying surface damage and risk.

PROJECT PARTNERS

- Transport Canada
- NRC Canada
- CSX, LORAM, Rohmann

COST & SCHEDULE

- Phase I: $110,000 (2017-2018) Stochastic modeling and simulations to quantify loading environment.
- Phase II: $40,000 (2019-2020) sensitivity analysis
- Phase II: (2020-2021) Complete Phase I, II, and write final report.

FRA PROJECT MANAGER: Ali Tajaddini • (202) 493-6483 • ali.tajaddini@dot.gov

SECTION TWO

ROLLING STOCK

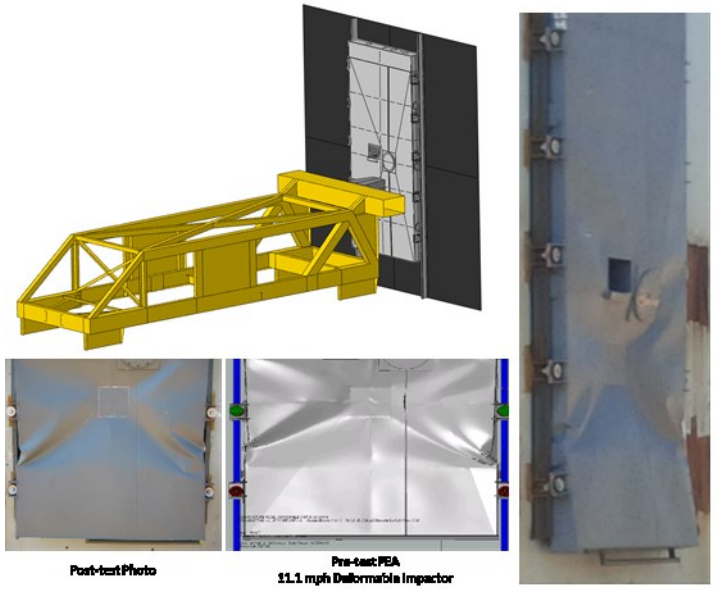
Raking Impact Testing of Diesel Multiple Unit (DMU) Fuel Tanks

PROJECT DESCRIPTION

- Develop the test method.
- Design and construct the test fixture.
- Prepare and test two diesel multiple unit (DMU) fuel tanks.
- Analyze and provide the data for model validation.

RAILROAD IMPACT

- Development of performance-based scenarios intended to be used to evaluate the puncture resistance of modern fuel tank designs, such as those on DMU locomotives.
- Evaluation of the crashworthiness of passenger fuel tank designs.
- Evaluation of performance under dynamic loading conditions, and recommendations for improved fuel tank protection strategies.



PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Volpe National Transportation Systems Center

COST & SCHEDULE

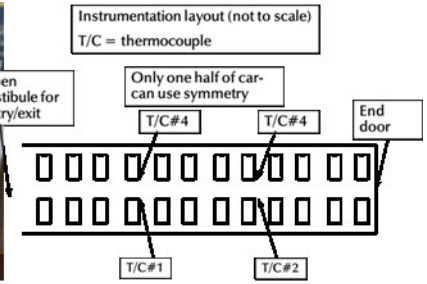
- Funding: $468,000
- Project Duration: September 2017 – January 2020

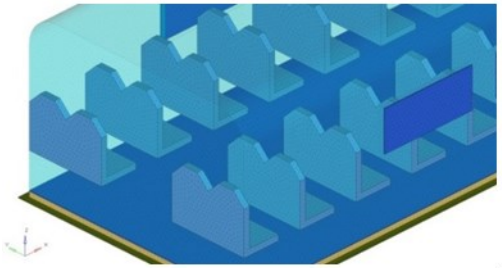
FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

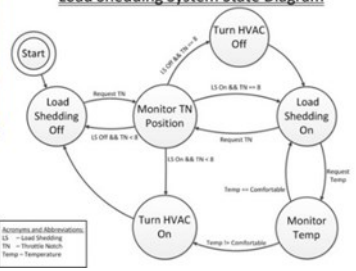
Load Shedding – Phase III, Concept Development, and Prototype

PROJECT DESCRIPTION

- Hotel power for passenger comfort on running commuter/passenger trains is provided from the head end power (HEP) system that is located on the operating locomotive. The overall traction power of the locomotive is de-rated about 10 percent when coupled to a HEP system; therefore, a 4,000 HP locomotive is able to supply about 3,600 HP for tractive effort, a reduction in the amount of energy available for achieving higher speeds.
- This phase work focuses on:
  - Thermal model validation and economic model update.
  - Hardware and software architectural layout for the load-shedding implementation.
  - Communication and control hardware and software development.







RAILROAD IMPACT

- Peak traction, auxiliary, and HEP needs are/can be separated in time (temporal separation of power peaks), such that peak needs are unlikely to be simultaneous.
- HEP needs can be temporarily minimized at times of peak traction need through an automatic (or controlled) load-shedding process.
- Improved energy efficiency on commuter locomotives.

PROJECT PARTNER

- Sharma & Associates, Inc.

COST & SCHEDULE

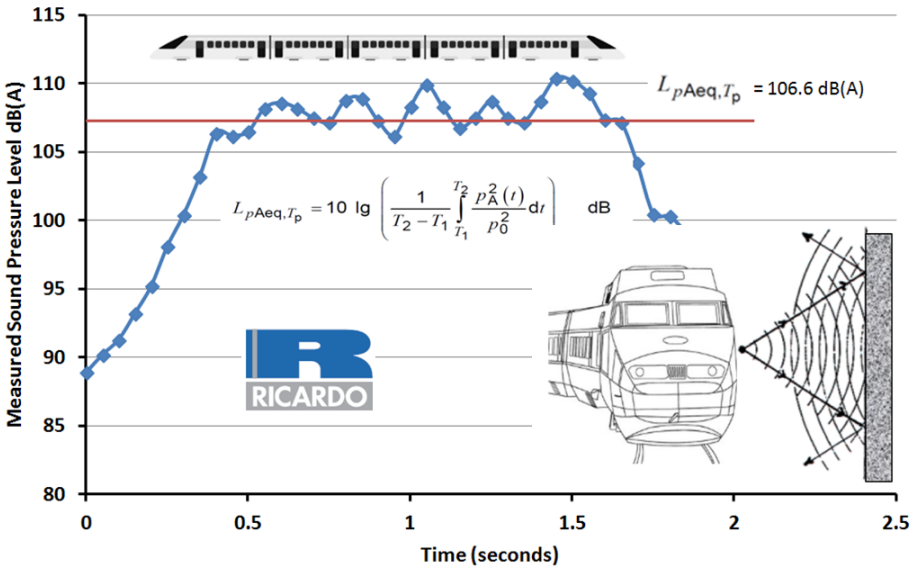
- Funding: 263,000
- Project Duration: July 2017 – December 2019

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Cost of Compliance for High-Speed Rail Noise

PROJECT DESCRIPTION

- Develop an analytical tool to allow global noise standards and regulations to be compared on a common basis.
- Will be applied to the rules and metrics identified in the recently completed FRA study of high-speed rail noise.
- Assess the cost of compliance for the three categories of noise emission reduction procedures (rolling stock, path to receiver, at receiver).
- Rank costs as $/dB(A) reduction and $/dB(A) per impacted resident.
- Allow the various procedures to be cost ranked individually or as a combination to achieve an overall noise emission reduction.



RAILROAD IMPACT

- Provide tool that allows U.S. rail industry to compare global rules on a common reference.
- Understand the costs associated with compliance.

PROJECT PARTNERS

- Ricardo, Inc.
- California High-Speed Rail Authority
- Amtrak
- WSP Rail Vehicles Division

COST & SCHEDULE

- Funding: $300,000
- Project Duration: September 2018 – February 2020

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Electronically Controlled Pneumatic Brake Device with Pneumatic Emulation – Field Demo

PROJECT DESCRIPTION

- Electronically Controlled Pneumatic (ECP) brake technology benefits can only be realized when the entire train consist is equipped with the technology.
- This project will develop pneumatic emulation technology to overcome the need for the entire train consist to be ECP-equipped.
- Current focus:
  - Upgrading and enhancement of ECP emulation technology as alternative to overlay ECP
  - Field demonstration of the selected emulator technology for interoperability per the industry standard S-4200 requirements.

RAILROAD IMPACT

- Increased railroad operating safety due to inherently more reliable and effective braking.
- An alternative to overlay ECP.
- Increased line-haul speeds due to reduced terminal and in-service train delays.
- Improved safety for both crew and public due to better performing equipment.
- Increased utility of cars equipped with ECP compared to stand-alone ECP system.

PROJECT PARTNER

- Sharma & Associates, Inc.

COST & SCHEDULE

- Funding: $348,000
- Project Duration: March 2017 – March 2019

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

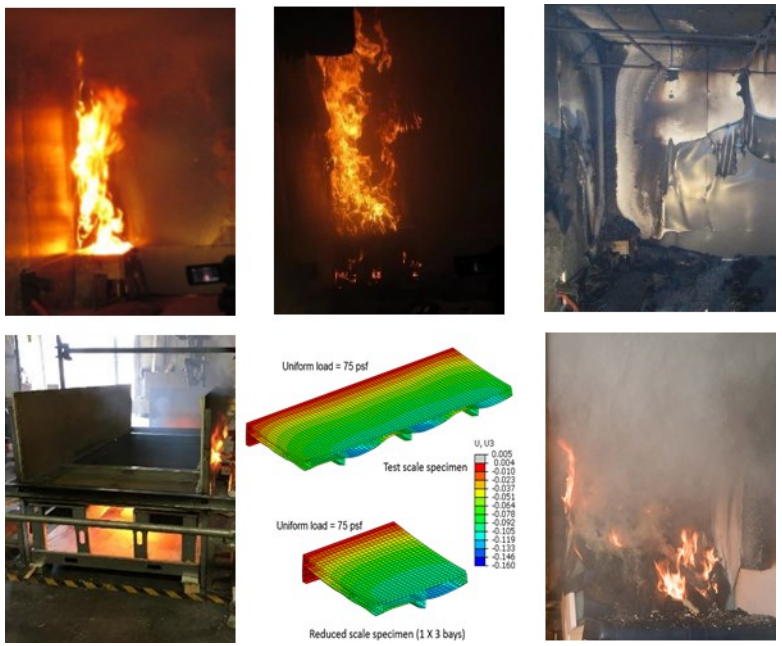
Fire Safety Research

PROJECT DESCRIPTION

- Evaluate and develop alternative fire performance criteria for passenger railcars.
- Develop models and scaling laws to reduce test article size for quantifying fully-developed rail car fire heat release rate.
- Conduct testing and modeling to demonstrate reduced-scale floor assembly fire resistance compliance testing.
- Perform literature review to quantify smoke toxicity contribution to passenger injuries/deaths and create material toxicity database.

RAILROAD IMPACT

- Provide validated computer models to predict fully-developed railcar fire heat release rate to support fire hazard assessments and smoke control design.
- Determine reduced-scale railcar fire test to quantify fully-developed fire heat release rate for cost-effective testing of railcar designs.
- Recommend a reduced-scale floor assembly for fire resistance testing to save cost on compliance testing.
- Demonstrate use of computer models for predicting railcar floor assembly thermal and structural response to support design.
- Evaluate the historic impact of fire smoke toxicity on passenger injuries/deaths to assess problem.
- Provide a consolidated database of material smoke toxicity for use in assessing and developing material smoke toxicity requirements.



PROJECT PARTNERS

- Jensen Hughes
- Volpe National Transportation Systems Center

COST & SCHEDULE

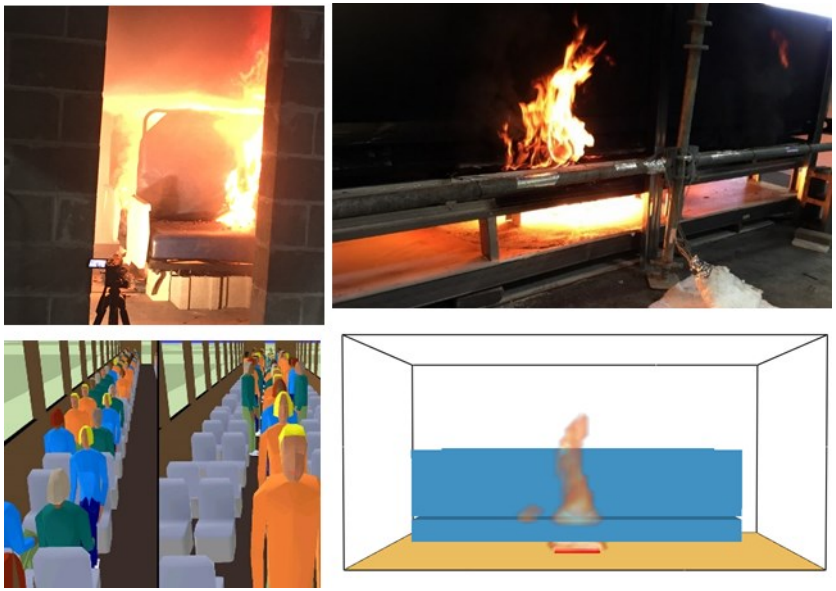
- Funding: $500,000
- Project Duration: September 2018 – December 2021

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Fire Safety and Emergency Preparedness Research Support

PROJECT DESCRIPTION

- Interface with industry through the National Fire Protection Association 130 Committee to revise and update standards.
- Compare egress modeling software, the application to passenger railcars, and the capability to predict fire growth.
- Evaluate evacuation concepts, strategies, and techniques for applicability to U.S. rail passenger cars.
- Investigate fire suppression technologies for effectiveness in passenger rail environment.



RAILROAD IMPACT

- Understand the evacuation of passenger from rail car in various accident scenarios and fire simulations.
- Interface with National Fire Protection Associations 130 Committee in development and maintenance of industry standards.

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

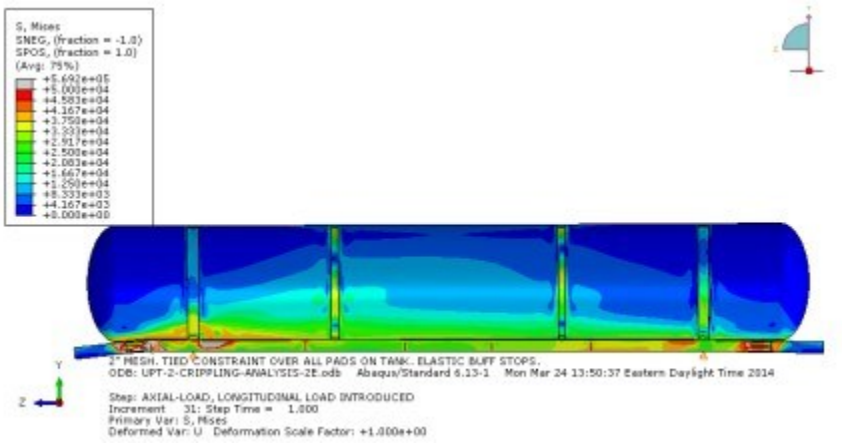
- Funding: FY19 – $125,000
- Project Duration: September 2018– August 2020

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Evaluation of the Safety and Efficiency Alternative Fuel for Locomotives

PROJECT DESCRIPTION

- Develop crashworthiness standards for alternative fuel tender cars (liquefied natural gas (LNG), compressed natural gas (CNG), hydrogen, etc.)
- Evaluate structural performance, puncture resistance, and fitting integrity with simplified analyses of natural gas fuel tenders.
- Evaluate safe speeds in accident scenarios.
- Impact testing of M-1004 LNG tender car
- Evaluate the merit of utilizing hydrogen fuel cell in railroad application
- Assess safety requirements for hydrogen fuel tender cars.



RAILROAD IMPACT

- Improve the state-of-the-art knowledge on safety and efficiency of alternative fuels such as hydrogen and fuel cell systems for rail applications.
- Collaborate with railroad industry in development of specifications for next generation of natural gas fuel tender.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Transportation Technology Center, Inc.
- Sandia National Laboratories

COST & SCHEDULE

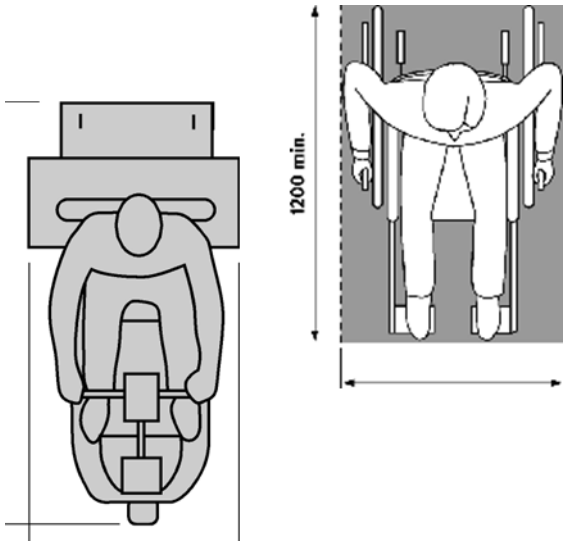
- Funding: $1,350,000
- Project Duration: May 2013 – April 2020

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Universal and Inclusive Accessibility for Next Generation of Passenger Rail Equipment

PROJECT DESCRIPTION

- Develop recommendations for improved accessibility on passenger rail equipment:
  - Larger accessible space to accommodate powered wheeled mobility devices.
  - Improved maneuverability in accessible restroom.
  - Automatic controls in accessible restrooms.
  - Dual-mode passenger information system to ensure communication with passengers who are deaf or have hearing loss.
- Investigate Rail Vehicle Access Advisory Committee recommendations for feasibility and cost, as measured by revenue seat loss.
- Investigate containment issues accommodating two or more wheeled mobility devices on passenger rail car.



RAILROAD IMPACT

- Inclusion of enhanced accessibility requirements on PRIIA bi-level equipment.
- Enhanced train travel for all passengers with improved communication during normal and emergency operations.
- Establishment of U.S. Access Board's Rail Vehicle Access Advisory Committee to develop guidance for new regulations to improve accessibility on passenger rail vehicles.
- Study of occupant protection for passengers who remain seated in wheeled mobility devices.

PROJECT PARTNERS

- Oregon State University
- Volpe National Transportation System Center
- Passenger Rail Investment and Improvement Act of 2008 (PRIIA) 305 Next Generation Equipment Committee

COST & SCHEDULE

- Funding: $210,000
- Project Duration: April 2017 - April 2020

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Advanced Devices Train and Test Bed

PROJECT DESCRIPTION

- Facilitate the development of an advanced devices train and test bed (ADT&TB) in order to test advanced devices; either developed or under development for functionality and ergonomics.
- Advanced devices include remote controlled electrically driven hand brake (EDHB), tri-couplers (air, electrical, and mechanical coupling systems), remote controlled angle cocks, and remote controlled cut-levers.
- Conduct evaluations and demonstrations of advanced devices and the advanced device wireless network.
- Advanced devices can be operated either on the side of the car or remotely from within the locomotive via a wireless connection.

RAILROAD IMPACT

- Improve safety of train operations by minimizing human interaction with cars and car devices.
- Improve reliability of newly developed devices through testing in revenue service environment.
- Increase train capacity and reduce costs by decreasing the time needed during stops due to functionality of devices.

PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Sharma & Associates, Inc.

COST & SCHEDULE

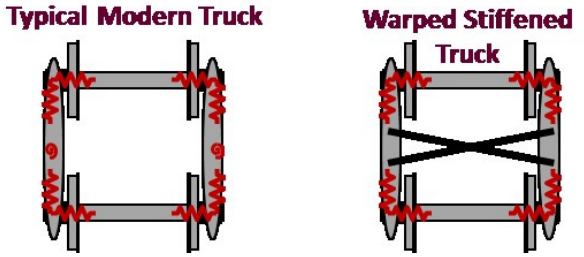
- Funding: FY19 – $144,299
- Project Duration: July 2014 – July 2020

FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

Improved Freight Car Truck Performance and Safety

PROJECT DESCRIPTION

- Phase I:
  - Task 1: Perform a literature search to identify relevant information already in the public domain.
  - Task 2: Use vehicle dynamics modeling to identify improvements, especially stiffness characteristics, required to achieve improved hunting and curving performance in three-piece trucks.
- Phase II:
  - Task 1: Use modeling results and on-track testing to identify the load environment of components designed to improve truck performance.
  - Task 2: Suggest methodologies to eliminate or mitigate the risks of fatigue failures.
- Phase III:
  - Perform lab/on-track fatigue testing to demonstrate the feasibility of improved performance truck.



PROJECT PARTNER

- Transportation Technology Center, Inc.

COST & SCHEDULE

- Funding: FY19 – $240,360 (Phase I, proposed)
- Project Duration: Phase I is one year, start date to be determined.

RAILROAD IMPACT

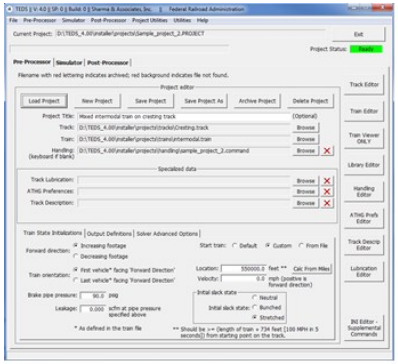
- Typical current freight car truck wedge design provides adequate warp restraint in the empty car and quasi-static loaded car condition, but sometimes falls short in dynamic loaded car conditions, such as loaded hunting.
- Improved freight truck using methods such as warp restraint will improve high speed stability (hunting stability) and curving performance.
- Improve freight truck can help reduce component fatigue failures that can result in safety issues such as dragging or loose equipment.
- Improved truck performance can also help address other issues such as centerplate liner damage and asymmetric wheel wear.

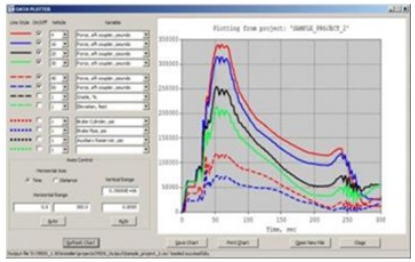
FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

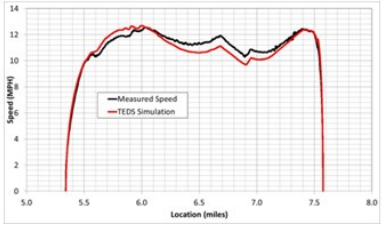
Train Energy and Dynamics Simulator

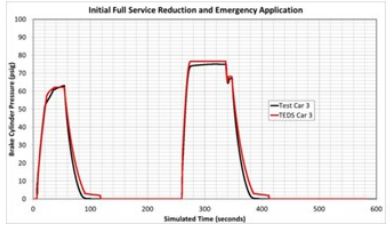
PROJECT DESCRIPTION

- Train Energy and Dynamics Simulator (TEDS) is a computer program developed by FRA for conducting longitudinal train dynamics simulations.
- May be used to assist development of guidelines and recommendations to improve train operating safety.
- Capable of simulating train handling, train makeup, head-end and distributed power, and ECP and automatic brake applications for speed control, stopping distances, and emergency stops.
- Published validation detail can be found in FRA report DOT/FRA/ORD-15/01.
- Used successfully for several simulations to assist the FRA Office of Railroad Safety in various investigations.
- Available for public use under a service agreement with FRA and Sharma & Associates, Inc. (SA).
- Apply TEDS to support FRA studies requiring train operations alternatives.









PROJECT PARTNER

- Sharma & Associates, Inc. (SA)

COST & SCHEDULE

- Funding: FY20 – $150,000
- Project Duration: September 2015 – September 2020

RAILROAD IMPACT

TEDS facilitates identification and quantification of safety risk in train operations affected by :

- Equipment
- Train makeup, including free slack between couplers
- Train handling
- Track conditions, including presence of lubricators
- Operating practices
- Environmental conditions
- Certain types of malfunctioning equipment, such as locomotive power drop
- Derailment/incidence investigations

U.S. Department of Transportation
Federal Railroad Administration

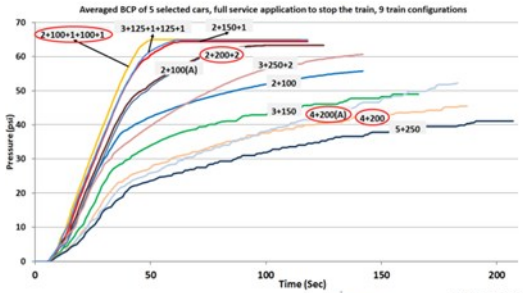
FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

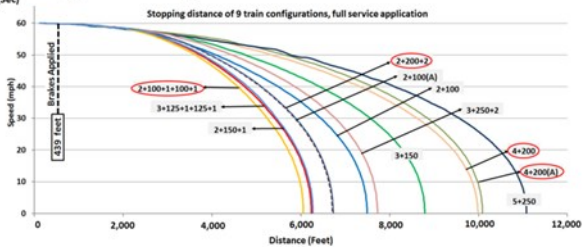
Risk Reduction for Very Long Trains

PROJECT DESCRIPTION

With the railroad industry's increase of the length and weight of trains operated over the rail network, accepted practices for both train makeup and train handling developed in the past may not be appropriate for very long trains (such as 200 car trains), possibly leading to excessive coupler forces and derailments. The effort seeks to address the following:

- How does the increase in air brake signal propagation time impact application and release, and how does the air brake system leakage on such long trains affect the brake pipe pressure on cars near the tail end of train?
- What train handling and train strategies may help reduce adverse effects of train length on operational safety?
- Are there potential crew attention issues during potentially lengthy terminal tests and train dispatch inspections (are they likely to have fatigue/attention issues towards the tail end of a long train)?
- How are the potentially high buff and draft forces under undulating territories likely to pose challenges to the engineer in handling a 200 car train or longer?
- How do the increased buff and draft forces impact individual car dynamic behavior and safety during curve negotiation?





RAILROAD IMPACT

- Improved train makeup.
- Improved motive power assignment.
- Reduced incidents/derailments.
- Improved operational safety.
- Reduced risk exposure to public.

PROJECT PARTNER

- Sharma & Associates, Inc. (SA)

COST & SCHEDULE

- Funding: FY20 – $192,000
- Project Duration: July 2017 – June 2021

FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

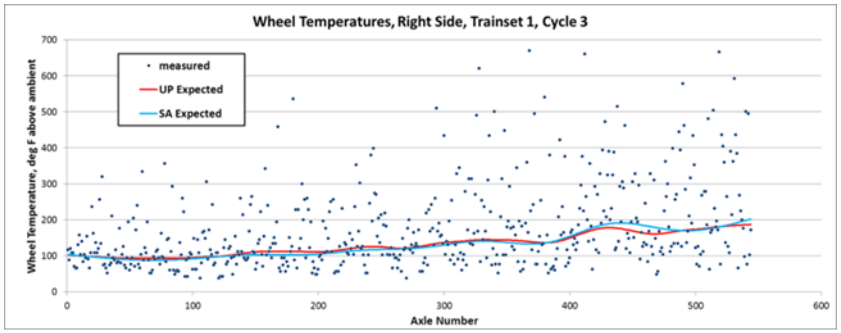
Wheel Temperature Detector Waiver Support

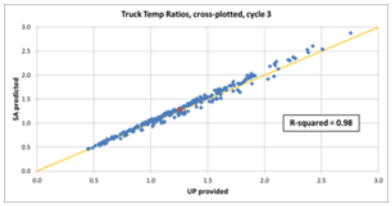
PROJECT DESCRIPTION

- Identify brake systems that are not functioning properly by detecting wheels that are inappropriately hot or cold.
- Assess the implementation of wheel temperature detector (WTD) technology and its effectiveness in improving the safety of train operations and detection of air brake system defects on moving trains.
- Develop database for maintaining the pilot study data supplied by the railroad for the WTD system and the car maintenance.
- Develop methodology for data analysis to support the Test Committee.
- Conduct data analysis to support the evaluation of the performance of the pilot study as it relates to meeting the success criteria established for the pilot study, including WTD alerts and associated repair records.

RAILROAD IMPACT

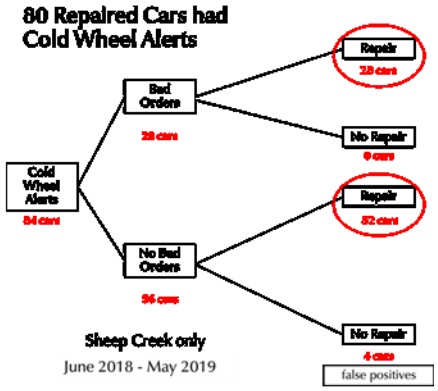
- Automate detection of hot and cold wheels.
- Preventive maintenance of fleet's air brake systems
- Improve train braking performance.
- Improve operational safety.
- Reduce risk exposure to public from air brake related incidences.





Number of unique cars: 2,569 freight cars
Number of records from WTD: 97,582 car axles on braking trains (does not include locomotives)

Alerts	Unique Cars
Number of cold wheel alerts: 93	84
Number of hot wheel alerts: 99	83
Number of brake-related bad orders: 118	93
Number of brake-related repairs: 3,984	1,235*



PROJECT PARTNER

- Sharma & Associates, Inc. (SA)

COST & SCHEDULE

- Funding: FY20 – $150,000
- Project Duration: August 2017 – July 2022

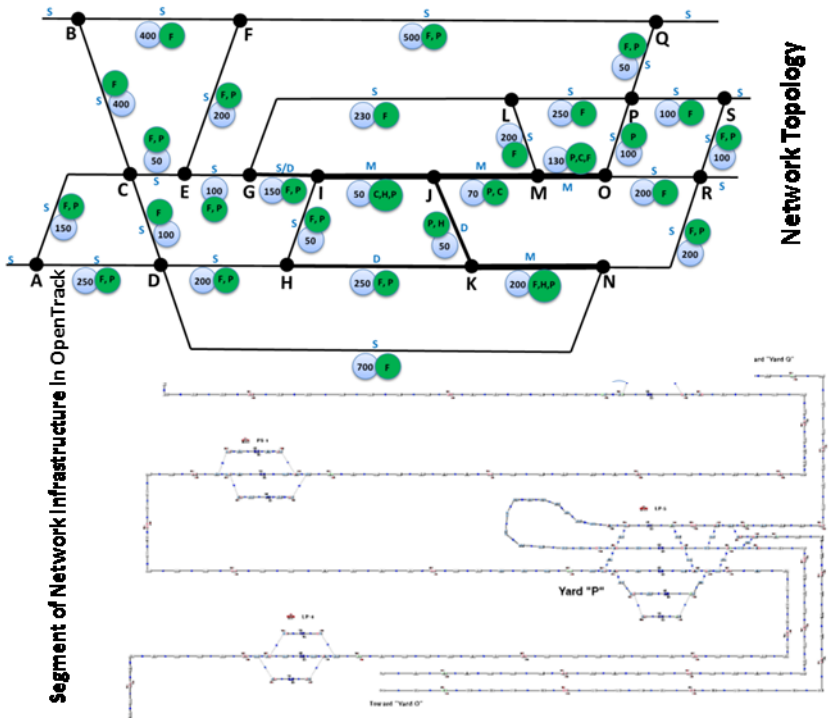
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

Effects of Technology Implementations on Network Operations

PROJECT DESCRIPTION

- Develop a methodology to quantify network level benefits for train operations resulting from the implementation of new technologies.
- Use network simulations software OpenTrack® for various network operational characteristics as follows:
  - Different types of corridors: single track, double track, and multiple track corridors.
  - Types of traffic: dedicated vs. shared-use corridors.
  - New technology implementation.
  - 1,800 miles of main tracks have been developed with 216 daily trains operating along different sections of the network, with variety of signaling and braking characteristics.



RAILROAD IMPACT

- Improve traffic congestion analysis.
- Objective evaluation of operating with new technologies.
- Capabilities to analyze the network related parameters of operating trains under PTC systems.
- Quantify network benefits due to new technologies.

PROJECT PARTNER

- Sharma & Associates, Inc. (SA)

COST & SCHEDULE

- Funding: FY19 – $149,000
- Project Duration: September 2018 – September 2021

FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

Wheel Failure Research Program

PROJECT DESCRIPTION

- The objective of this effort is the reduction of wheel failures, including vertical split rims and shattered rims, through collaboration with industry.
- An industry-wide stakeholder working group (SWG) focuses on evaluating current failure modes and characteristics as well as future steps to minimize contributions to failures.
- SWG develops research strategies, including analysis of historical data, testing failed wheels, and modeling studies to mitigate failures and reduce risks to achieve overall safety improvement.

RAILROAD IMPACT

- Increase understanding of current wheel failure mechanisms and facilitate mitigation.
- Reduce derailments causing severe equipment and track damage.
- Reduce public safety risks and costs associated with such incidents.

PROJECT PARTNERS

- ENSCO, Inc.
- AAR
- Wheel Suppliers

COST & SCHEDULE

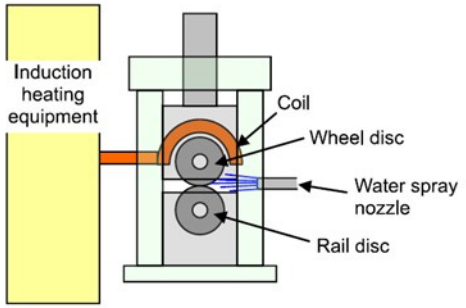
- Funding: Phase III – $250,000
- Project Duration: September 2017 – December 2020

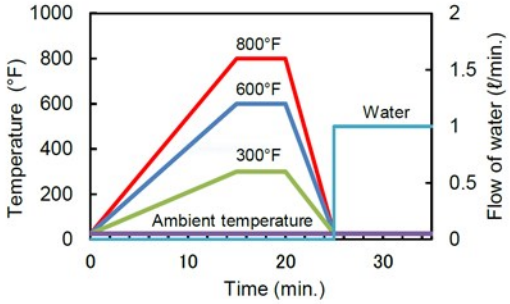
FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

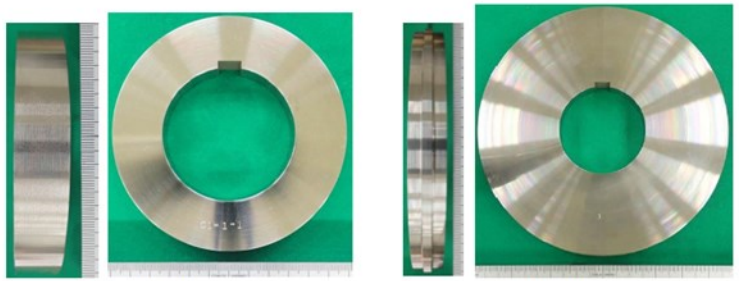
Effects of Temperature on Wheel Spalling

PROJECT DESCRIPTION

- Use a twin-disc roller test machine to study the effects of contact pressure, slip ratio, lubrication, and temperature on the development of rolling contact fatigue (RCF) cracks and wear of railway wheels.
- Induction heating coil will control the temperature of the "wheel" disc up to approximately 1,000° F.
- Investigate how temperature at the wheel-rail interface can affect wheel surface performance.







(a) Wheel disc (b) Rail disc

RAILROAD IMPACT

- Reduce occurrence of high-impact wheels, thus improving safety and reducing the effects of high-impact forces on degradation of roller bearings, rail, and track structure.
- High-impact wheels are often a result of wheel RCF, in which cracks initiate at or near the tread surface of the wheel and propagate until pieces of the wheel tread surface break out.
- Yield strength and residual stress are both important factors in a wheel's ability to resist damage from RCF. Both of these properties can be affected by changes in temperature.

PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Nippon Steel Technology Co., Ltd.

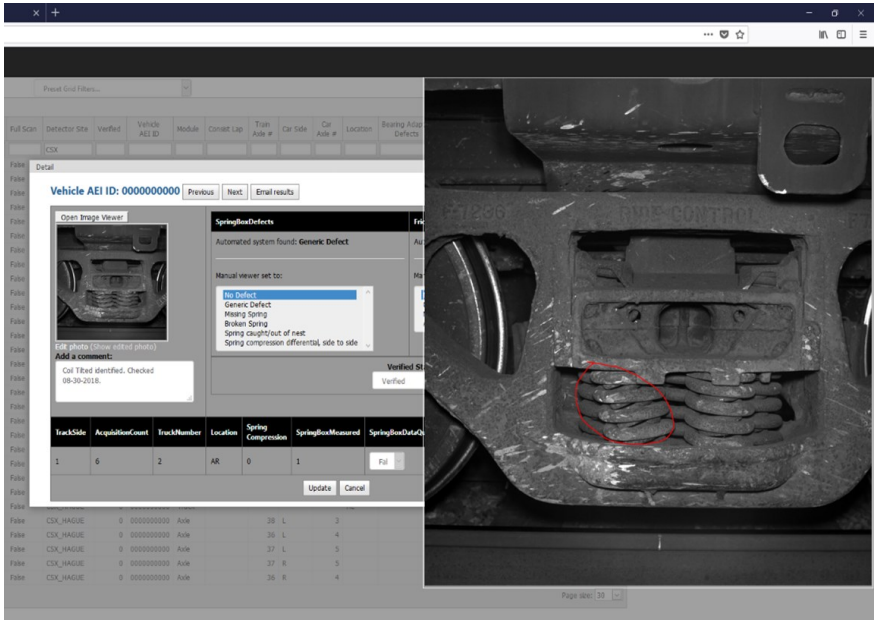
COST & SCHEDULE

- Funding: $279,350
- Project Duration: August 2017 – November 2019

Resonant Acoustic Wayside Cracked Axle Detection

PROJECT DESCRIPTION

- RAWCAD is a four-phase project aimed at developing and demonstrating a wayside automated cracked axle detection system for moving trains.
- RAWCAD makes use of the fact that axles are periodically loaded due to rotation.
- As a cracked axle rotates through one revolution, fatigue cracks open and close, causing cracked axles to display a continual resonance shift.
- This project seeks to develop novel methods for measuring and identifying the vibration response on moving axles.
- The first phase will confirm the effect on a static axle.



RAILROAD IMPACT

- Railcars must currently be removed from service to detect axle defects.
- Automated axle inspection on moving trains can lead to improved capacity and efficiency for the railroads while simultaneously improving safety.
- Automated cracked axle detection will reduce in-service defects and proactively improve safety.

PROJECT PARTNER

- Transportation Technology Center, Inc.
- Vibroacoustic Concepts, LLC

COST & SCHEDULE

- Funding: $343,820 approved for Phases 1 & 2
- Project Duration: September 2018 – July 2021
  - Phase 1 – semi-static testing completed
  - Phase 2 – in-motion testing started September 2019

FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

Diagnosis & Detection of Bearing Grease Degradation & Defects

PROJECT DESCRIPTION

- This research will investigate the properties of grease degradation related to bearing performance – across all bearing types and grease types over the life-cycle of in-service bearings.
- This research will also determine the best location in the bearing to sample bearing grease, as determined by the worst grease condition.
- Finally, this research will also demonstrate if it is possible to identify the grease metrics associated with bearing failure modes based on grease sampling and state-of-the-art statistical methods.

RAILROAD IMPACT

- Improve safety by investigating the properties of grease degradation from bearings at the end of service life, focusing on defect-related lubrication degradation.
- Reduce accidents by proposing methods to diagnose bearing defects through grease analysis.

PROJECT PARTNER

- Transportation Technology Center, Inc.

COST & SCHEDULE

- Funding: $458,000
- Project Duration: September 2018 – October 2021

FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

Technologies and Testing to Prevent Water Ingress to Railroad Bearings

PROJECT DESCRIPTION

- This research will test the ability of the current baseline bearing rubbing lip seals versus the frictionless seals to prevent water ingress over the life of the bearing.
- This project will also determine if water ingress will occur in revenue service bearing seals through environmental fluctuations.
- Finally, recommendations will be made to correctly identify fretting corrosion, as differentiated from water damage, and mitigate it in revenue service.

RAILROAD IMPACT

- The primary objective of this research is to improve safety and reduce accidents from bearing defects, which will be done in two parts:
  - Research methods of water ingress causing bearing degradation.
  - Recommend solutions to prevent water ingress.

PROJECT PARTNER

- Transportation Technology Center, Inc.

COST & SCHEDULE

- Funding: $400,000
- Project Duration: September 2018 – October 2021

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

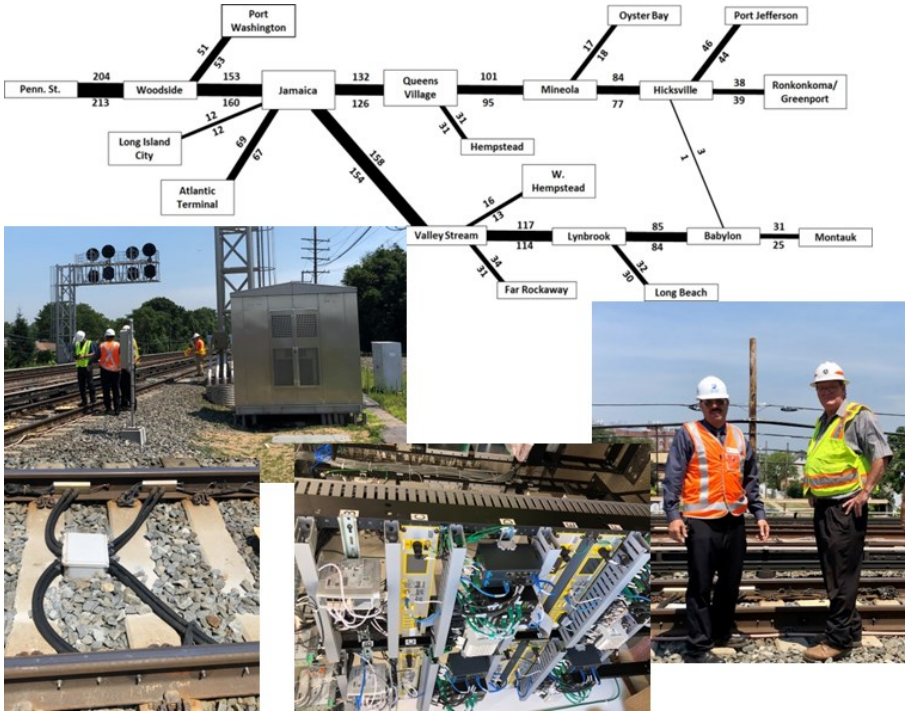
Wayside Advanced Technology Systems

PROJECT DESCRIPTION

- Partner with Metro-North Railroad (MNR), Long Island Rail Road (LIRR), and New York Atlantic Railway (NYA) to assist with pilot demonstrations of new wayside technology systems to detect defects and precursors to safety critical defects in railroad rolling stock.
- Document new installation at MNR, LIRR and NYA.
- Detection threshold analysis to help the railroads establish detection thresholds for Inspection, Alarm and Emergency level actions balanced against the shop capacity and commuter service demands for coaches.
- Identify Best Practices for Implementation and revise the Implementation Guide ***(FRA Report – An Implementation Guide for Wayside Detector Systems, May 2019).***

RAILROAD IMPACT

- Improve the process for demonstrating and implementing new technology.
- Establish a standard process for wayside technology pilot demonstrations.
- Wayside technology systems will reduce the number of incidents and accidents through proactive maintenance, driven by monitored performance of rolling stock equipment and components.



PROJECT PARTNERS

- Sharma & Associates, Inc.
- Metro-North Railroad
- Long Island Rail Road
- New York & Atlantic Railway

COST & SCHEDULE

- Funding: FY 20 – $89,850
- Project Duration: September 2018 – September 2021

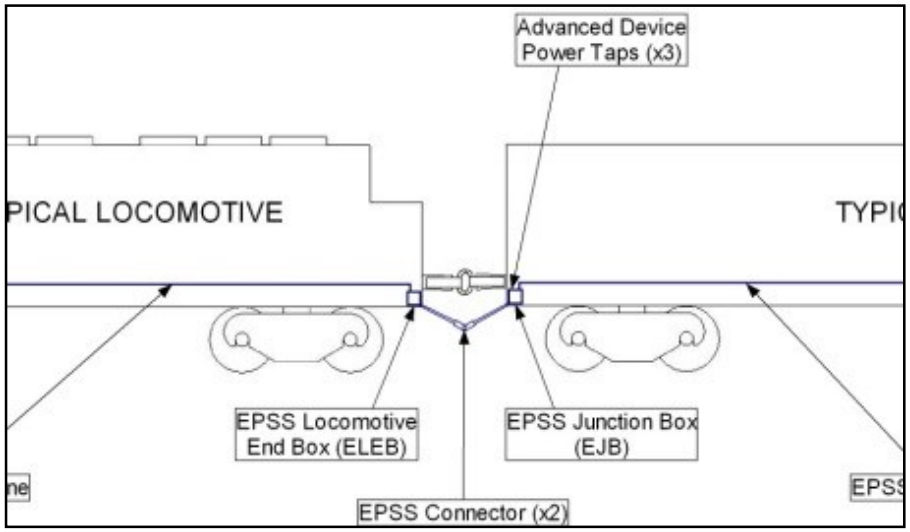
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

Test Rack Hardening of Electrical Power Supply System for Freight Cars

PROJECT DESCRIPTION

- An electrical power supply system (EPSS) takes electrical power from locomotives and distributes it along adjoining freight cars in a train.
- Successful initial test of the prototype EPSS system at the Transportation Technology Center in Pueblo, Colorado, included one locomotive and two freight cars that utilized advanced devices including electrically driven handbrakes.
- Design, prototype, and test an EPSS DC access/battery charger. The interface/charger is powered by the EPSS AC power line and provides a standard 24 volts DC interface to safety and security devices where desired.
- Completed a full-scale field test of the EPSS on a one locomotive and eight-car freight train. The system worked without any issues and the power line losses were insignificant.
- 50-car simulator in-lab EPSS test rack: Built and currently in use for test hardening of the EPSS design and collection of performance data for EPSS model calibration for use in extrapolating to much longer trains.



PROJECT PARTNER

- Sharma & Associates, Inc.

COST & SCHEDULE

- Funding: Phase II – $299,000
- Project Duration: September 2016 – September 2020

RAILROAD IMPACT

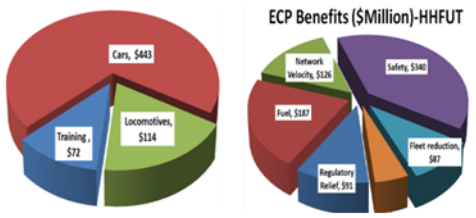
- Electrical power available on freight cars would increase safety, security, and efficiency in freight railroad operations. It would allow for the implementation of safety and efficiency improvement devices, including remote-controlled actuators and passive sensors for use with car switching mechanisms and intrusion detection, and many other opportunities.
- The EPSS DC access/battery charger development allows future developers of safety, security, and efficiency improvement devices a 24 VDC interface with which to connect.

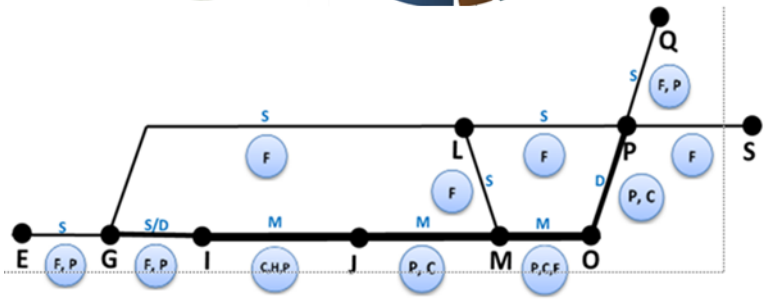
FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

Electronically Controlled Pneumatic (ECP) Brakes Implementation and Pilot Demo

PROJECT DESCRIPTION

- Recently issued regulations on tank cars have required the implementation of ECP brakes on tank cars carrying hazardous, flammable materials. This project focuses on a roadmap for ECP implementation.
  - Develop a "mini-network" with representative characteristics of the North American rail system, including various types of traffic, tracks, signaling systems, and train configurations similar to the real practices in the North America's network.
  - Develop network simulation scenarios based on adjusting train braking algorithms with certain daily traffic volume out of the entire network.
  - Conduct a comprehensive analysis of the simulated results in terms of network capacity parameters such as train delay, dwell time, train conflicts, train speed, network velocity, track occupancy level, number of meet-pass and stops, safety, and accident mitigation.





RAILROAD IMPACT

- Improved train control and operational strategy analysis methods.
- Evaluate effects of shorter stopping distance to reduce over-speed and collision incidents.
- Improved network capacity through increased train speeds & train performance.

PROJECT PARTNER

- Sharma & Associates, Inc.

COST & SCHEDULE

- Funding: FY20 – $98,900
- Project Duration: July 2017 – June 2021

FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

Optimization of Electrically Driven (Set and Release) Hand Brake (EDHB)

PROJECT DESCRIPTION

- An electrically driven hand brake (EDHB) is a remotely controlled, electrically driven, set and release, vertical wheel hand brake that keeps all normal manual AAR Group N and related Groups' specified functions and requirements. Subsequent to successful prototype development, this work has included:
  - Development of a draft performance specification template for AAR review and successful prototype testing and validation have been accomplished.
  - Long term field exposure testing on three prototype EDHBs installed on freight cars at the Facility for Accelerated Service Testing (FAST) at TTC is completed.
  - Optimized the controller/motor interface design and efficiency and implemented an improved means for feedback of chain load for communications and control of application and release functions.
- Completed testing of initial wireless control system prototype.

PROJECT PARTNER

- Sharma & Associates, Inc.

COST & SCHEDULE

- Funding: Phase IV – $348,000
- Project Duration: April 2014 – November 2019

RAILROAD IMPACT

- Reduce risk of operator injuries and the need to go in-between/climb railcars.
- Reduce the potential for runaway trains by allowing more straightforward and effective hand brake application and release.
- Reduce damage to hand brakes due to controlled application and release forces.
- Mitigate slid flat and out-of-round damage to wheels.
- Mitigate damage to lading, track, vehicles, and bridges due to damaged wheels.
- Reduce railroad operating costs.

FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

Advanced Technology Integration – Ecosystem Platform

PROJECT DESCRIPTION

Develop and integrate a modern, powered, communications and control eco-system for freight vehicles.

- Research available communication and control platforms that might be applicable for railroad use.
- Design and build a three car test rack for studying the selected prototype ecosystem platform; will utilize the EPSS test rack shown here as much as possible to minimize build costs.
- Utilize the test rack for in-lab testing/development.
- With FRA, initiate the development and acceptance of AAR interchange specifications/standards for an electrical power supply, electrical hand brake, and the subject eco-system platform.

RAILROAD IMPACT

- Improve freight railroad operations safety and security.
- Power, communications and controls platform will make it easier for adoption of various safety and security monitoring device applications.
- Written and adopted standards and recommended practices, by AAR, will open the door for safety and security device implementation that will be allowed for interchange.

PROJECT PARTNER

- Sharma & Associates, Inc.

COST & SCHEDULE

- Funding: FY20 – $99,000
- Project Duration: Sept. 2019 – June 2023

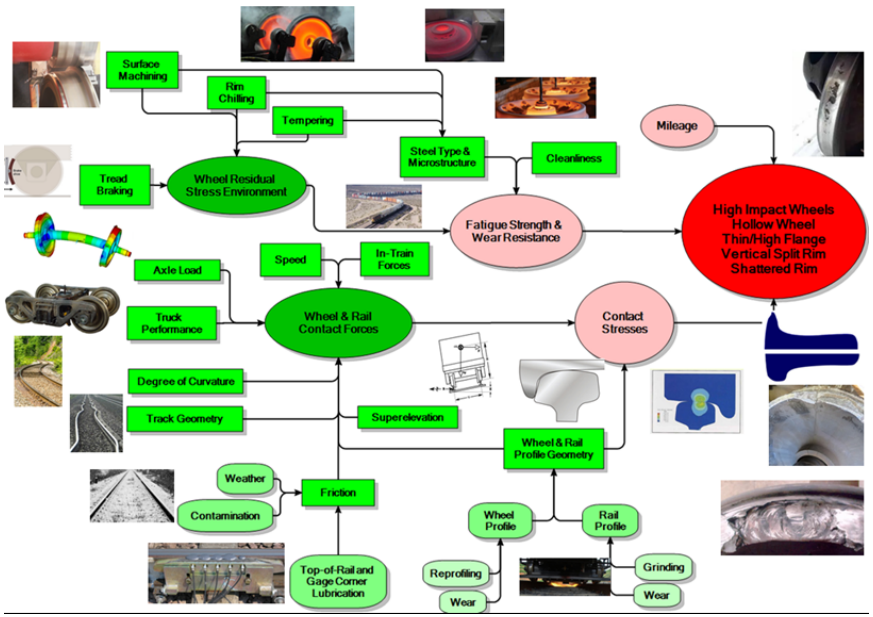
FRA PROJECT MANAGER: Monique Stewart • (202) 493-6358 • monique.stewart@dot.gov

Framework for the Development of a Wheel Life Model

PROJECT DESCRIPTION

Railway vehicles, using steel wheels rolling on steel rails, constitute the most fuel-efficient transportation system for moving large volumes of goods over long distances. Over time, the tonnage carried per wheel has progressively increased, thus subjecting the wheel-rail contact area to higher and higher stresses. These higher stresses have accelerated the problem of rolling contact fatigue (RCF).

- Conduct literature review to document damage resistance models of freight wheels, contact stress environment and residual stresses analysis for manufacturing processes to validate against any published data.
- Identify contact load environment based on field tests and revenue service grouped by degree of curvature.
- Develop wheel and rail contact model using boundary element method (CONTACT©) and embed preliminary transient thermal FEA model simulating tread braking.
- Investigate new shakedown and ratcheting areas for a framework for a wheel life model.



RAILROAD IMPACT

- Improved methodology and analysis for wheel fatigue life evaluation
- Reduced risk to public attributed to wheel failure by use of reliable analysis tools for predicting failure mechanisms.
- Improved railroad operational safety against wheel failure- related derailments

PROJECT PARTNER

- Sharma & Associates, Inc.

COST & SCHEDULE

- Funding: FY19 – $224,804
- Project Duration: September 2018-March 2020

FRA PROJECT MANAGER: Tarek Omar • (202) 493-6189 • tarek.omar@dot.gov

Compliance Testing for Locomotive LED Sample Fixtures Phase III and IV

PROJECT DESCRIPTION

- The railroad industry is beginning to introduce LED lighting for locomotive headlights.
- This project is intended to set test procedures for evaluation of new locomotive LED headlights and auxiliary lights.
- Light fixture samples that satisfied requirements set forth in Phase I and II LED sample testing will be further evaluated.
- The focus of Phase III testing is a subjective evaluation of LED headlamp performance under dynamic field testing conditions.
- Phase IV environmental testing will evaluate the performance of LED headlamps in the presence of freezing rain and ice accumulation.

RAILROAD IMPACT

- Phase III and IV LED testing will provide the Association of American Railroads (AAR) Headlight-Auxiliary Light Standard Technical Advisory Group with a better understanding of the real-world performance of LED headlamps.
- This task is intended to help AAR to update the locomotive headlight standards and recommended practices.

PROJECT PARTNERS

- Association of American Railroads Headlight-Auxiliary Light Standard Technical Advisory Group
- ENSCO, Inc.
- ESi
- Norfolk Southern and Union Pacific

COST & SCHEDULE

- Funding: $265,000
- Project Duration: July 2019 – July 2020

FRA PROJECT MANAGER: Tarek Omar • (202) 493-6189 • tarek.omar@dot.gov

Emergency Responders: Extrication Video

PROJECT DESCRIPTION

- There is a gap in trainings pertaining to rescue operations centered on locomotives.
- FRA acknowledged this gap and sponsored the previous Locomotive Emergency Response Training (LERT).
- FRA received multiple requests to create a module with a focus on extrication procedures.
- FRA envisions this training program to follow a similar scope as developed in the LERT and the ongoing development of a Rail Safety Training Course for Law Enforcement video.
- The primary goal of this program is to bring a clear understanding of rescue and extrication practices of train crews involved in highway-rail grade crossing collisions, derailments, or other railroad emergencies.
- Training will be delivered in video format viewed via the internet.

RAILROAD IMPACT

- Responding crews are not armed with the prerequisite knowledge to help them in rescue operations and in avoiding potential hazards.
- The primary goal of this program is to bring a clear understanding of rescue and extrication practices of train crews involved in highway-rail grade crossing collisions, derailments, or other railroad emergencies, providing responders with unique information.
- The information provided in the video will supplement emergency response training with railroad related information required to help responders perform their duties accurately and efficiently.

PROJECT PARTNER

- KEA Technologies, Inc.

COST & SCHEDULE

- Funding: $150,000
- Project Duration: December 2018 – May 2020

Wireless Digital Train Line for Passenger Trains (Phase II)

PROJECT DESCRIPTION

- Current analog train line system is outdated, error prone, and at the limit of its capabilities.
- Wireless technologies can contribute to enhancement of digital train line (DTL) in providing high performance communications in support of passenger services and control and communications of train management elements, and needs to be explored.
- We will investigate the current state of train line system, assist involved organizations with development of DTL, and explore wireless extension to DTL.
- Work closely with the Next Generation Equipment Committee, Association of American Railroads, American Association of State Highway and Transportation Officials, Amtrak, et al.

RAILROAD IMPACT

- This project investigates an in-depth analysis of DTL in utilizing wireless technology.
- A wireless digital train line (WiDTL) can provide a flexible, high-performance, highly expandable, low-maintenance system for control and comm.
- WiDTL can provide rail operators tightly integrated train control functionality, fault alerting, system operations, etc.
- WiDTL can provide passenger services such as interactive infotainment systems, onboard wifi, on-demand services.

PROJECT PARTNER

- University of Nebraska-Lincoln, Advanced Telecommunications Engineering Laboratory
  - Contact: Dr. Hamid Sharif (hsharif@unl.edu) 402-554-3628

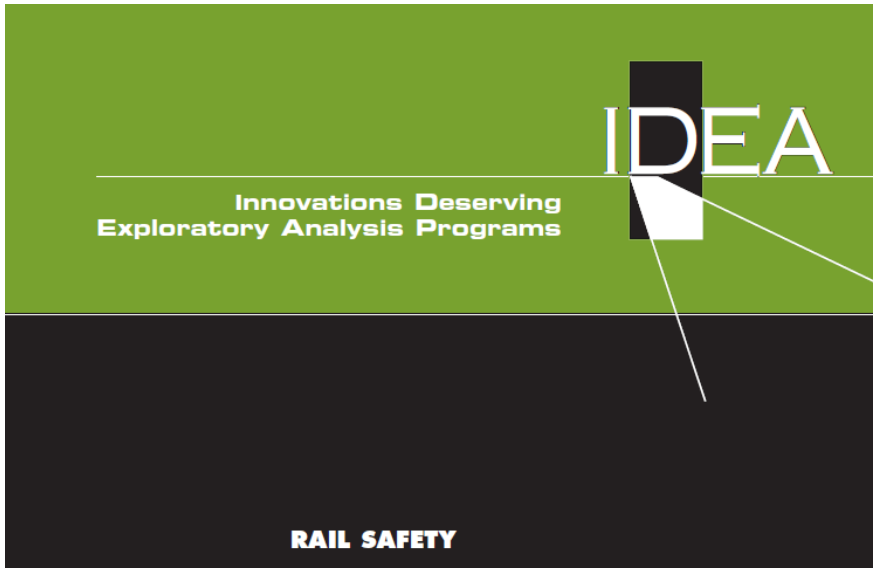
COST & SCHEDULE

- Funding: $150,000
- Project Duration: April 2019 – March 2020

Rail Safety Innovations Deserving Exploratory Analysis (IDEA) Program

PROJECT DESCRIPTION

- IDEA programs differ from traditional research programs in that they are initiated by researchers, inventors, universities, or companies, both within and outside the usual transportation research community, rather than by a request for proposals.
- Each year, three proposals are funded for up to $100,000 each.
- The National Academy of Sciences carries out the Rail Safety IDEA program through the Transportation Research Board.



RAILROAD IMPACT

- Capture the unexpected concepts that challenge conventional thinking.
- Explore promising but unproven concepts with the potential to advance Railroad safety and performance.
- Support Universities' research centers and small companies to improve their railroad research capabilities and expertise.

PROJECT PARTNER

- Transportation Research Board

COST & SCHEDULE

- Funding: FY19 – $400,000
- Project Duration: August 2019 – March 2023

FRA PROJECT MANAGER: Tarek Omar • (202) 493-6189 • tarek.omar@dot.gov

Nondestructive Evaluation (NDE) of Railroad Tank Cars

PROJECT DESCRIPTION

- Disseminate prior NDE probability of detection (POD) results/findings with the tank car industry and stakeholders.
- Conduct a feasibility study to identify the capabilities/limitations of new and advanced NDE methods for tank car inspections.
- Investigate the effects of corrosion on railroad tank car structures, and the potential use of state-of-the-art NDE methodologies for remaining tank car shell thickness measurement.
- Gather information on the newer types of tank cars and the common failure modes and determine if newer weld test panels are needed for future POD studies.

RAILROAD IMPACT

- Provides inspection reliability – a key consideration in the safety and operations of tank cars.
- Increases safety through technological development.
- Addresses industry needs in the areas of maintenance, inspection, and damage tolerance.
- Quantification of the NDE methods through POD metrics provides direction and insight into the current capabilities of the industry when using the allowed NDE methods.
- Provides for operator and procedure qualifications.

PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Tank car industry and stakeholders
- NDE equipment OEMs

COST & SCHEDULE

- Funding: FY19 – $100,000
- Project Duration: October 2018 – September 2020

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Francisco González • (202) 493-6076 • francisco.gonzalez@dot.gov

Tank Car Impact Tests

PROJECT DESCRIPTION

- Continuation of FRA and industry tank car impact research programs.
- Develop and improve test methods.
- Provide data for improving modeling methods.
- Design and construct test fixtures.
- Prepare and test various tank car designs:
    1. DOT 105A-500W – April 27, 2016
    2. DOT 117J-100W – September 28, 2016
    3. DOT 105 – July 26, 2017
    4. DOT 105 – August 1, 2018
    5. DOT 111 – October 30, 2018
    6. 2019: Car and date TBD, possibly a cryogenic tank car.
- Analyze and provide the data for validation of finite element models.
- Reports on test and model results.

RAILROAD IMPACT

- Development of performance-based testing requirements.
- Development of methods to evaluate the crashworthiness and structural integrity of different tank car designs.
- Evaluation of crashworthiness performance of tank cars used in the transportation of hazardous materials.

PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Volpe National Transportation Systems Center
- Tank car donors:
    - Trinity Rail
    - Shell
    - Axial

COST & SCHEDULE

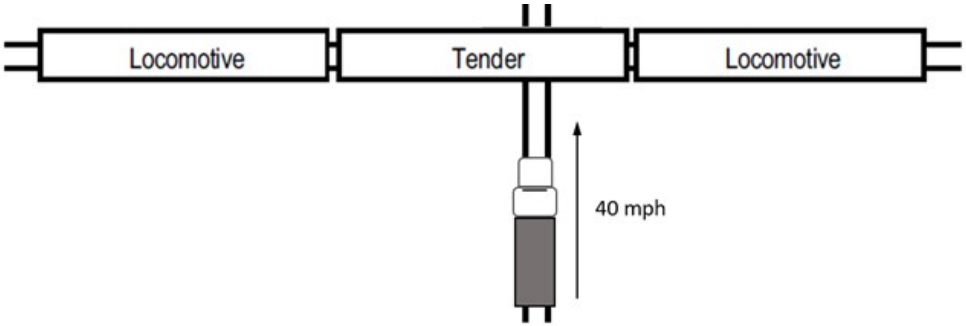
- Funding: $2,522,063
- Project Duration: July 2015 – July 2019

FRA PROJECT MANAGER: Francisco González • (202) 493-6076 • francisco.gonzalez@dot.gov

Structural Crashworthiness of Tender for Liquefied Natural Gas

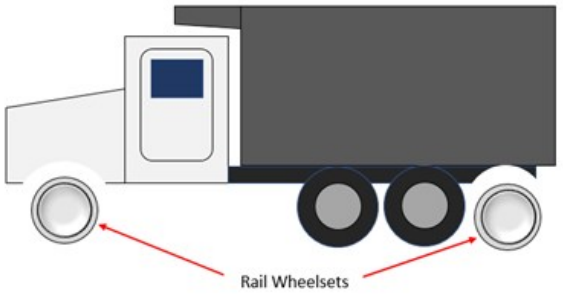
PROJECT DESCRIPTION

- Provide data to help evaluate the survivability of the valve functions to cut off supply and shut off any liquefied natural gas (LNG) or gas flow under certain grade crossing accident conditions.
- Will be performed according to the proposed draft Association of American Railroads (AAR) standard: AAR Natural Gas Fuel Tender Specifications, M-1004.



RAILROAD IMPACT

- Will allow use of LNG as a locomotive fuel.
- Potential fuel cost savings.
- Potential clean fuel technology.



PROJECT PARTNERS

- Transportation Technology Center, Inc.
- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $441,000
- Project Duration: August 22, 2017 – August 21, 2019

FRA PROJECT MANAGER: Francisco González • (202) 493-6076 • francisco.gonzalez@dot.gov

Tank Car Research

PROJECT DESCRIPTION

- FRA has shown that high magnitude coupling forces that occur in yard operations have the potential to exceed yield limits of mild steel.
- FRA, Union Tank Car, and Amsted Rail recently completed a comprehensive test program to characterize tank car load environments at Amsted Rail's test facility in Camp Hill, PA.
- This task is focused on comprehensive analysis of the collected impact test data to arrive at limiting conditions for coupling speed and impacting mass.
- Additional testing will focus on brake system performance in revenue service operations.

RAILROAD IMPACT

- Create better understanding of the operational environment and root cause of fractures on tank cars.
- Develop speed and mass combination curves to mitigate tank car stub sill failures.
- Conduct over the road brake testing to target a variety of issues being faced by the industry.

PROJECT PARTNERS

- ENSCO Inc.
- Union Tank Car
- Amsted Rail

COST & SCHEDULE

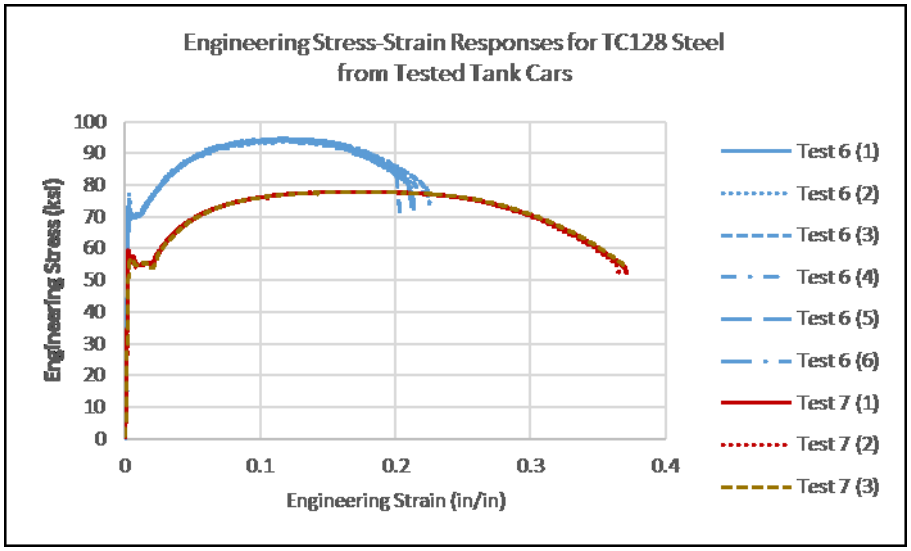
- Funding: $310,000
- Project Duration: September 2018 – September 2020

FRA PROJECT MANAGER: Francisco González • (202) 493-6076 • francisco.gonzalez@dot.gov

Structural Behavior under Operating Conditions

PROJECT DESCRIPTION

- Conduct engineering analyses and develop computational tools to evaluate structural performance of railroad tank cars under normal operating conditions.
- Conduct material testing to determine mechanical properties and fracture behavior of tank car steels.
- Conduct study on fabrication techniques affecting material properties.
- Develop computational models of tank car steels.



RAILROAD IMPACT

- Previous industry- and FRA-sponsored research has revealed a wide range of material properties found in tank car fleet.
- Additional data has become available since that previous research was conducted.
- Understanding the range of material behaviors in tank car fleet needed to determine “baseline” tank car fleet structural performance.
- Developing computational models of these materials supports parametric studies of material variations.
- Understanding the effects of fabrication techniques on mechanical properties in “as-built” cars can identify potential benefits to tank car performance.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Transportation Technology Center, Inc.

COST & SCHEDULE

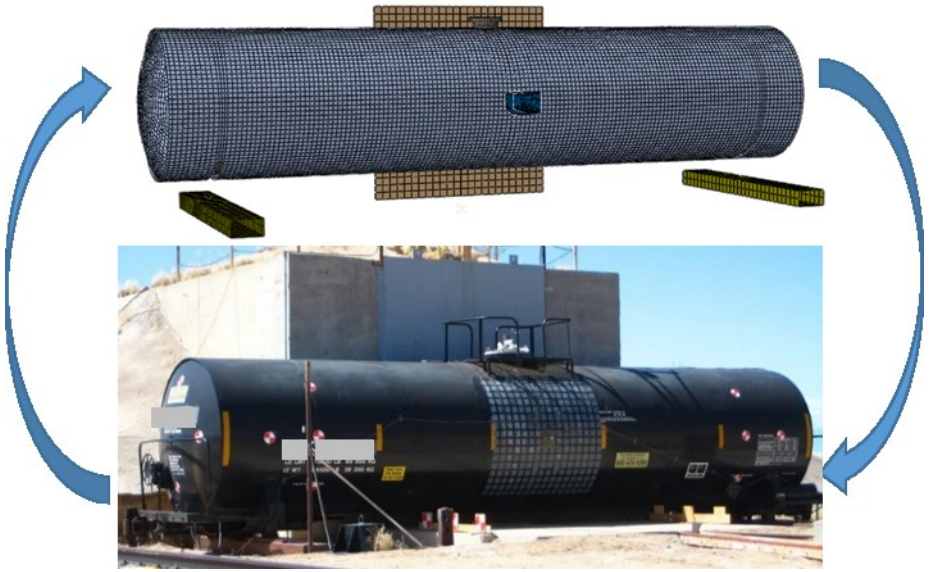
- Funding: FY19 – $150,000
- Project Duration: August 2018 – April 2020

FRA PROJECT MANAGER: Francisco González • (202) 493-6076 • francisco.gonzalez@dot.gov

Structural Behavior under Accident Conditions

PROJECT DESCRIPTION

- Evaluate puncture resistance of various tank car designs (e.g., DOT-105, DOT-111, DOT-117, etc.) in standardized shell impact scenario.
- Examine effects of parameters such as support conditions, impactor size, etc. on shell puncture.
- Develop computational models of tank car designs under impact conditions.
- Compare test data with model results to validate models.



RAILROAD IMPACT

- Development of performance-based evaluation requirements.
- Development of methods to evaluate and compare the crashworthiness and structural integrity of different tank car designs.
- Evaluation of crashworthiness performance of tank cars used in the transportation of hazardous materials.
- Development of objective methods for demonstrating validation of computational models.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Transportation Technology Center, Inc.

COST & SCHEDULE

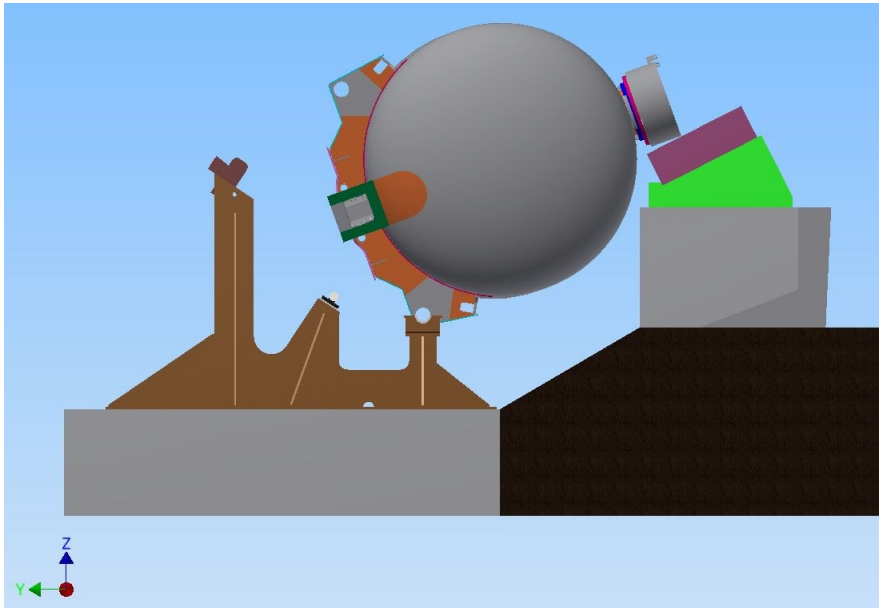
- Funding: FY19 – $150,000
- Project Duration: August 2018 – April 2020

FRA PROJECT MANAGER: Francisco González • (202) 493-6076 • francisco.gonzalez@dot.gov

Improving Safety of Tank Car Fittings in Hazmat Service

PROJECT DESCRIPTION

- Evaluate the performance of top fittings protection used on current design tank cars, particularly those used in unit trains carrying flammable materials, under rollover conditions.
- Conducted through a series of analytical simulations and full scale rollover tests.
- Designs considered include:
  - CPC-1232 style designs
  - Innovative, industry-proposed options
- Calibrate analytical models to test results.
- Develop criteria and protocols for future industry research.



RAILROAD IMPACT

- Improve overall safety of tank car operations by mitigating the release of hazardous material in tank car rollover derailments.
- Help develop performance information that can be used by the industry for standards development.
- Develop recommendations for future design and testing of fittings for industry use.

PROJECT PARTNERS

- Sharma & Associates, Inc.
- Tank car manufacturers
- Railroads (CSX,UP, BNF,CP,NS)

COST & SCHEDULE

- Funding: FY20 – TBD
- Project Duration: 2016 – 2020

FRA PROJECT MANAGER: Francisco González • (202) 493-6076 • francisco.gonzalez@dot.gov

Performance of Pressure Relief Valve Under Fire Conditions

PROJECT DESCRIPTION

- Tank cars are required to have a pressure relief valve (PRV) to protect the tank car under derailment fire conditions.
- However, the performance of PRVs under fire conditions has not previously been evaluated/confirmed.
- The intent of this project is to document, by scale testing under nominal fire conditions, PRV performance with respect to opening pressure, reclosing, and evacuating the tank.
- Initial tests planned with water as lading; subsequent tests conducted with flammable lading.
- Results will be used to validate detailed analytical models being developed by agencies like Transport Canada.

RAILROAD IMPACT

- Helps the industry better understand the risks associated with hazardous materials transportation, as PRV performance under derailment fire conditions is critical to safety.
- Quantification of PRV performance will help industry with designs and standards of PRDs that are appropriate for flammable liquid service.

PROJECT PARTNERS

- Sharma & Associates, Inc.
- Transport Canada
- Underwriters Laboratories
- BAM
- TransQuip
- Fort Vale

COST & SCHEDULE

- Funding: FY20 – TBD
- Project Duration: 2018 – 2020

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Francisco González • (202) 493-6076 • francisco.gonzalez@dot.gov

Fire Performance of a UN-T75 Portable Tank

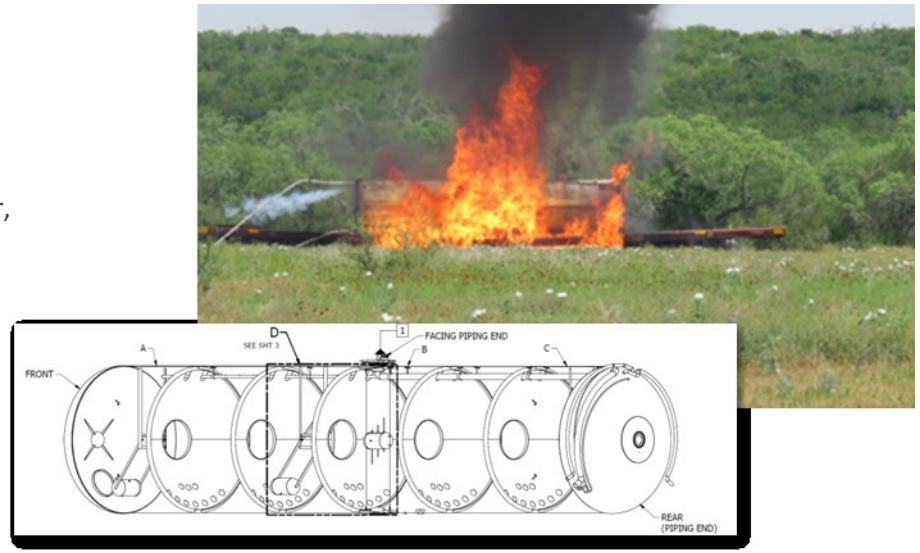
PROJECT DESCRIPTION

PHASE I:

- Conducted a full-scale fire test on a UN-T75 portable tank (see photograph to the right).
- Obtain experimental data.
- Provide a realistic fire exposure of the UN-T75 tank on a flatcar, simulating a fire exposure in an accident conditions.
- Conduct a computer simulation of the experiment data.
- Use nitrogen as a commodity and a diesel fire.

PHASE II:

- Repeat Phase I test with LNG in test tank, instead of liquid nitrogen.
- Make improvements to internal instrumentation, including several floating temperature measurements (see schematic to the right), which will be used for future computer model validation.
- Phase II test scheduled for fall 2020.



RAILROAD IMPACT

- Evaluate the survivability of the portable tank in fire conditions.
- Evaluate the performance of the pressure relief device.
- Obtain important data for future design improvements.
- Improvements to crashworthiness of tender.

PROJECT PARTNERS

- Southwest Research Institute
- Sharma & Associates, Inc.
- FECR
- Friedman Research Corporation
- Transport Canada
- PHMSA
- Taylor-Wharton (formerly CVA)

COST & SCHEDULE

- Funding:
  - FY19 – Phase II: $230,000
  - FY18 – Phase II: $400,000
  - FY17 – Phase I: $300,000
- Project Duration: September 2017 – September 2019

FRA PROJECT MANAGER: Francisco González • (202) 493-6076 • francisco.gonzalez@dot.gov

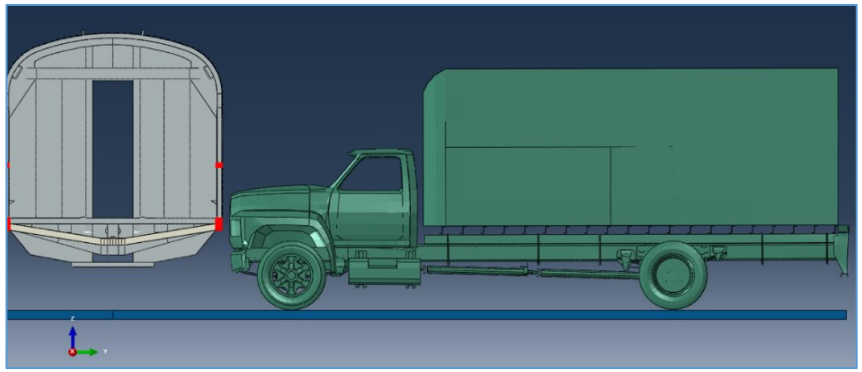
Passenger Equipment Structural Crashworthiness

PROJECT DESCRIPTION

- Develop design strategies for improving the structural crashworthiness of passenger rail cars relative to existing designs.
- Develop specifications and regulations and support various waiver requests and evaluations of compliance with FRA regulations.
- Previous work focused on occupied volume integrity (OVI), or the ability of a passenger rail car to support a large longitudinal load without compromising the space occupied by passengers and crew.
- Current focus on side structure integrity criteria. Side strength requirements for various passenger equipment designs are being investigated in response to a National Transportation Safety Board recommendation to FRA.

COST & SCHEDULE

- Funding: $50,000
- Project Duration: August 2018 – April 2020
    - Paper and presentation at The American Society of Mechanical Engineers International Mechanical Engineering Congress & Exposition, November 2018
    - Results of parametric study, December 2019
    - Comprehensive report on side structure integrity, December 2019



RAILROAD IMPACT

- Current longitudinal loading requirement for passenger cars requires the structure to sustain an 800,000 lb. load along the line of draft with no permanent deformation.
- New passenger equipment rule contains alternative OVI requirements which move the evaluation load from the line of draft to the collision load path.
- Similar to OVI, side strength plays a role in accident survivability.
- Modeling performed to assess structural performance under a variety of loading conditions and the tendency for rollover when vehicles are subjected to side impacts.
- Development of techniques for demonstrating compliance with the requirements and conducting assessments of the results of those analyses assist FRA in ensuring that passenger vehicles achieve sufficient occupied volume strength.

PROJECT PARTNER

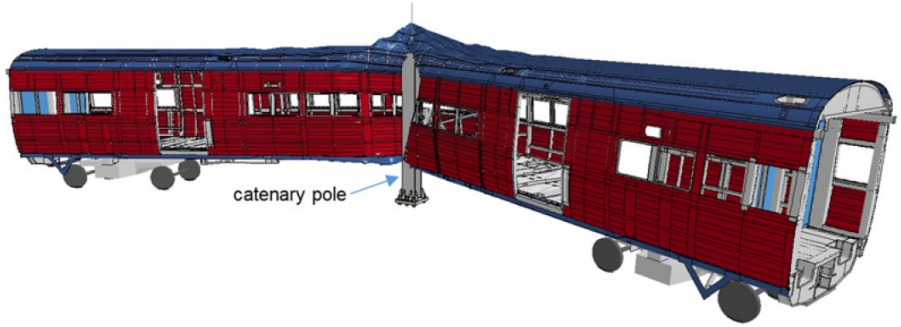
- Volpe National Transportation Systems Center

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

Resilient Wayside Structures and Passenger Car Survivability

PROJECT DESCRIPTION

- Passenger fatalities and injuries can occur during derailments due to interaction with wayside structures, such as catenary poles, bridge abutments, and discontinuities in third rail.
- Apply design considerations for roadside (highway) structures to railroad wayside structures to reduce stiffness and strength, incorporate energy absorbing mechanisms, and allow failure to occur in a controlled and predictable manner.
- Develop a proof-of-concept breakaway base connection design to reduce the hazards presented by catenary poles to demonstrate design practicality through experimental testing and additional high-fidelity numerical modeling.
- Experimental test program will involve static friction tests, static lateral load tests, and dynamic impact tests.
- Roadmap for market delivery will also be identified through the development of a robust commercialization strategy.



COST & SCHEDULE

- Funding: $284,541
- Project Duration: July 2018 – January 2020
  - Development of experimental test plan, completed
  - experimental characterization of breakaway mechanism, completed.
  - Proof-of-concept pendulum impact testing, completed
  - numerical analysis of OLE support structure, October 2019
  - Commercialization planning, throughout project
  - Final report to be issued in 2020.

RAILROAD IMPACT

- Damage mitigation concept that modifies existing anchor bolt base connection designs would be both effective in enhancing passenger safety and likely attractive to passenger railroads.
- Commercialization planning will also involve the development of a preliminary connection design package, including drawings/sketches, material specifications, and recommended design guidance.
- Design package will serve to facilitate discussions with industry on market delivery/integration and practical use on projects.

PROJECT PARTNERS

- Protection Engineering Consultants
- Arup
- Southwest Research Institute

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

Locomotive Structural Crashworthiness

PROJECT DESCRIPTION

- Demonstrate effectiveness of crashworthy components in preventing override in collisions involving locomotives.
- Evaluate performance of the combination of a push-back coupler and deformable anti-climber under full-scale dynamic impact scenarios.
- Design crashworthy components as a retrofit to existing locomotives.
- Perform individual component testing to demonstrate performance and develop technical information to inform finite element modeling.
- Perform routine coupling tests to develop range of expected impact forces and to demonstrate designed behavior.
- Plan for full-scale vehicle-to-vehicle (V2V) impact tests in January 2019 and beyond to assess the performance of the retrofit components in a moderate-speed collision for a range of impacted equipment.
- Activities to also include a full-scale train-to-train impact test, as well as development of locomotive crashworthiness standards.

COST & SCHEDULE

- Funding: FY19 – $1,000,000
- Project Duration: August 2018 – December 2020
  - FRA report on conventional coupling tests, September 2019
  - Presentation on V2V test #1 results, February 2019
  - Joint Rail Conference paper on coupling tests evaluation and V2V test #1 plans, April 2019
  - FRA report on F40 locomotive retrofit, September 2019
  - FRA report on the conventional and CEM coupling tests, September 2019
  - Joint Rail Conference paper on V2V test #1 results, April 2020
  - Presentation on V2V test #2 results, Spring 2020

RAILROAD IMPACT

- Locomotives, because of their great longitudinal strength and stiffness, are particularly susceptible to override when they collide with another vehicle, and the consequences can be catastrophic.
- Research has shown that conventional anti-climbing structures can deform on impact and form a ramp, increasing the likelihood of override.
- Such behavior was exhibited in a 23-mph collision that occurred in Red Oak, Iowa, on April 17, 2011 (see photo above).
- Research has also shown that the addition of modest structural features to the forward end of a locomotive can greatly reduce the propensity for override.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- TIAX
- Transportation Technology Center, Inc.
- CANARAIL

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

Interior Occupant Protection

PROJECT DESCRIPTION

- Research to inform development and revision of American Public Transportation Association (APTA) safety standards to address the crashworthiness of passenger seats and workstation tables in passenger rail cars.
- Preferred option (Option A) in the table safety standard requires dynamic sled testing with an advanced anthropomorphic test devices (ATDs) to evaluate abdominal injuries.
- The H3RS ATD was developed in the UK specifically to assess abdominal injuries due to impacts with tables in trains.
- Conduct research, development, and testing to improve the biofidelity, reliability, and repeatability of the performance of the H3RS ATD.
- Additional activities include further development of a simulation model representative of the H3RS ATD and a study to identify additional table force-crush behavior and geometry prone to cause occupant injury.

COST & SCHEDULE

- Funding: $375,000
- Project Duration: August 2018 – April 2020
  - Facilitate revisions to APTA Workstation Table Standard, early 2019.
  - Prepare proposal for revised APTA Seat Standard, December 2018.
  - Two papers presented at the ASME IMECE on validated mathematical dynamic modeling (MADYMO) model of H3RS ATD and workstation tables, November 2018.
  - Presentations to industry working group on analyses to evaluate the crash pulse developed over a range of collisions speeds, late 2019.

RAILROAD IMPACT

- Impacts with fixed workstation tables can cause significant abdominal injuries to passengers.
- UK and U.S. have safety standards for workstation tables that involve use of ATDs capable of assessing abdominal injuries.
- In partnership with UK researchers, costs to improve the fidelity of the H3RS ATD can be shared.
- A globally acceptable test device which would present an opportunity to exploit advances in ATD instrumentation since the H3RS ATD was first developed in 2002.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Rail Safety and Standards Board (UK)
- Transportation Research Laboratory (UK)

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

Field Investigations

PROJECT DESCRIPTION

- Activities include documenting the damage to the equipment (both interior and exterior), reconstructing the sequence of events, and identifying causal mechanisms for injury and fatality.
- Findings serve to assess the current performance of rail equipment, interiors, emergency egress/access, fuel tank integrity, and other safety features.
- Produce technical presentation of the field investigation from the preliminary findings.
- Issue report or paper describing the findings from the field investigations and the accident reconstruction.

COST & SCHEDULE

- Funding: $200,000
- Project Duration: August 2018 – April 2020
    - Accident investigations have been performed for: Lake City, SC, in August 2000; Nodaway, IA, in March 2001; Crescent City, FL, in April 2002; Placentia, CA, in April 2002; Kensington, MD, in July 2002; Flora, MS, in April 2004; Glendale, CA, in January 2005; Chicago, IL, in September 2005; Chicago, IL, in November 2007; Chatsworth, CA, in 2008; Red Oak, IA, in April 2011; Lovelock, NV, in 2011; Goodwell, OK, in June 2012; Bridgeport, CT, in May 2013; Spuyten Duyvil, NY, in December 2013; Philadelphia, PA, in 2015; Hoboken, NJ, in September, 2016; Dupont, WA, in December 2017; Cayce, SC, in February, 2018.

RAILROAD IMPACT

- Derive passenger equipment safety research program areas from information gleaned from real-world conditions.
- Identify deficiencies related to equipment performance and operating practices, and inform changes to regulations and industry standards.
- Tune program direction based on the findings of the field investigations to ensure maximum application and effectiveness of research results.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Owners/operators of equipment involved in investigated accidents

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

Passenger Equipment Glazing Integrity

PROJECT DESCRIPTION

- Develop engineering strategies for improved occupant containment by glazing systems, while meeting all other existing safety, service, and manufacturing requirements.
- Glazing system functions as windows and expected to be impact resistant, provide emergency egress, provide emergency access, be fire resistant, and provide occupant containment.
- Develop detailed plans for drafting, analyzing, and testing engineering strategies for glazing systems.
- Define all safety and operational requirements placed on glazing systems; assess the performance of current glazing systems in meeting those requirements; develop modifications for improving occupant containment; and conduct analysis and testing to compare the performance of conventional and modified glazing systems.

COST & SCHEDULE

- Funding: FY19 – $176,966
- Project Duration: August 2018 – July 2020
    - Present research findings to APTA or RSAC to facilitate rule-making, April 2020.
    - Issue report describing project and results .

RAILROAD IMPACT

- At least 25 fatalities attributed to glazing malfunction in the last 44 years.
- Subsequent to the commuter train derailment in Spuyten Duyvil, New York, on December 1, 2013, the National Transportation Safety Board (NTSB) issued a recommendation for more effective passenger containment by glazing systems in derailments.
- NTSB re-iterated its recommendation after the derailment in Philadelphia, Pennsylvania, on May 12, 2015.
- Currently, no FRA regulations exist related to passenger containment by glazing systems.
- Outcomes of this research include strategies for improving the survivability of glazing in rollover accidents to improve occupant containment.

PROJECT PARTNERS

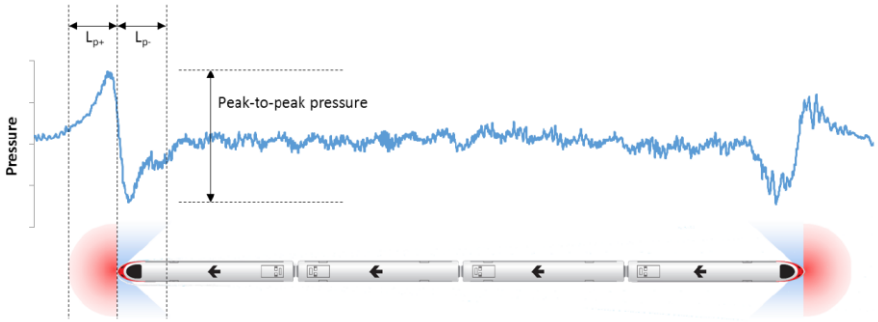
- Volpe National Transportation Systems Center
- Sharma & Associates, Inc.

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

Aerodynamic Assessment and Design Guidance Manual for High-Speed Rail (HSR)

PROJECT DESCRIPTION

- Proposed work follows on FRA's publication of the Arup team's Phase 1 report, "High-Speed Rail Aerodynamic Assessment and Mitigation Report," in December 2015.
- Previous work defined numerous national and international criteria, guidelines, studies, practices, and mitigation measures for components of the aerodynamic effects of high-speed rail relative to passed trains, track work personnel, waiting platform passengers, adjacent structures, and equipment.
- Information was limited in scope and/or not readily transferrable to the development of a design guidance manual that would be flexible to accommodate varying train types and operational conditions, and, could be used specifically by the North American railway industry.
- Need exists to bring the results of these studies together so issues can be evaluated and mitigated relative to the aerodynamic effects with the potential to cause harm to passengers, track workers, equipment, and adjacent structures.
- Manual will encompass both the open and tunnel environments for high-speed rail.



RAILROAD IMPACT

- Implement safe high-speed rail services, preventing injuries to railway track workers and the traveling public, and reduce damage to equipment, cargo, and structures in close proximity to high-speed railway tracks.
- Probability is very high that the rail industry will adopt the Aerodynamic Assessment and Mitigation Design Guidance Manual for High-Speed Trains, based on the importance of safety, future reduction of facilities' modifications costs, and development of appropriate operational procedures.

COST & SCHEDULE

- Funding: FY19 – $73,400
- Project Duration: June 2017 – November 2019
  - Publish report describing project and results.

PROJECT PARTNERS

- Arup
- Transportation Technology Center, Inc.
- Birmingham University (UK)
- Central Japan Railway Company
- Central South University of China

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

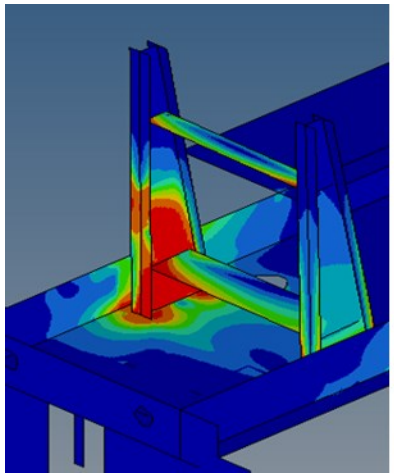
Improving Survivability for Locomotive Crews

PROJECT DESCRIPTION

- Modern locomotives are built to crashworthiness standards defined in Title 49 of the Code of Federal Regulations, Part 229, and Association of American Railroads S-580 standards.
- Locomotives manufactured before 1990, specifically the narrow-nose locomotives, were not designed to crashworthiness standards and lack crew protection in case of train collisions.
- Collision post-design alternatives compliant with current standards and amenable to a retrofit with no impact on locomotive functionality will be developed and tested in the next phase of work.
- Locomotives compliant with existing standards can preserve the space occupied by an engineer in the leading cab in a train collision up to moderate speeds, but do not provide protection against injuries resulting from secondary impacts resulting from abrupt locomotive deceleration.
- Novel combination airbag/knee bolster arrangement can be adapted to existing engineer desk geometry will be tested as part of this program to mitigate secondary impacts.

COST & SCHEDULE

- Funding: FY19 – $378,000
- Project Duration: August 2013 – May 2020
  - Issue report on collision post-tests, 2020.
  - Issue report on SIPS tests with improved airbag, 2020.



RAILROAD IMPACT

- Will have no impact on locomotive functionality, bring legacy locomotives into compliance with crashworthiness requirements, and minimize the injury and fatality risk to crew in a collision.
- Secondary Impact Protection System (SIPS) will be shown to limit forces and accelerations imparted to cab occupants due to secondary impacts to industry-acceptable levels in the event of a moderate to severe collision scenario.

PROJECT PARTNER

- Sharma & Associates, Inc.

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

Regulatory Development, Waiver Support, and Technology Transfer

PROJECT DESCRIPTION

- Support development and revision of regulations and safety standards for:
  - High-speed passenger trains.
  - Conventional speed passenger trains.
  - High-speed passenger trains used in mixed service.
- Activities include:
  - Definition of accident scenarios of concern and assessment of likelihood and loss from accidents.
  - Identification of technologies for improved occupied volume protection, injury prevention, fuel containment, and glazing impact resistance.
  - Application of information derived to support policy decisions, regulations, and standards development, and verification of required performance.

COST & SCHEDULE

- Funding: $350,000
- Project Duration: August 2018 – April 2020
  - Presentations and briefings for the National Transportation Safety Board, American Public Transportation Association, and the Railroad Safety Advisory Committee (and its task forces) as requested/needed, TBD.
  - Reviews of technical documentation submitted by railroads to demonstrate compliance with FRA regulations as requested, TBD.

RAILROAD IMPACT

- FRA support for rail equipment standards development since the advancement of Amtrak's technical specification for the Acela in 1993, which evolved into FRA's Tier II equipment standards, the first national standards requiring crash energy management.
- Publication of first rule addressing crashworthiness and other features of Tier III passenger equipment on November 21, 2018.
- Additional standards supported include the Passenger Equipment Safety Standards, Locomotive Crashworthiness Standards, and Cab Car End Frame Standards.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Passenger equipment manufacturers, operators, suppliers, and consultants

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

Coupler Torsional Strength Research

PROJECT DESCRIPTION

- Rollover in severe passenger train accidents and derailments can cause a harsh environment for train occupants to survive as well as damage to the rail equipment.
- Couplers play a key role in the inter-car rollover behavior in derailments.
- The coupled connection between the rolling and adjacent car(s) can prevent the rolling car from overturning completely. During these incidents, a torsional load is supported by the coupler and its structural attachments to the carbody.
- This research will provide engineering analysis, test fixture design and fabrication, and destructive testing to evaluate the torsional strength and critical failure locations of couplers typically used on passenger railcars in the U.S.
- Finite element analysis will be performed to determine the critical structural locations in a coupler/coupler carrier-to draft sill mechanism.
- Results will be used to inform the design of the test fixture and tests will be performed to measure the applied torque at which couplers fail and determine modes of failure.

COST & SCHEDULE

- Funding: FY19 – $349,345
- Project Duration: September 2019 – May 2020
  - Intermediate reports to be delivered on accident investigations, finite element analysis and preliminary test plan.
  - Publish final report documenting all activities, 2020.

RAILROAD IMPACT

- Existing regulations and industry standards include limited requirements for coupler performance and generally address the strength of a coupler arrangement in terms its ability to sustain a prescribed vertical upward and downward load on the coupler (without failure) and its carrier (without permanent deformation).
- This work will develop information regarding the torsional strength characteristics of common coupler arrangements which can be considered for adoption in the relevant industry standards to potentially provide improved rollover resistance.

PROJECT PARTNER

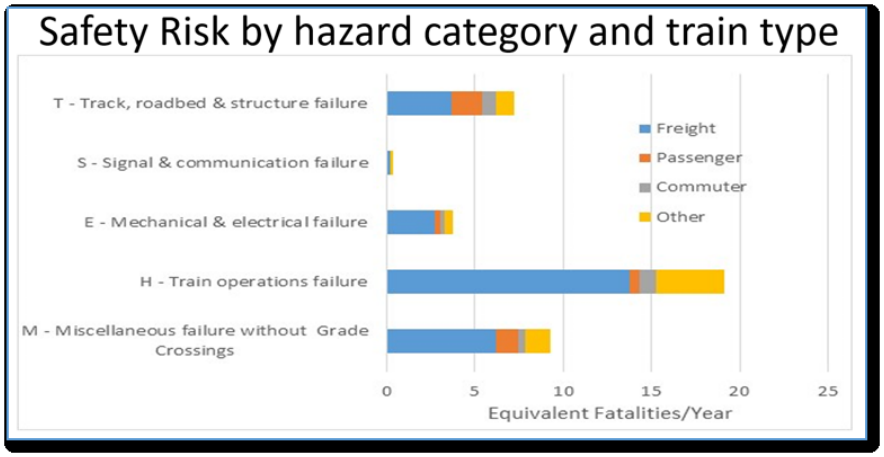
- Sharma & Associates, Inc.

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

Extended Development of FRA Safety Risk Model

PROJECT DESCRIPTION

- FRA's Office of Research, Development, and Technology (RD&T) manages a large portfolio of research projects consisting primarily of projects chosen, scoped, and focused on improving railroad safety. Rational project selection strategies are of great value in maximizing the effectiveness of the RD&T program.
- FRA RD&T has developed a means of assessing safety risk broadly across the railroad industry which is reflected in its Safety Risk Model (SRM), similar to that which has been created and implemented by the Railway Safety Standards Board (RSSB) in the UK.
- The SRM provides a means for quantitative risk-ranking to facilitate project selection. Knowledge of the characteristics of the distribution of risk will allow FRA to make strategic project investments for maximum safety benefit and allow for future assessments of risk reduction resulting from implementation of the products of the R&D efforts.
- Future updates to the model will include means to assess risk based on regional population density (rural, urban, superurban) to derive "state level" safety risks for the purpose of guiding safety inspections.



RAILROAD IMPACT

- The application of the results derived from the SRM will enable FRA to focus R&D efforts (and limited available resources) on topics which cause the greatest amount of harm (fatalities, injuries property damage) in the railroad industry.
- This should result in R&D research products which are of the greatest benefit to the railroad industry in improving safety performance.

COST & SCHEDULE

- Funding: FY19 – $75,356
- Project Duration: September 2019 – September 2020

PROJECT PARTNER

- Sharma & Associates, Inc.

FRA PROJECT MANAGER: Jeff Gordon • (617) 494-2303 • jeffrey.gordon@dot.gov

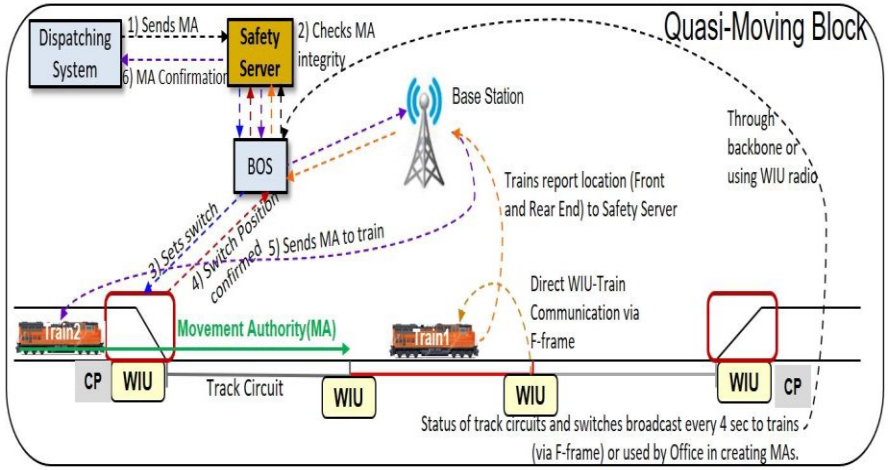
SECTION THREE

TRAIN CONTROL & COMMUNICATIONS

Quasi-Moving Block Train Control

PROJECT DESCRIPTION

- Develop a concept of operations (CONOPS), with industry input and review, describing the technical approach for implementing quasi-moving block train control.
- Identify new functions, key design details, interfaces, and issues requiring resolution.
- Analyze communication, hardware, and software needs and identify potential technology gaps.
- Develop safety analysis and draft implementation plan.



RAILROAD IMPACT

- Improve operational efficiency and network capacity by safely reducing train headways.
- Improve safety by preventing train collisions under restricted speed operation.
- Test and evaluate remote sensing suite that will influence the feasibility of automated train operation in the future.

PROJECT PARTNER

- Transportation Technology Center, Inc.

COST & SCHEDULE

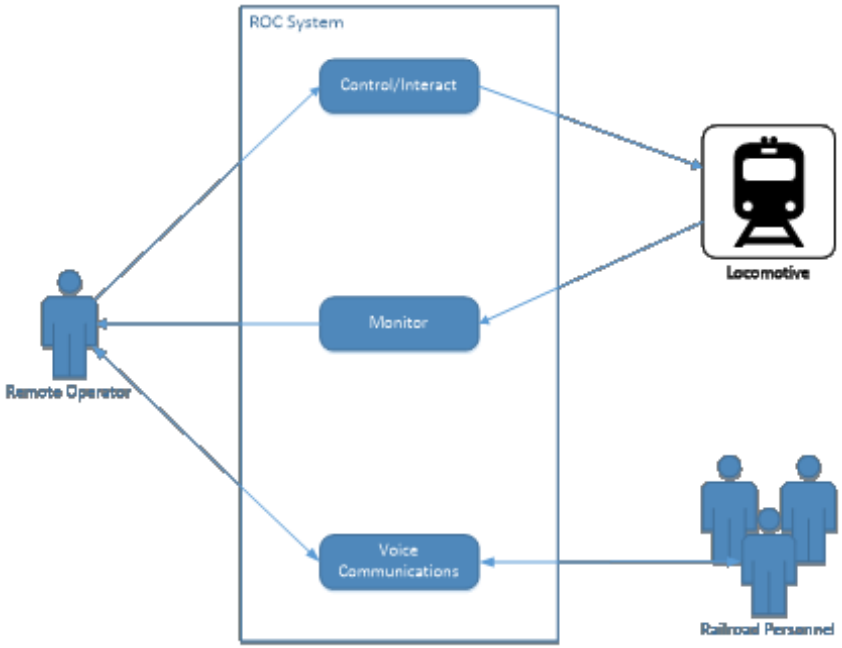
- Funding: $400,013
- Project Duration: September 2017 – September 2019

FRA PROJECT MANAGER: Jared Withers • (202) 493-6362 • jared.withers@dot.gov

Automated Train Operation

PROJECT DESCRIPTION

- Develop a concept of operations (CONOPS), with industry input and review, describing the technical approach for implementing automated train operations (ATO).
- Research, develop, and evaluate sensor platforms and technologies for support of ATO.
- Develop and analyze safety cases for ATO.



RAILROAD IMPACT

- Improve operational efficiencies and network capacity.
- Improve safety by reducing human error.
- Test and evaluate remote sensing suite that will influence the feasibility of automated train operation in the future.

PROJECT PARTNER

- Transportation Technology Center, Inc.

COST & SCHEDULE

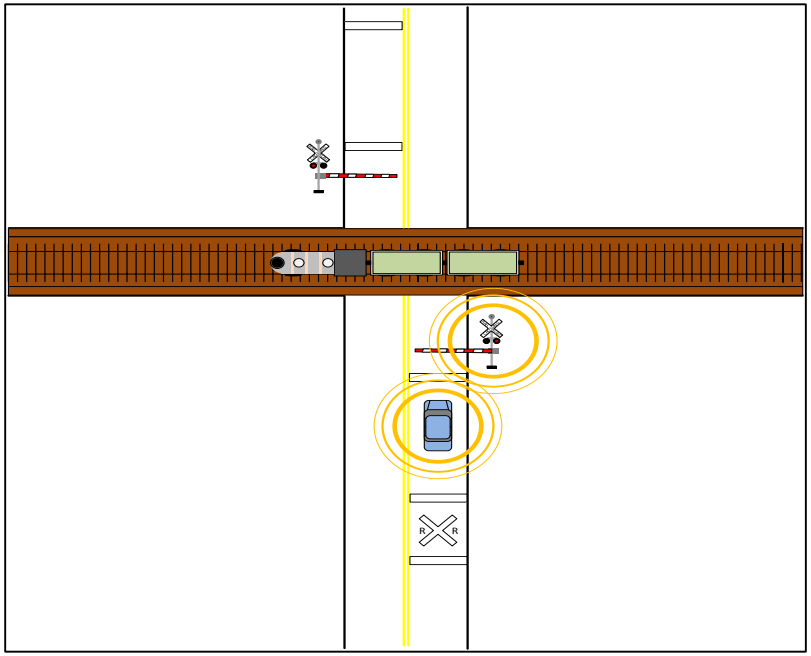
- Funding: $1,105,414
- Project Duration: September 2015 – December 2020

FRA PROJECT MANAGER: Jared Withers • (202) 493-6362 • jared.withers@dot.gov

Rail Crossing Violation Warning

PROJECT DESCRIPTION

- Develop a connected vehicles reference application for in-vehicle driver warning of immanent violation of a grade crossing protection system.
- Suitable for retrofitting existing infrastructure.
- Evaluate the technical feasibility of implementing the proposed system.
- Provide recommendations and data for future analyses.



RAILROAD IMPACT

- Mitigation of many grade crossing accidents.
- Rail side integration with connected and automated vehicle systems being deployed by the automotive industry.
- Test platform for evaluating the effectiveness of connected vehicle safety systems for grade crossing scenarios.

PROJECT PARTNERS

- Battelle
- Honda R&D America
- CTC, Inc.
- Transportation Technology Research Center, Inc.

COST & SCHEDULE

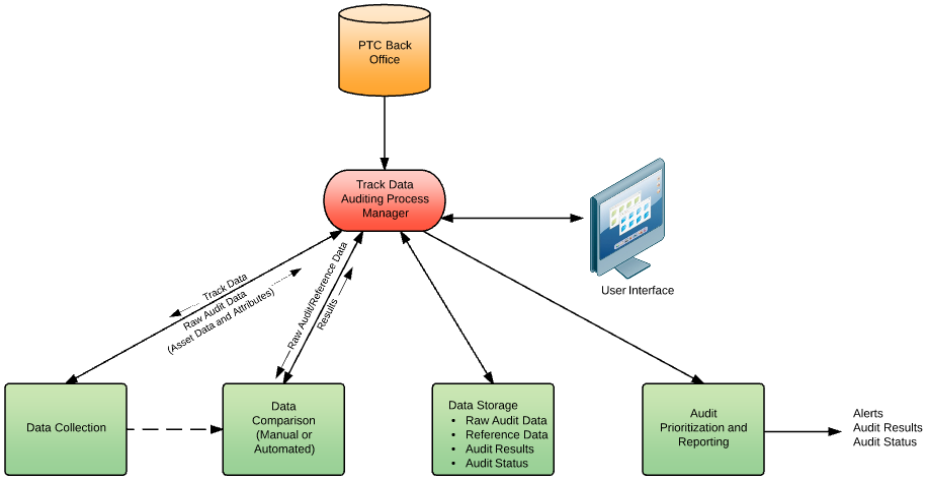
- Funding: $853,156
- Project Duration: September 2015 – March 2020

FRA PROJECT MANAGER: Jared Withers • (202) 493-6362 • jared.withers@dot.gov

Positive Train Control (PTC) Critical Asset Track Data Auditing System

PROJECT DESCRIPTION

- Facilitate and document a railroad consensus for the functionality and requirements for a system to support PTC track map auditing.
- Develop system specification documentation based on stakeholder engagement and railroad need.
- Survey/evaluate technologies and concepts that could meet the documented requirements.
- Identify any significant gaps between requirements and available technology.



RAILROAD IMPACT

- Supports implementation of PTC and other safety-related systems that depend on accurate, up-to-date track information.
- Supports automation of track database auditing for enhanced safety and efficiency.
- Supports development of a system to scan for PTC-critical track assets and detect and report discrepancies from the reference database.

PROJECT PARTNER

- Transportation Technology Center, Inc.

COST & SCHEDULE

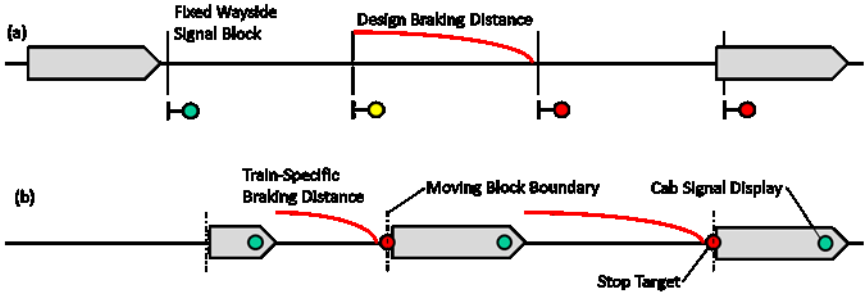
- Funding: $946,641 (total project cost)
- Project Duration: September 2015 – January 2019

FRA PROJECT MANAGER: Jared Withers • (202) 493-6362 • jared.withers@dot.gov

Leveraging Connected Highway Vehicle Platooning Technology to Improve the Efficiency and Effectiveness of Train Fleeting

PROJECT DESCRIPTION

- Investigate control algorithms developed to support connected highway vehicle platooning.
- Simulate fleets and understand how closely following trains respond to different throttle and brake control algorithms under moving blocks.
- Develop improved train control algorithms that allow railway operators to optimally balance fuel efficiency and train headway when fleeting trains.
- Show potential of train-to-train communication in efficiently fleeting trains with moving blocks.



RAILROAD IMPACT

- Facilitate driver advisory systems that allow for minimum train headways without repeated PTC enforcement brake applications and associated incident risks from in-train forces.
- Support fuel-efficient operations of train fleets at minimum headways to increase line capacity.
- Thorough understanding of the implications of operating train fleets under moving blocks to support investments in advanced PTC systems.

PROJECT PARTNERS

- University of Illinois at Urbana-Champaign
- Vanderbilt University
- Michigan Technological University
- New York Air Brake

COST & SCHEDULE

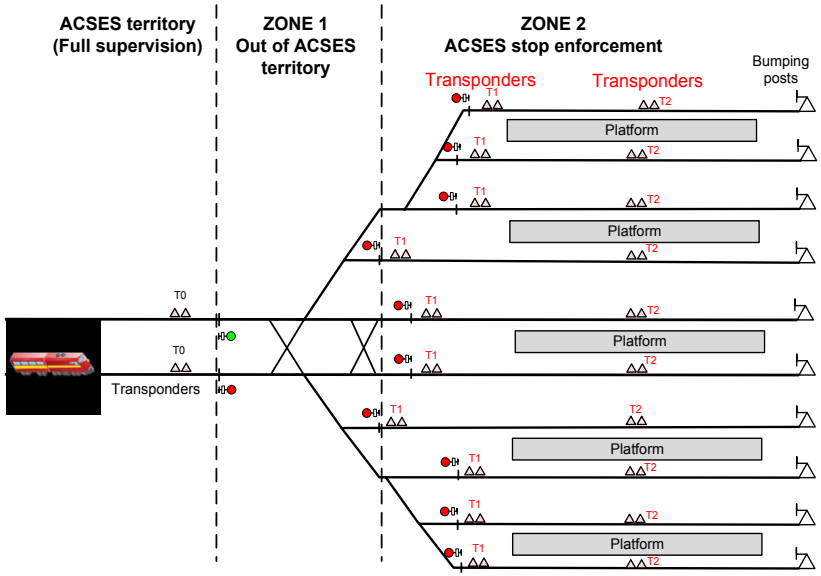
- Funding: $399,840
- Project Duration: October 2019 – October 2020

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Restricted Speed Enforcement for Positive Train Control (PTC) Systems

PROJECT DESCRIPTION

- Evaluation safety of PTC-preventable accidents below restricted speeds, particularly end-of-track collisions in passenger terminals.
- Develop concept of operations (ConOps) for PTC enforcement to prevent end-of-track collisions.
- Estimate the cost-effectiveness and operational impact of PTC enforcement on terminating tracks in terminals.
- Develop field testing to verify and validate the research concept and method.



RAILROAD IMPACT

- Evaluation of the safety, cost, and operational implications of PTC enforcement to prevent end-of-track collisions in passenger terminals.
- High-level operational concept for modifying positive train control systems to function below restricted speeds.
- Field testing to verify the technical feasibility of PTC enforcement under restricted speeds.

PROJECT PARTNERS

- Rutgers, The State University of New Jersey
- HNTB
- Amtrak

COST & SCHEDULE

- Funding: $400,550
- Project Duration: February 2017 – May 2020

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Pilot Grant Program — Law Enforcement Strategies for Reducing Trespassing

PROJECT DESCRIPTION

- The objective of this program is to evaluate the effectiveness of funding local law enforcement activities intended to reduce trespassing on the rail right-of-way.
- The funded agencies will perform rail trespassing enforcement related activities and report those activities and associated benefits to FRA.
- The research team will evaluate the effectiveness of dedicated funding in reducing rail trespassing incidents and risk factors based on the data obtained from the activities performed in this grant program.

RAILROAD IMPACT

- Document the effectiveness of the presence of law enforcement officers in reducing railway trespassing.
- Provide further information and education to trespassers.
- Supported analysis for potential legislative processes
- Increase public safety.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- City of North Tonawanda, New York
- City of Worcester, Massachusetts
- Palm Beach County Sheriff's Office, Florida
- Town of Brighton, New York

COST & SCHEDULE

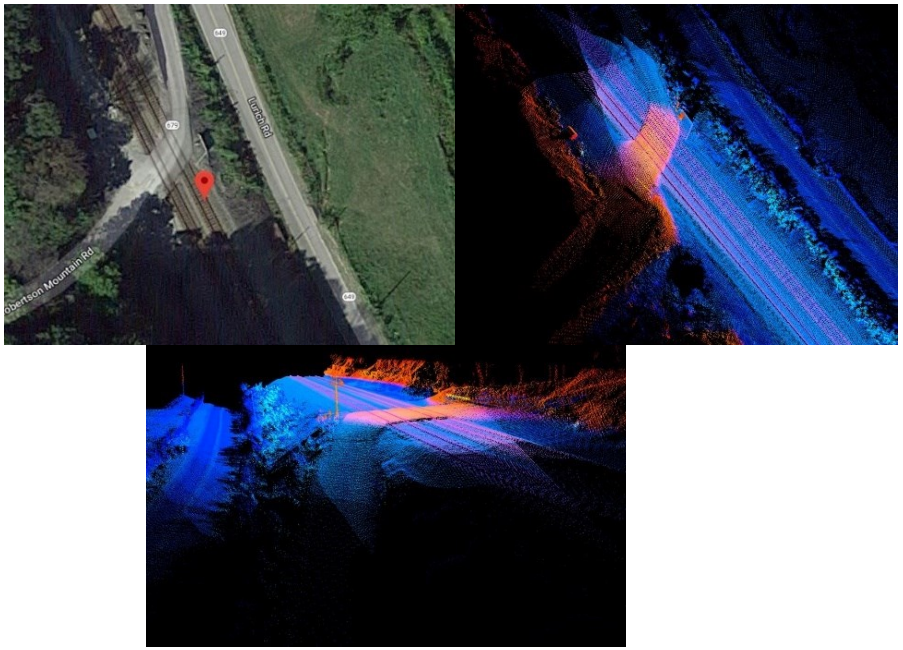
- Funding: $196,357 (overall award)
- Project Duration: October 2018 – December 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Enhanced Humped Crossing Database Using LiDAR

PROJECT DESCRIPTION

- Enhance FRA's National Grade Crossing Inventory database by including LiDAR point clouds of humped crossings that have a history of accidents.
- Study the feasibility of implementing a portable LiDAR system (e.g., UAV) for grade crossing scanning.
- Develop and test a quasi real-time alerting system if a humped crossing is detected and not reported as such.



RAILROAD IMPACT

- Consistent verification to what is currently reported to the National Grade Crossing Inventory database.
- Provide a new tool for the public to further analyze and study the crossing profiles.
- Improve efficiency in documenting the state of a grade crossing profile.
- Increase public safety.

PROJECT PARTNER

- ENSCO, Inc.

COST & SCHEDULE

- Funding: $299,804
- Project Duration: October 2018 – April 2020

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

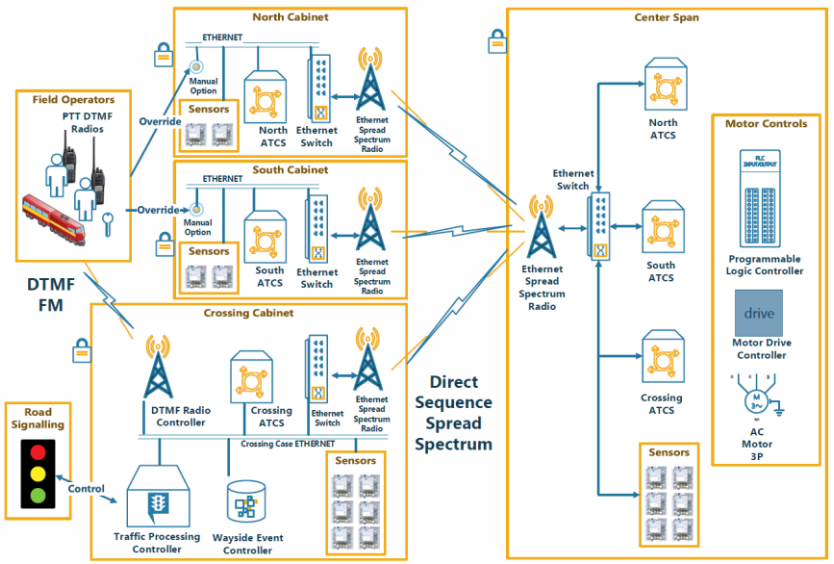
Cybersecurity Risk Management for Connected Railroads

PROJECT DESCRIPTION

- Develop a cybersecurity risk management framework specific to railroads.
- Focus on understanding communications-related cybersecurity risks for connected railroad technologies.
- Implement the risk methodology for selected use cases, such as advanced train control systems and remote control of movable bridges.
- Provide recommendations and identify future research needs for mitigating railroad cybersecurity risks.

RAILROAD IMPACT

- Description of selected connected railroad technologies and use cases
- Assessment of cybersecurity risk profiles (scenario and hazard source, vulnerability, capability of attack, impact of an attack)
- Implementation issues of cybersecurity risk management and research needs.



PROJECT PARTNERS

- Rutgers, The State University of New Jersey
- George Mason University
- HNTB
- Industry partners (e.g., Conrail, Belt Railway of Chicago, Amtrak, PATH, CSX)

COST & SCHEDULE

- Funding: $799,713
- Project Duration: September 2017 – November 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Trespass Detection and Warning – Drone System

PROJECT DESCRIPTION

- Test the effectiveness of drone technology to detect trespassers on railroad property.
- A mobile camera will be deployed on a remote-controlled aerial vehicle (drone) by the police and provide coverage over a significant amount of right-of-way (ROW) when in use. It will be used to identify and track trespassers in ROW areas that are difficult to access by the police, and be an integral part of the police department's trespass and suicide prevention efforts.
- Once properly trained, officers will fly over rail property using both standard HD cameras and FLIR cameras to detect trespassers. Officers will then provide education to trespassers on rail safety.

RAILROAD IMPACT

- Reduce trespass frequency on the Brunswick, Maine, corridor, through detection and education of trespassers on the ROW.
- Demonstrate potential benefits, including documenting best practices and lessons learned, of implementation and evaluation of drone technology to detect trespassers on railroad property. Application could be nationwide.
- An aerial mobile camera will increase coverage and safety along the entire ROW.
- Reduce trespass deaths; there were 509 ROW trespass fatalities and 508 injuries in 2017.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Brunswick, Maine, Police Department

COST & SCHEDULE

- Funding: $150,000
- Project Duration: January 2018 – December 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Photo Enforcement-Based Education at Crossings

PROJECT DESCRIPTION

- Study the effectiveness of photo enforcement technologies to detect and enforce highway-rail grade crossing violations.
- Collaborate with the City of Orlando, FL on its red light running program by implementing cameras at a grade crossing.
- City funded the installation of cameras at one grade crossing on East Princeton Street and provided grade crossing safety education materials to violating drivers.
- Signage installed by the City on June 23, 2016. Photo enforcement system operational in August 2016.
- Research team collected and analyzed vehicle data before and after the cameras were installed.
- Short-term results under internal review.
- Long-term (2 years after installation) evaluation underway

RAILROAD IMPACT

- Develop, implement, and evaluate techniques or technologies that reduce violations of grade crossing traffic control devices that may lead to incidents and casualties.
- Provide driver education on safety at grade crossings.
- Provide best practices for successful implementation of grade crossing photo enforcement systems.
- Supported analysis for rulemaking and legislative processes.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- City of Orlando, Florida
- SunRail

COST & SCHEDULE

- Funding: $250,000
- Project Duration: March 2016 – June 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Gate Skirts Research

PROJECT DESCRIPTION

- To evaluate a specific type of pedestrian gate enhancement, commonly known as gate skirts, designed to prevent pedestrians from violating the grade crossing while the grade crossing protection systems are activated.
- Current research in Ramsey, New Jersey, (grade crossing at East Main Street) builds on the lessons learned from previous research on gate skirt prototypes in Matawan, New Jersey, and New Britain, Connecticut.
- Gate skirts installed at Ramsey crossing on September 5, 2017.
- Before/after data collected and analyzed and results under internal review.
- Pedestrian channelization to be installed and evaluated in 2019.

RAILROAD IMPACT

- Demonstrate and evaluate new technologies and strategies that increase pedestrian safety at grade crossings; there were 172 pedestrian incidents at grade crossings in 2017 (about 9 percent of the total crossing incidents).
- Partnerships with State DOTs and railroads.
- Information exchange with rail safety partners on cutting-edge technologies and/or strategies.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- New Jersey DOT
- New Jersey Transit
- Borough of Ramsey, New Jersey

COST & SCHEDULE

- Funding: $50,000
- Project Duration: May 2017 – September 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Vehicle Railroad Right-of-Way (ROW) Incursion Prevention

PROJECT DESCRIPTION

- Study to evaluate the effectiveness of engineering treatments to deter vehicles from turning onto the rail ROW.
- Partnered with SunRail and the City of Orlando to develop vehicle ROW incursion prevention engineering treatments, identify suitable grade crossings for implementation, collect before and after data, and evaluate the results.
- Treatments installed at two crossings in the City in December 2016: West Washington Street and West Jefferson Street.
- Treatments consist of the extension of pavement markings through the crossing and addition of reflective markers and flexible delineators on both sides and in-between the tracks.
- Results of year-over-year comparison published in August 2018.
- Additional data being collected for 2-year comparison.

RAILROAD IMPACT

- Develop strategies to reduce the number of vehicles that mistakenly enter the ROW, thus reducing the possibility of an incident with a train (such as the one on February 14, 2015, in Oxnard, California, where a vehicle was struck by a Metrolink train, resulting in 1 fatality and 27 injuries).
- Develop low-cost solutions to increase safety at crossings.
- Information exchange on cutting edge technologies and/or strategies.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- City of Orlando, Florida
- SunRail

COST & SCHEDULE

- Funding: $165,000
- Project Duration: October 2016 – March 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Vehicle Blocked Crossing Research

PROJECT DESCRIPTION

- To develop, install, and evaluate low-cost treatments to increase driver awareness of the tracks at crossings.
- The Massachusetts Bay Transportation authority (MBTA) indicated interest in collaborating on developing a system to warn drivers of the dangers of stopping on the tracks and identified a crossing on Brighton Street in Belmont, Massachusetts, for the study.
- A video data collection system was installed at the crossing on March 9, 2017.
- Town of Belmont installed pavement markings on November 12, 2017.
- Before/after data was analyzed to determine potential benefit of markings.
- Research team obtained LED-enhanced R8-8 signage and scheduled to install in spring 2019.

RAILROAD IMPACT

- Provide effectiveness estimates for different engineering treatments to deter drivers from stopping on the tracks.
- Provide additional warning opportunity where signs may be obstructed or vehicle operator is distracted.
- Contribute to reduction of casualties at highway-rail grade crossings.
- Potential to save multiple lives/injuries per incident and $5M+/yr. in accident-related costs per incident.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- MBTA
- Town of Belmont, Massachusetts

COST & SCHEDULE

- Funding: $150,000
- Project Duration: March 2017 – June 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Rail Right-of-Way (ROW) Trespass Mitigation Treatments

PROJECT DESCRIPTION

- To review, select, and evaluate emerging technologies and strategies for railroad ROW trespass applications, specifically anti-trespass guards and landscaping rock treatments.
- New technologies or approaches to mitigate the trespass problems will be investigated for possible demonstration at trespass-prone locations.
- Anti-trespass guard panels installed in June 2015 on ROW adjacent to the West Dickson Street crossing in Fayetteville, Arkansas.
- Before/after data collected and analyzed, with final results currently under internal review.
- Rock treatments currently being investigated.

RAILROAD IMPACT

- Develop low-cost solutions to increase safety around rail ROW.
- Reduce the number of pedestrians who trespass onto rail ROW.
- Information exchange on cutting-edge technologies and/or strategies.
- Leveraged through a public-private partnership.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Arkansas and Missouri Railroad
- Florida Department of Transportation
- SunRail
- CTC, Inc.

COST & SCHEDULE

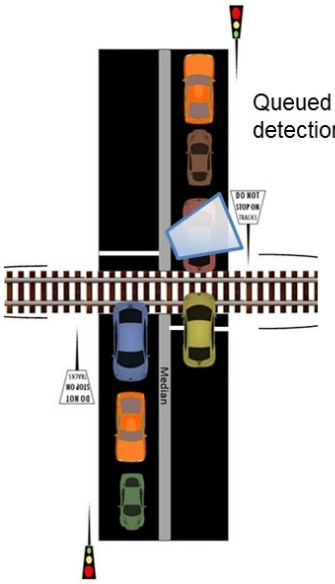
- Funding: $300,000
- Project Duration: October 2014 – September 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

LED-Enhanced “Do Not Stop On Tracks” Sign Research

PROJECT DESCRIPTION

- Evaluate the effectiveness of flashing LED-enhanced “Do Not Stop on Tracks” (R8-8) signs on reducing traffic queuing at highway-rail grade crossings.
- Perform tradeoff analysis of applicable sensor technologies for stopped vehicle detection.
- Perform a before/after analysis of LED R8-8 sign triggered by laser-based queue detection system.
- Location: Katonah, New York, on Metro-North Commuter Railroad, Harlem Line (Jay Street crossing).
- System installed in October 2018.
- Evaluation currently underway.



RAILROAD IMPACT

- Develop techniques or technologies that reduce instances of vehicles queuing over and stopping on rail tracks, which may lead to incidents and casualties (such as the 2015 crash in Valhalla, New York, that killed 6 and injured 15).
- Facilitate implementation and evaluation of innovative safety technologies.
- Information exchange on cutting-edge technologies and/or strategies for grade crossing safety.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Town of Bedford, New York
- Metropolitan Transportation Authority/Metro-North Railroad

COST & SCHEDULE

- Funding: $185,000
- Project Duration: June 2017 – June 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Emergency Notification System Sign Study

PROJECT DESCRIPTION

- To learn more about drivers' awareness and understanding of the Emergency Notification System (ENS) signs posted at highway-rail grade crossings.
- Shed light on how drivers react when crossing infrastructure that appears to be malfunctioning or when they get stuck on the crossing.
- Focus on whether drivers look for or attempt to make use of the information on the ENS sign.
- This experiment will be conducted in the Volpe driving simulator.

RAILROAD IMPACT

- Identify possible trends in vehicle driver behavior at and approaching grade crossings.
- Identify potential driver education/awareness strategies regarding presence and use of ENS signs.
- Provide guidance on most effective location and orientation of ENS signs.
- Supported analysis for potential legislative processes

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $150,000
- Project Duration: June 2018 – November 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

UAS Technology Exploratory Study

PROJECT DESCRIPTION

- The objective of this project is to investigate potential use of drone technology to quickly create accurate 3D profiles of humped grade crossings (using LiDAR, photogrammetry, and other methods).
- Includes measuring crossings that have previously been modeled using other proven but less portable methods (including the rail geometry car system) and comparing strengths and weaknesses.
- Project includes comparison to existing FRA LiDAR crossing profile data, development of grade crossing inventory procedures for collected data, and exploration of data processing software options.

RAILROAD IMPACT

- Commercial vehicle driver safety at grade crossings.
- Each year, about 14 percent of grade crossing accidents involve a tractor-trailer, and a substantial number of those are a result of the vehicle getting stuck on the tracks due to the low ground clearance across the crossing (a humped crossing).
- Accurate measurements of grade crossing profiles would aid in the identification and remediation of humped crossings.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Federal Highway Administration (FHWA)

COST & SCHEDULE

- Funding: $160,000
- Project Duration: March 2019 – September 2020

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Rail Trespass Prevention Summits

PROJECT DESCRIPTION

- To plan, coordinate, and execute a series of trespasser prevention summits with representatives from each of the top 10 counties for trespasser casualties, engaging with local community leaders, law enforcement, railroads, and the public. It will involve supporting coordination, facilitation, and documentation of the summits.
- These summits are one of the action items listed in FRA's National Strategy for Trespass Prevention on Railroad Property.

RAILROAD IMPACT

- Provides FRA partners with information on the latest trespass prevention strategies.
- Fosters an exchange of information on trespassing mitigation between all stakeholders.
- Provides railroads and industry stakeholders with a concise message of FRA's strategic plan.
- Facilitates development of site-specific strategies for trespass mitigation at the top 10 counties with the most trespass casualties nationwide, thereby improving rail safety.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- County and local governments
- Railroads
- State DOTs

COST & SCHEDULE

- Funding: $150,000
- Project Duration: August 2019 – September 2020

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Trespass Detection from Available Sources

PROJECT DESCRIPTION

- This research aims to study the effectiveness of using publicly available cameras to detect rail ROW trespassing. Many real-time, publicly available video feeds with views of the rail ROW currently exist. One such feed is from a camera in Ashland, VA.
- The use of Artificial Intelligence for automating detection from camera feeds will also be explored in this project.
- Data from these cameras may provide additional insights into trespass activities at those locations.

RAILROAD IMPACT

- Improved research support by providing widespread access to various information sources.
- Information exchange on cutting edge technologies and/or strategies
- Reduce the number of pedestrians that trespass onto railroad ROW.
- Increase public safety.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Rutgers University

COST & SCHEDULE

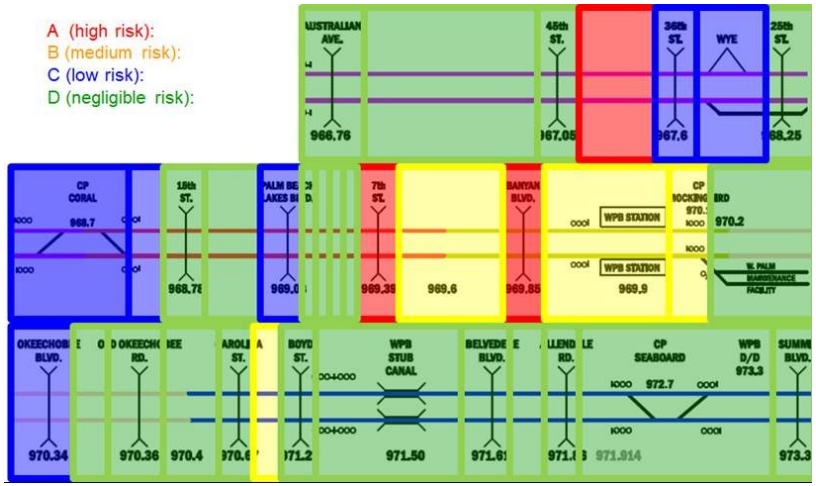
- Funding: $80,000
- Project Duration: March 2019 – December 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Trespass Risk Methodology

PROJECT DESCRIPTION

- This project builds on the trespass risk methodology developed in the West Palm Beach trespass study and other recent industry models to develop a method to assess the trespass risk on rail ROWs using currently available data.
- Data sources such as accident/incident data, suicides, trespass observations, locomotive video data, debris strikes, and others will be considered.
- More than 500 trespass fatalities and nearly as many injuries occur each year on the nation's rail network. FRA, railroads, and State and local agencies use all available data to identify areas of greatest risk and implement mitigation strategies. However, no standard methodology exists to estimate trespass risk.



RAILROAD IMPACT

- Information exchange with State DOTs and railroads on cutting-edge methodologies for trespass prevention.
- Provide tools for stakeholders to assess trespass risk and implement mitigation strategies.
- Increase public safety.
- Reduce trespass deaths. (There were 536 ROW trespass fatalities and 482 injuries in 2018.)

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $130,000
- Project Duration: March 2019 – September 2020

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Trespass Risk in Quiet Zones

PROJECT DESCRIPTION

- This project will analyze rail trespass incident data to determine the effects of implementation of Quiet Zones (QZs) on trespass incidents, and include pedestrian incidents at crossings as well.
- Localities desiring to establish a QZ are first required to mitigate the increased risk at grade crossings caused by the absence of a horn. This is typically done through additional safety improvements such as gates with channelization or medians, four-quadrant gates, one-way streets, and crossing closures. However, no trespass mitigation requirements are included.
- It is uncertain how well these improvements work in place of the train horn for both pedestrian safety at crossings and trespassing on a rail ROW.

RAILROAD IMPACT

- Identify possible trends in pedestrian safety around rail ROWs.
- Supported analysis for rulemaking and legislative processes.
- Increase public safety.
- Reduce trespass deaths (there were 536 ROW trespass fatalities and 482 injuries in 2018).

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $90,000
- Project Duration: March 2019 – December 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Artificial Intelligence for Trespassing

PROJECT DESCRIPTION

- This project will continue the work on Artificial Intelligence (AI) algorithms for different trespass and crossing scenarios started under the Anti-Trespass Treatments project (subtask 2.4).
- This work will also include continued collaboration with Rutgers on its AI detection system and support installation and evaluation at the E. Main St crossing in Ramsey, NJ.
- Collaboration with Michigan Tech on their AI algorithms will also be explored.

RAILROAD IMPACT

- Develop techniques or technologies for automated trespass detection and disseminate to rail stakeholders to increase safety around rail rights-of-way (ROW).
- Reduce the number of pedestrians that trespass onto railroad ROW.
- Increase public safety.

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $100,000
- Project Duration: November 2019 – September 2020

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

ROW Trespass CRISI Grant Evaluation

PROJECT DESCRIPTION

- The objective of this project is to evaluate the implementation of drone and other technologies for rail right-of-way (ROW) trespassing by the Florida Department of Transportation (FL DOT).
- Under an FRA Consolidated Rail Infrastructure and Safety Improvements (CRISI) grant, FL DOT launched a pilot program using drone technology, closed-circuit television with remote monitoring and geographic information system spatial analysis to aid partnerships among local law enforcement agencies to combat trespassing in Volusia, Seminole, Orange, and Osceola counties.

RAILROAD IMPACT

- Demonstrate potential benefits, including documenting best practices and lessons learned, of implementation and evaluation of drone technology to detect trespassers on railroad property. Application could be nationwide.
- Partnerships with State DOTs and railroads.
- Information exchange with rail safety partners on cutting edge technologies and /or strategies.
- Increase public safety.
- Supported analysis for potential legislative processes.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Florida Department of Transportation

COST & SCHEDULE

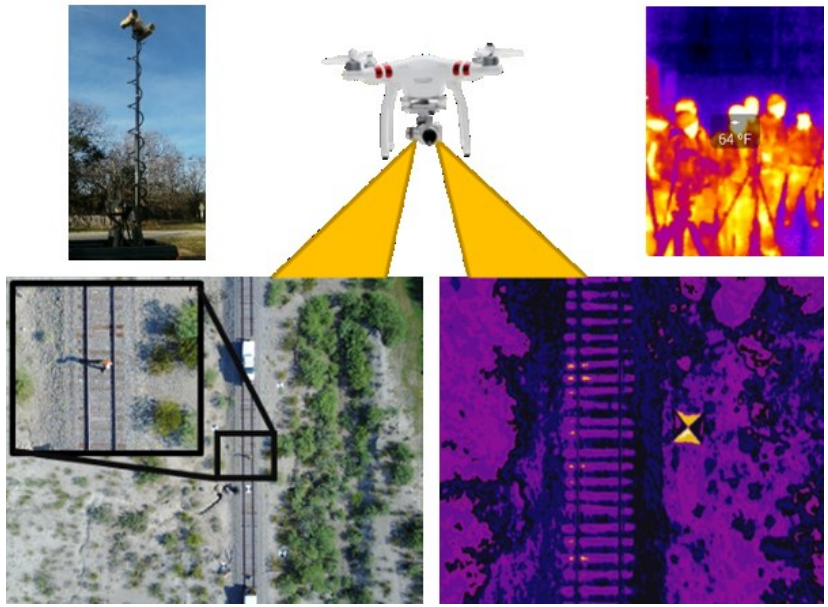
- Funding: $50,000
- Project Duration: November 2019 – September 2020

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Railroad Artificial Intelligence Intruder Learning System (RAIILS)

PROJECT DESCRIPTION

- This project investigates the effectiveness of Artificial Intelligence (AI) technology for the problem of intruder detection in rail properties.
- A comprehensive literature review highlighting past and current advancements in AI algorithms and their applicability to railway sensing will be compiled.
- In conjunction with feedback from rail industry representatives, ground-based and unmanned aerial vehicle (UAV)-based systems equipped with AI algorithms will then be developed for the purpose of automatically detecting trespassers.
- The prototype system will be tested at locations made available by industry partners.



RAILROAD IMPACT

- Multi-source remote sensing removes the need for manual inspection of railroad property.
- AI-based detection will enable automatic notification of trespassers in real time.
- Improved, automated detection has the potential to improve safety outcomes while reducing cost.

PROJECT PARTNERS

- Michigan Technological University
- Lake State Rail Company
- Michigan Department of Transportation

COST & SCHEDULE

- Phase 1 – April 2019 – October 2019: $103,808
- Phase 2 – October 2019 – June 2020: $199,857

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

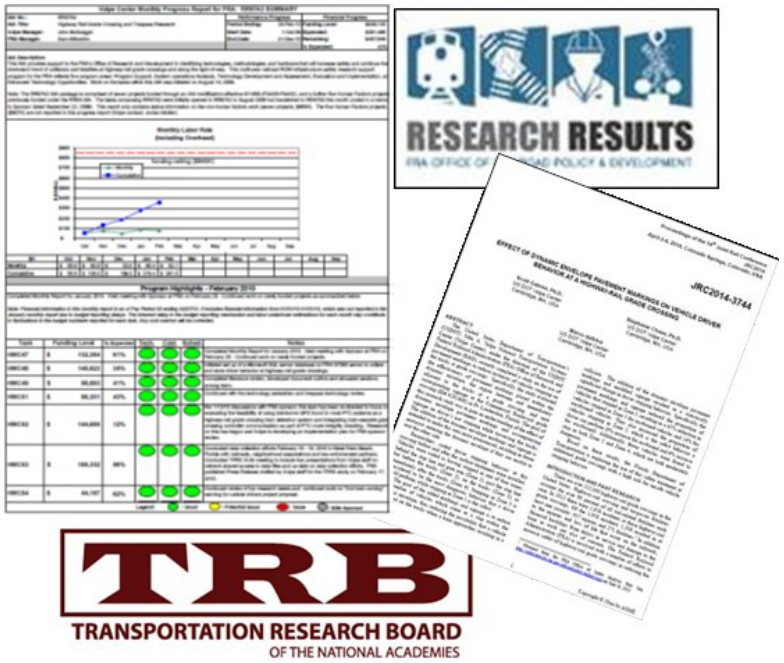
Grade Crossing and Trespass Research Program Support

PROJECT DESCRIPTION

- Participate in professional activities within the scope of research topic that are not specifically funded under another task (e.g., TRB AHB60 Committee, technical papers).
- Exchange information on cutting-edge technologies and/or strategies for grade crossing safety and trespass prevention (including outreach to FRA grade crossing managers).
- Provide reports on a periodic basis to define and track key activities in support of the research program.

RAILROAD IMPACT

- Information exchange with State DOTs and railroads on cutting-edge technologies and/or strategies for grade crossing safety and trespass prevention.
- Quick response capability in support of FRA Office of Research, Development & Technology.
- Support FRA RD&T on studies requiring immediate action not covered in any existing task.



PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

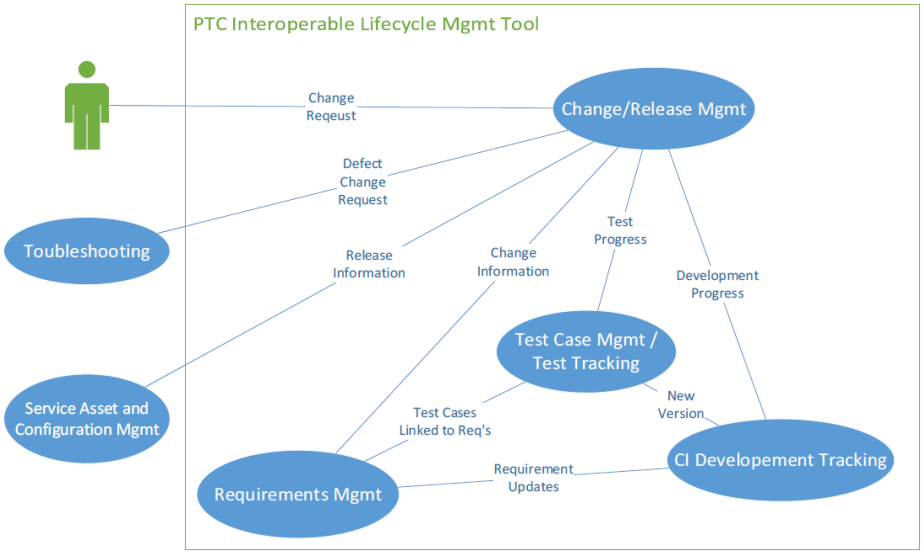
- Funding: $210,000
- Project Duration: November 2016 – March 2019

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • francesco.bedini@dot.gov

Positive Train Control (PTC) Interoperability

PROJECT DESCRIPTION

- Organize industry stakeholder advisory group.
- Develop operational concepts/system description documentation.
- Develop requirements for the PTC Interoperable Lifecycle Management System.
- Research existing commercially available tools options.
- Support the Interoperable Train Control (ITC) Change and Configuration Management Team.



RAILROAD IMPACT

- Support implementation of PTC systems that depend on accurate configuration information between railroads.
- Support automation of PTC Compatibility Database.
- Improve operational safety and network capacity by reducing the manpower and time to verify inter-railroad operations.
- Migration support for new/updated software and hardware releases.
- Support multiple and unique PTC applications and installations.
- Expandable to support future upgrades / versions of PTC.

PROJECT PARTNERS

- Association of American Railroads
- Transportation Technology Center, Inc.

COST & SCHEDULE

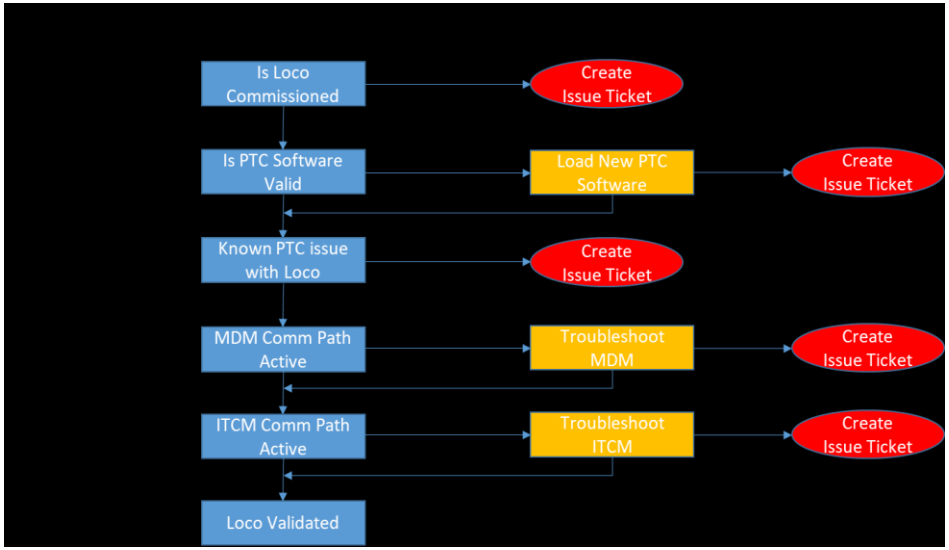
- Funding: $886,000
- Project Duration: March 2017 – March 2020

FRA PROJECT MANAGER: Rick Orcutt • (719) 584-0507 • richard.orcutt@dot.gov

Monitoring and Analysis of the Integrated Network

PROJECT DESCRIPTION

- Collaborate with Technical Advisory Group made up of members from FRA, AAR and TTCI.
- Determine data collection needs, analytic methods, and feasibility of monitoring and analysis of the integrated network (MAIN).
- Develop analytic tools to quickly identify and alert users of problems; provide key information for diagnosing problems; and automatically diagnose problems when possible.
- Automate communications and file transfers between railroads for analysis and recovery of Positive Train Control (PTC) enforcements.



RAILROAD IMPACT

- Provide real-time alerts/alarms, health and status information, diagnostics support, and key performance indicators for (PTC) help desks, railroad signal and locomotive troubleshooters, network operation centers, dispatchers, urban area coordinators, PTC220 LLC, and PTC maintainers.
- Deploy an industry standard technological platform for railroads to exchange data.
- Provide ongoing message statistics and frequency of instances where locomotives are unable to obtain a communication timeslot (or are delayed in doing so).

PROJECT PARTNERS

- Association of American Railroads
- Transportation Technology Center, Inc.
- Railinc Corp.

COST & SCHEDULE

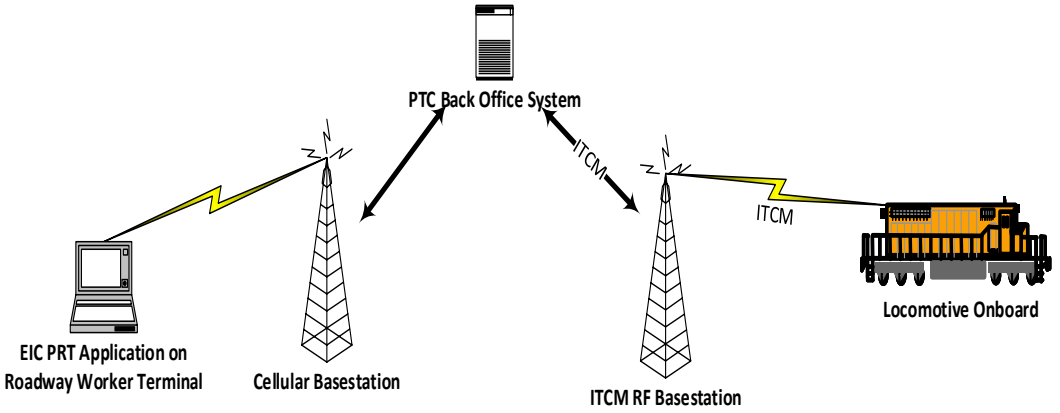
- Funding: $1,489,300
- Project Duration: August 2016 – May 2020

FRA PROJECT MANAGER: Rick Orcutt • (719) 584-0507 • richard.orcutt@dot.gov

Employee in Charge Portable Remote Terminal (EICPRT)

PROJECT DESCRIPTION

- Transmitted electronically from an EIC Terminal through the back office server to the onboard computer.
- Allows an employee in charge (EIC) to grant permissions for train crews to enter a work zone.
- Provides enforcement of Positive Train Control (PTC) instructions (i.e., speed limits).
- Use of the EIC terminal application for electronic control of working limits does not supersede the maintenance-of-way operating rules or required verbal communication.



RAILROAD IMPACT

- PTC enforcement of EIC instructions, thereby protection is maintained.
- Mitigates EIC working outside of maintenance-of-way protected time.
- Prevents instructions to the locomotive by third party (spoofing) through the EICPRT interface.

PROJECT PARTNERS

- Association of American Railroads
- Transportation Technology Center, Inc.

COST & SCHEDULE

- Funding: $3,200,400 (project cost)
- Project Duration: September 2012 – December 2020

FRA PROJECT MANAGER: Rick Orcutt • (719) 584-0507 • richard.orcutt@dot.gov

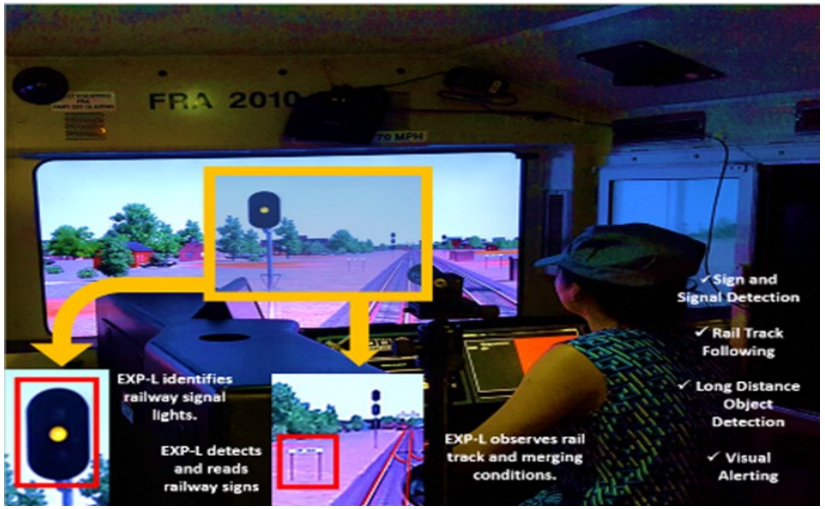
SECTION FOUR

HUMAN FACTORS

External Perception for Locomotives (ExPL)

PROJECT DESCRIPTION

- Via machine-learning, machine vision technologies develop an in-situ perception system for locomotives that detects and interprets the state of railway signals and signs and detects objects on the track. Specific examples include rail grade crossings and speed restrictions.
- Leverage extensive rail human factors expertise with MIT Man Vehicle Laboratory.
- Show feasibility and proof-of-concept in the Volpe Center Cab Technology Integration Laboratory using realistic test cases such as adverse weather or recreated accidents.



RAILROAD IMPACT

- A real-time, automated second set of eyes will be developed to compensate for loss of situational awareness in the train cab.
- Improved crew situational awareness
- A novel framework will be developed for a machine vision/machine learning system that goes beyond human capability for real-time railway signal and sign detection, and obstacle detection in day/night conditions.
- Path toward standards for system design and human factors will be developed and presented.

PROJECT PARTNERS

- Aurora Flight Sciences
- MIT Human Systems Laboratory

COST & SCHEDULE

- STUDY COMPLETED
- Funding:
  - Phase I — System Design: $156,000
    - System will be implemented into the Volpe CTIL train simulator; Initial data collection.
  - Phase II — Development: $161,000
    - Machine vision and machine learning algorithm development
    - Software prototype with datasets delivered.
  - Phase III — Maturation and Refinement: $120,000
- Project Duration: April 2018 – April 2019

FRA PROJECT MANAGER: Mike Jones • (202) 493-6106 • michael.e.jones@dot.gov

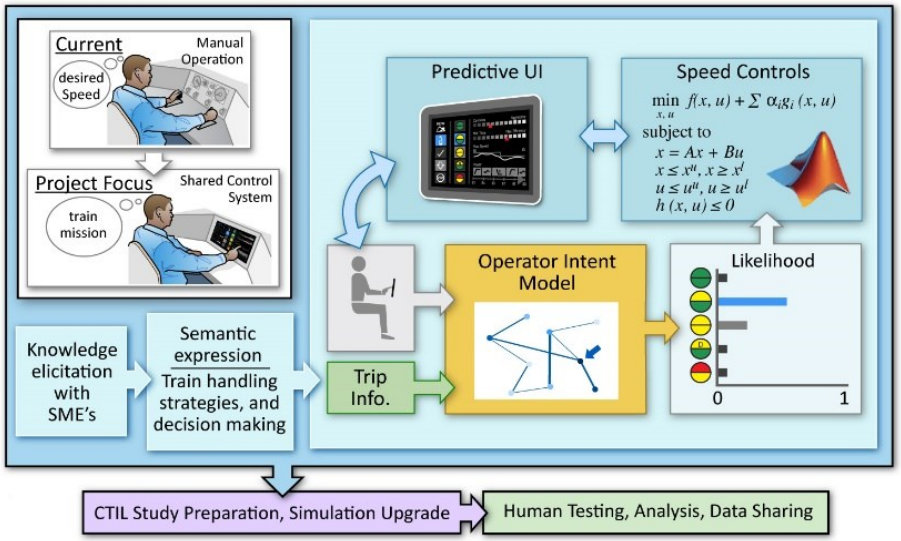
Design of a Robust Locomotive Operating Mode

PROJECT DESCRIPTION

- Explore the performance impact of new user interface for manual operating mode which directs automated systems to carry out sequences of tasks and incorporates a higher orders of operator interactions (mission/speed input vs. notch input to locomotive).

RAILROAD IMPACT

- Foundational research for future operational concepts
- Understand impact of advanced automation with less experienced crew on train safety and system performance.
- Improve rail safety by identifying critical deviations through real-time mismatch between operator behavior and modeled intent.
- Enable new automation system and adaptive display.



PROJECT PARTNERS

- GE Global Research
- MIT Human Systems Laboratory

COST & SCHEDULE

- Funding:
  - General Electric: 20% cost share
  - Year 1 — Phase 1: $489,304
  - Year 2 — Phase 2: $500,908
- Project Duration: October 2018 – September 2020

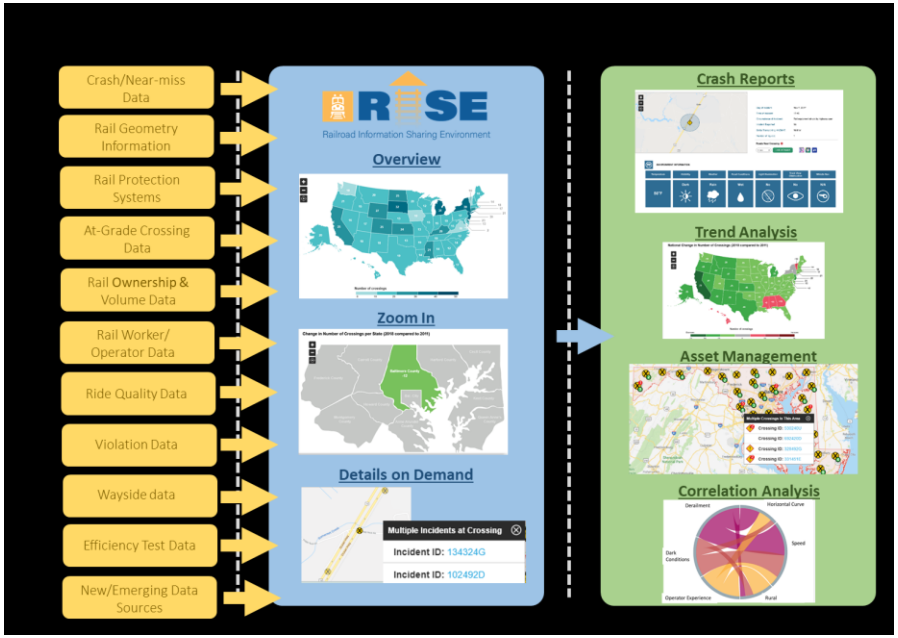
FRA PROJECT MANAGER: Mike Jones • (202) 493-6106 • michael.e.jones@dot.gov

Rail Information Sharing Environment (RISE)

PROJECT DESCRIPTION

The end product of this project will produce a RISE prototype that streamlines the process of querying, analyzing, and visualizing rail data.
The development of the RISE platform will be guided by the following tasks:

1. **Project Foundation**: Establishing working group and engaging stakeholders to guide the development of RISE
2. **Data Protection**: Developing framework to ensure sensitive data is secure.
3. **RISE Prototype Demo and Evaluation**: Evaluate the use of RISE on real-world case studies recommended by stakeholders.
4. **RISE Results and Feasibility**: Documenting the outputs of the RISE prototype and assess the feasibility to support rail safety analysis.



RAILROAD IMPACT

- While the current FRA Office of Railroad Safety database contains a multitude of relevant data for measuring the safety, efficiency, and reliability of the U.S. rail system, there are few tools available to the greater rail analysis community to convert this data into actionable information. There are even fewer tools available to assist analysts in communicating their findings to a broad audience that ranges from technical experts to the general public. This project seeks to meet this critical need to promote the use of the FRA's rich data to improve railway safety.

PROJECT PARTNERS

- Center for Advanced Transportation Technology Laboratory, University of Maryland
- Partnering passenger railroads

COST & SCHEDULE

- FRA: $300,000 (total request amount)
- Total Project Value: $300,000
- Duration: 1 year
- Contract start: September 2019

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Rachel Grice • (202) 493-8005 • rachel.grice@dot.gov

MIT Augmented Reality Head-Up Display (HUD)

PROJECT DESCRIPTION

- Design, develop, and evaluate prototype head-up display (HUD).
- Conduct quantitative evaluation of HUD design with human-in-the-loop experiments in CTIL.

RAILROAD IMPACT

- HUD supports enhanced situation awareness and detection of critical external events.
- HUD enables smooth transitions between automated and manual control of the locomotive.

PROJECT PARTNERS

- MIT Human Systems Laboratory
- General Electric Global Research

COST & SCHEDULE

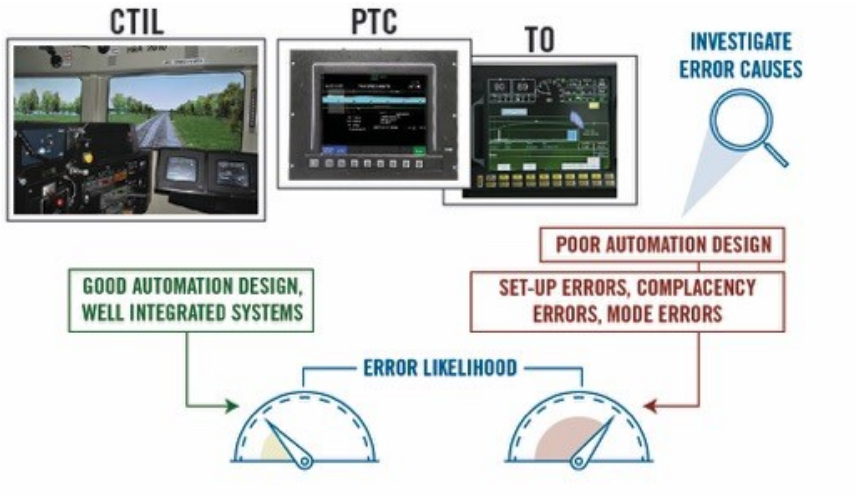
- Funding:
  - Year 1 — Phase 1: $500,000
  - Year 2 — Phase 2: $500,000
  - Optional Phase — Actual locomotive testing
- Project Duration: September 2018 – September 2020

FRA PROJECT MANAGER: Mike Jones • (202) 493-6106 • michael.e.jones@dot.gov

Human Error Potential in Human-Automation Interaction

PROJECT DESCRIPTION

- Human-in-the-loop research investigating human-automation interaction (HAI) with Positive Train Control (PTC) and trip optimizer (TO).
- Compare crew performance in low- and high-workload automated scenarios with crew performance in low- and high-workload manual scenarios.
- Investigate the potential for automation set-up errors, complacency errors, and mode errors.
- Investigate effects of distraction and workload on error potential.
- Identify design and training recommendations to improve HAI and reduce error likelihood.



RAILROAD IMPACT

- Identify factors that contribute to error in the locomotive cab with automated system use.
- Reduce error potential by up to an order of magnitude through HAI design and training recommendations.
- Improve the safety of rail operations by reducing risk of human error.

PROJECT PARTNER

- Tier 1 Performance Solutions LLC

COST & SCHEDULE

- Funding: $397,276
- Project Duration: September 2018 – December 2019

FRA PROJECT MANAGER: Mike Jones • (202) 493-6106 • michael.e.jones@dot.gov

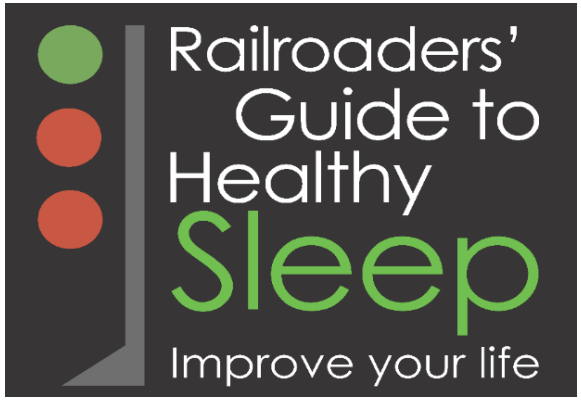
Railroaders' Guide to Healthy Sleep Website
www.RailroaderSleep.gov

PROJECT DESCRIPTION

- 2012: The Volpe Center (in conjunction with Harvard Medical School) launched an interactive, multimedia educational website approved by stakeholders and tailored toward providing railroaders and their support networks:
  - Scientifically valid information about the importance of sleep
  - An anonymous self-assessment sleep disorders screening tool
  - Proven, practical tips and strategies for improving sleep health.
- 2016: Redesigned and reorganized site with additional railroader/ stakeholder feedback and new content to address balancing work/ life challenges.
- Since the redesign, project focus is (1) industry outreach and promotion to increase target audience awareness and use, and (2) adding features/content based on stakeholder and railroader feedback (e.g., Shareable Resources tab).

RAILROAD IMPACT

- Fatigue in the transportation industry has been a top priority of the National Transportation Safety Board starting in 1990. The Rail Safety Improvement Act of 2008 includes a requirement for carrier fatigue education and training.
- The website can help carriers in their efforts to meet this upcoming requirement.
- This educational website, intended for railroaders, focuses on the causes of sleepiness and key mitigation strategies under an operator's control that can help reduce sleepiness and fatigue-related incidents.



PROJECT PARTNERS

- U.S. DOT Volpe Center
- Harvard Medical School, Division of Sleep Medicine
- Brotherhood of Locomotive Engineers and Trainmen
- Rail carriers
- SMART Transportation Division
- Association of American Railroads
- American Short Line and Regional Railroad Association

COST & SCHEDULE

- Funding: Project Lifecycle ~ $600,000 (including project evaluation effort)
- Project Duration: April 2015 – March 2020 (IAA expiration)
- Continued efforts to increase awareness and use and add features/content, pending sponsor approval and website availability (currently offline).

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Rachel Grice • (202) 493-8005 • rachel.grice@dot.gov

Effects of In-Vehicle Auditory Alerts on Driver Behaviors at Rail Grade Crossings

PROJECT DESCRIPTION

- Development and testing of in-vehicle auditory alerts for grade crossing proximity
- Technology assessment of vehicle auditory displays
- Use of driving simulators and research
- Phase 1: Literature review, audio design, and driving simulator research
- Phase 2 Driving simulator research at multiple sites
- Phase 3: On-road pilot research

RAILROAD IMPACT

- This research can provide critical information to developers interested in incorporating rail crossings (and IVAAs) in their applications. It can provide a data-based approach to design optimized, in-vehicle auditory alerts for rail crossings and help with standardizing the warnings across platforms. More specifically, the project outcomes can provide design guidelines that consider different road conditions, auditory parameters, driver characteristics, distractions, and actual implementation directions.

PROJECT PARTNERS

- Michigan Technological University and Virginia Tech

COST & SCHEDULE

- Totals by Funding Source and % of Project:
- FRA (total request amount): $515,916 – 93%
- MTU (cost share): $40,964 – 7%
- Total Project Value: $556,880
- Contract Start: April 2019
  - Phase 1: 16 months $248,221
  - Phase 2: 12 months
  - Phase 3: 12 months

FRA PROJECT MANAGER: Mike Jones • (202) 493-6106 • michael.e.jones@dot.gov

The Impact of Commute Times on the Fatigue and Safety of Locomotive Engineers and Conductors

PROJECT DESCRIPTION

- Commute times currently not recognized or acknowledged as a contributing factor to fatigue by the FRA.
- Extent to which commute times impact fatigue and safety of locomotive engineers and conductors is unknown.
- Study will use a two-phase approach:
  - Phase I – Planning and development
  - Phase II – Execution of survey and focus groups
- Surveys and focus groups will identify and assess various aspects of fatigue and the impact these have on safety.

RAILROAD IMPACT

- Identify existing gaps in research related to fatigue in the railroad industry.
- Gain a better understanding of the contributors to fatigue in safety-critical rail workers.
- Assess the impact of commute times on fatigue and safety in the railroad industry.
- Study will assess the issue of commute times and determine if further investigation is necessary.
- Study will provide recommendations on best practices for combating fatigue in the railroad industry.

PROJECT PARTNER

- Virginia Tech Transportation Institute

COST & SCHEDULE

- Total Project Value: $180,000
- Contract started in July 2018
- Contract funded in 3 phases:
  - Phase 1: 12 months
  - Phase 2: 8 months
  - Phase 3: 10 months

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Rachel Grice • (202) 493-8005 • rachel.grice@dot.gov

Suicide Countermeasures

PROJECT DESCRIPTION

- Work with railroad carriers to implement pilot tests of various countermeasures to understand which countermeasures could .
- Mitigate suicides on the rights-of-way (ROW).
- Develop rail-specific guidelines for reporting suicides on ROWs.
- Track suicide and trespass rates and identify potential regions of concern (e.g., hotspots) using Geographic Information Systems (GIS) mapping.
- Continue to gather information about the prevalence of suicides on ROWs, as well as demographic characteristics of individuals involved and characteristics of time and location that may impact countermeasure development.

RAILROAD IMPACT

- Reduction in the number of suicide casualties that occur on the railroad rights-of-way (ROW).
- Reduction in service disruption and employee time off due to suicide incidents
- Better understanding of potential countermeasures and improved understanding of feasibility of implementing countermeasures to mitigate suicides.
- Improvement in the quality of data being collected on suicide and trespass casualties by railroad carriers.
- Involvement of other groups who may be able to share countermeasure costs.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Various railroad carriers
- Various universities

COST & SCHEDULE

- Funding: $1.05 million
- Project Duration: October 2018 – September 2020

FRA PROJECT MANAGER: Starr Kidda, Ph.D. • (202) 493-1300 • starr.kidda@dot.gov

Short Line Safety Institute (SLSI)

PROJECT DESCRIPTION

- Partner with SLSI to help short line and regional railroads enhance and improve safety practices, and to increase their commitment to safety.
- Work with SLSI to develop and test safety culture assessment tools and provide ongoing program improvements.

RAILROAD IMPACT

- SLSI was formed to improve safety practices and to provide safety training for Class II and Class III freight railroads to build a stronger, sustainable safety culture.
- The SLSI:
  - Conducts safety culture assessments and provides recommendations on how to improve safety culture
  - Provides training and education about safety culture
  - Serves as a research center that compiles and disseminates information on safety needs and trends
  - Communicates to stakeholders about safety culture improvement efforts

Short Line Safety Institute

PROJECT PARTNERS

- SLSI
- University of Connecticut
- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding:

  FY19: September 2019 – December 2020
  - $2.4 million grant to SLSI
  - $100,000 to Volpe for project evaluation

  FY20: September 2020 – December 2021
  - $3 million in continued funding

FRA PROJECT MANAGER: Starr Kidda, Ph.D. • (202) 493-1300 • starr.kidda@dot.gov

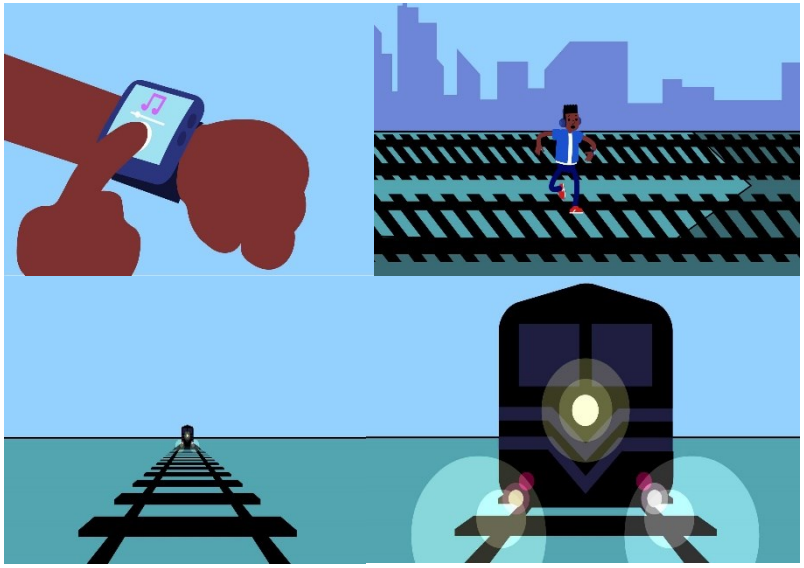
FRA Social Media Animation Campaign

PROJECT DESCRIPTION

- Trespassing on the nation's railroad rights-of-way is the leading cause of rail-related fatalities, accounting for 62 percent of all U.S. rail-related deaths in FY 2018. An average of 448 trespassers died each year between FY 2009 and FY 2018, excluding suicides. Trespassing fatalities have increased 21 percent over the last 5 years – from 470 in 2014 to 570 in 2018.
- Develop an animated video campaign on social media channels that communicates the dangers and consequences of unsafe behaviors on railroad property.
- Evaluate the effectiveness of leveraging social media to a target audience of 16- to 34-year olds.

RAILROAD IMPACT

- Increase awareness of the target audience of 16- to 34-year old social media audience.
- Communicate the dangers and consequences of unsafe behaviors on railroad property.
- Evaluate the effectiveness of leveraging social media channels to communicate safety messages.



PROJECT PARTNERS

- N-Squared Media Solutions, LLC
- Enlighteneering, Inc.

COST & SCHEDULE

- Funding: $249,170
- Project Duration: October 2018 – January 2020

FRA PROJECT MANAGER: Michele Geary • (202) 493-6129 • michele.geary@dot.gov

CONTACT US

Federal Railroad Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

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