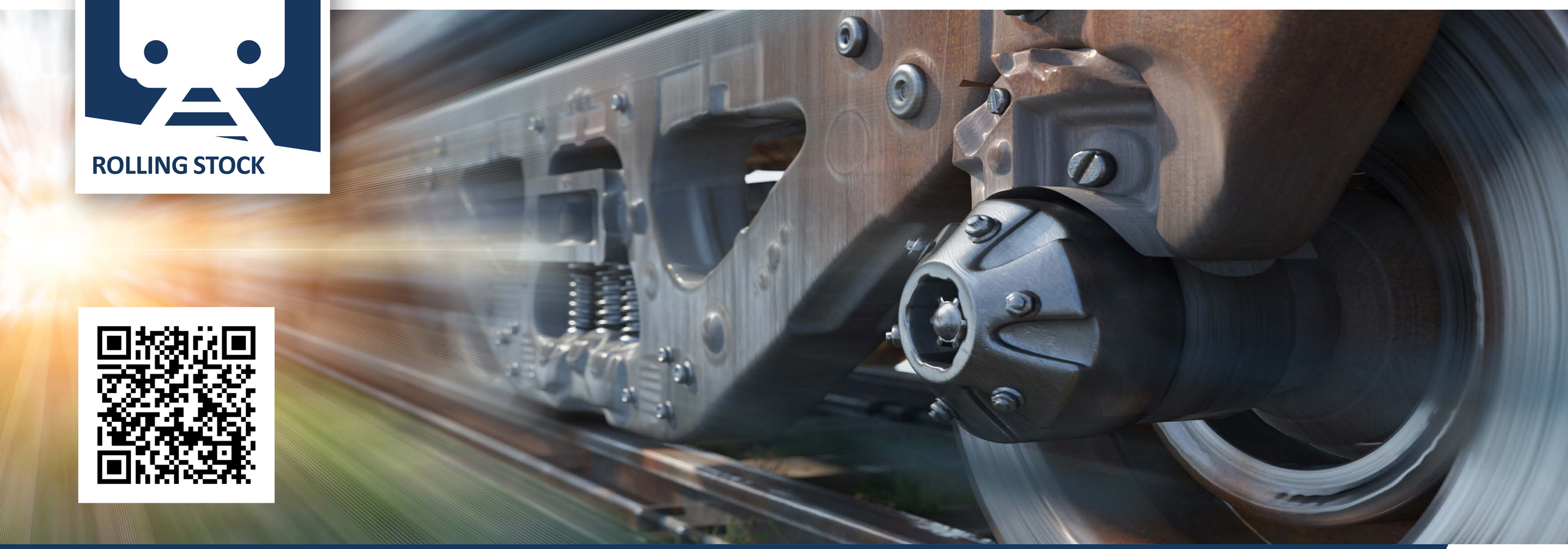
ROLLING STOCK



FOCUS: APPLIED RESEARCH | **FRA FUNDING:** $300,000

Non-destructive Testing of Tank Cars and Probability of Detection (POD)

PROJECT DESCRIPTION

The rulemaking issued by U.S. Department of Transportation requires the replacement of the hydrostatic pressure test with appropriate non-destructive testing (NDT) methods:

- Test methods must be quantified to demonstrate the sensitivity and reliability of the inspection and testing.
- POD evaluations of these NDT methods by industry technicians and company procedures.
- Evaluate and quantify NDT methods authorized for use in replacing the hydrostatic pressure test in the qualification or re-qualification of railroad tank cars.
- Quantify NDT methods using the POD approach.

PROJECT STATUS

- Draft final report under FRA review.

PROJECT RESULTS

- Completed the POD charts.

RAILROAD IMPACT

- NDT reliability is a key consideration in the safety and operations of tank cars.
- Quantification of the test methods through POD to provide direction and insight into the current capabilities of the industry when using the allowed NDT methods.
- Provides reliability of inspections.
- Provides for operator and procedure qualification.

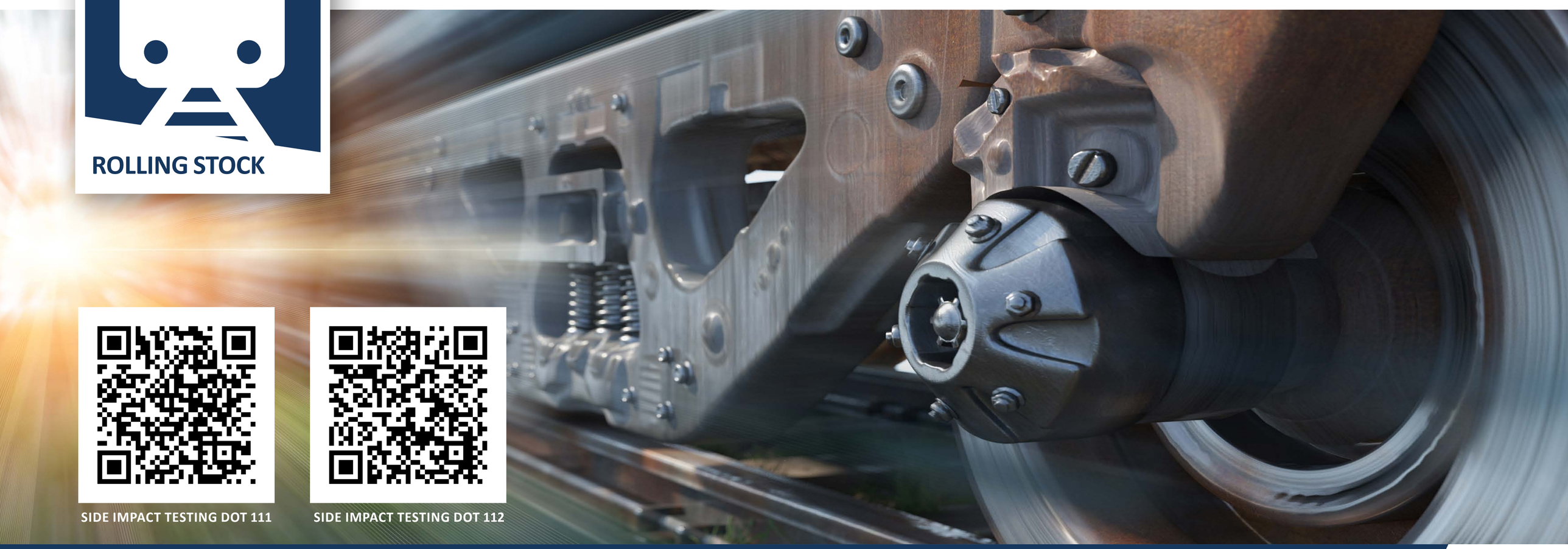
PROJECT PARTNER(S)

- Transportation Technology Center, Inc. (TTCI)
- Tank car shops

U.S. Department of Transportation
Federal Railroad Administration

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

ROLLING STOCK



SIDE IMPACT TESTING DOT 111

SIDE IMPACT TESTING DOT 112

FOCUS: APPLIED RESEARCH | **FRA FUNDING:** $300,000

Full-Scale Tank Car Testing

PROJECT DESCRIPTION

- Develop the test method.
- Design and construct the test fixture.
- Prepare and test different DOT-specification tank cars.
- Analyze and provide the data for model validation.

PROJECT STATUS

- Preparing for two future tests this year.

PROJECT RESULTS

- Conducted several side impact testing on several DOT-specification tank cars.

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 PARTNER(S)

- Transportation Technology Center, Inc. (TTCI)
- Volpe National Transportation Systems Center

U.S. Department of Transportation
Federal Railroad Administration

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

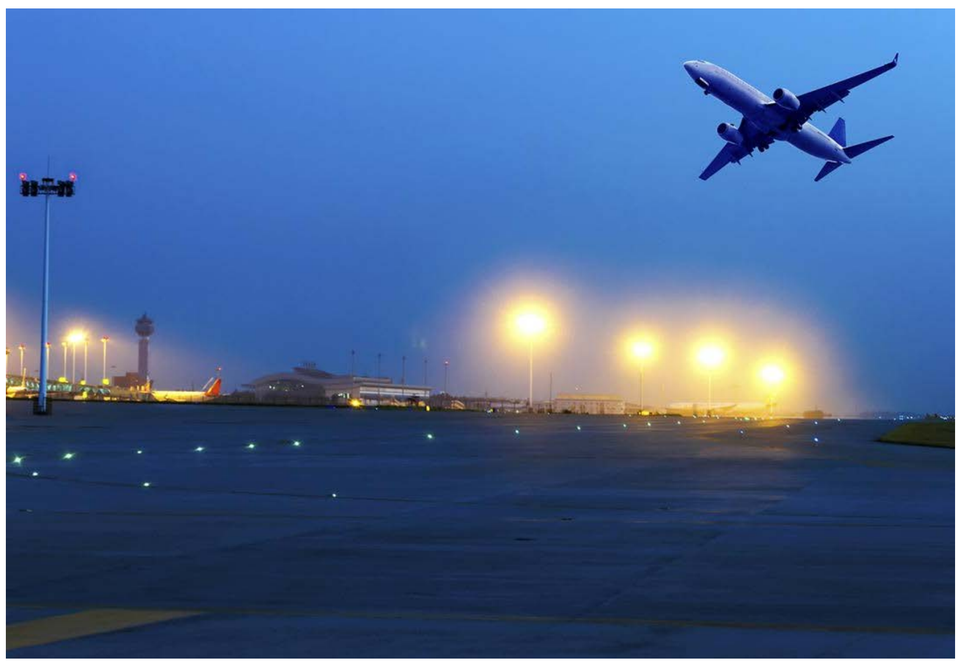
HUMAN FACTORS

FOCUS: HUMAN-AUTOMATION INTERACTION | **FRA FUNDING:** $295,000

Human-Automation Interaction Aviation Lessons Learned

PROJECT DESCRIPTION

- Research implementation of automation in the aviation domain and provide lessons learned to the rail industry domain.



RAILROAD IMPACT

- The rail industry is implementing automation to improve safety (e.g., Positive Train Control, or PTC).
- Aviation has decades of experience with automation (Flight Management Systems).
- Similarities across the industries and in the safety-related equipment suggest that human-automation interaction lessons learned from aviation can apply in the rail domain.
- The focus of this effort was on the locomotive cab and the engineer's interaction with automation.
- Recommendations on the need for system-system integration and consistency in locomotive cab automation.

PROJECT STATUS

- Study completed; technical report in process.

PROJECT PARTNER

- Alion Science & Technology

U.S. Department of Transportation
Federal Railroad Administration

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

FEDERAL RAILROAD ADMINISTRATION

OFFICE OF RESEARCH, DEVELOPMENT & TECHNOLOGY

HUMAN FACTORS

FOCUS: HUMAN FACTORS RESEARCH | **FRA TOTAL FY18 FUNDING:** $795,000

Rail Trespass and Suicide Prevention

PROJECT DESCRIPTION

- Study the two leading causes of rail-related death in the U.S. on railroad property.
- **Prevalence/Demographics**
  - Identify trends over time; better understand why incidents occur and if they are changing.
- **GIS Mapping**
  - Explore patterns where suicide and trespass incidents occur and use this information to inform countermeasure development or deployment.
- **Global Railway Alliance for Suicide Prevention (GRASP)**
  - Engage with rail suicide prevention experts from around the world; advance the global state of knowledge and help guide effective mitigation strategies in the U.S.
- **Media Reporting**
  - Reduce potential for copycat suicide attempts by encouraging responsible reporting practices after an incident.
- **Countermeasure Pilot Testing**
  - Evaluate trespass and suicide countermeasures; provide best practices to U.S. rail industry to help implement them.

RAILROAD IMPACT

- Improved railroad safety by understanding why rail trespass events and suicides happen in the U.S., where and when they are most likely to occur, and how to prevent them.
- Trespass and suicide prevention knowledge transfer between carriers with similar issues.

PROJECT PARTNER

- Volpe National Transportation Systems Center

PROJECT STATUS

- FRA is currently developing a national strategy to prevent trespasser incidents on railroad property; we expect to deliver this report to Congress by August 2018.

U.S. Department of Transportation

Federal Railroad Administration

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

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OFFICE OF RESEARCH, DEVELOPMENT & TECHNOLOGY

TRAIN CONTROL & COMMUNICATIONS

FOCUS: APPLIED RESEARCH | **FRA FUNDING:** $286,664

Positive Train Control (PTC) Interoperability Support

PROJECT DESCRIPTION

- Develop Operational Concepts and System Description for tools and processes to support ongoing PTC Interoperable Lifecycle Management.
- Document high-level functional requirements for a PTC Interoperable Lifecycle Management system.
- Conduct market research on existing systems.
- Review alternatives identified and develop recommendations for industry-wide interoperable lifecycle management of PTC.

RAILROAD IMPACT

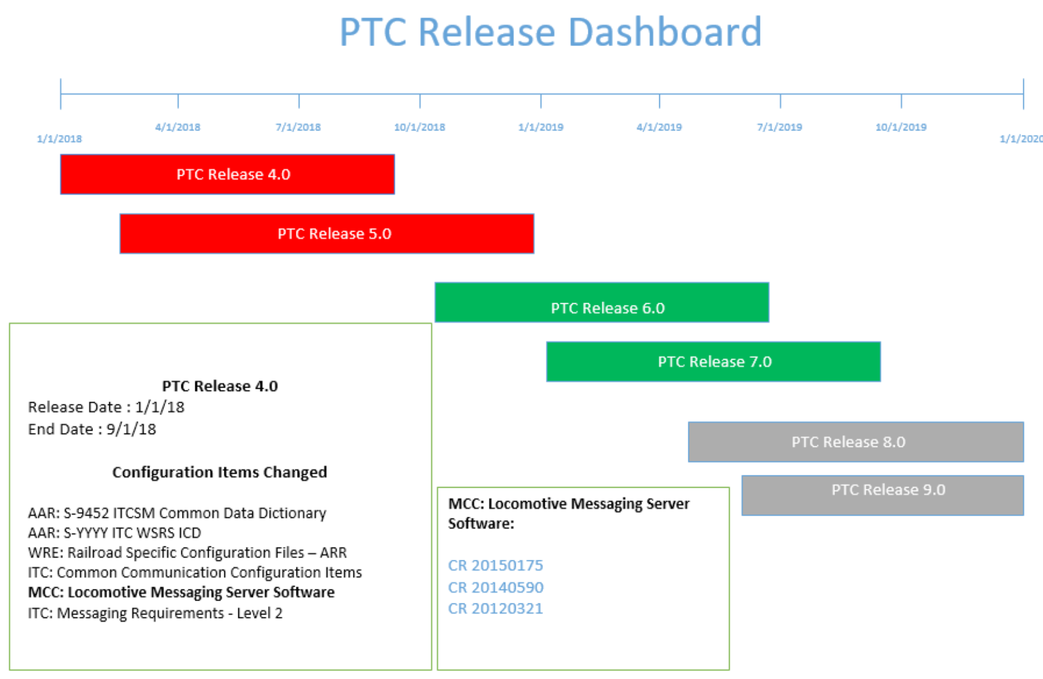
- Support interoperability between PTC railroads with tools to maintain compatibility of versions of configuration items (CIs) and manage changes throughout the system lifecycle.
- Provide visibility to all interoperable railroads on scheduling and changes for upcoming releases of PTC CIs.
- Enable standardized tracing of new and changing PTC requirements to PTC test cases to reduce potential defects found after deployment.
- Manage changes to PTC CIs, including impacts on other CIs.

PROJECT PARTNER(S)

- Transportation Technology Center, Inc. (TTCI)
- Class I freight railroads operating in the Northeast Corridor (NEC)
- Commuter and passenger railroads

PROJECT STATUS

- Completing the final report and Research Results, to be available on the FRA eLibrary by October 2018.



U.S. Department of Transportation

Federal Railroad Administration

FRA PROJECT MANAGER:

Richard Orcutt (719) 584-0507 richard.orcutt@dot.gov

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OFFICE OF RESEARCH, DEVELOPMENT & TECHNOLOGY

TRAIN CONTROL & COMMUNICATIONS

FOCUS: APPLIED RESEARCH | **FRA FUNDING:** $994,704

Northeast Corridor PTC Network Design

PROJECT DESCRIPTION

- Design of the 220 MHz radio frequency (RF) network for the Northeast Corridor (NEC), including the following:
  - Data gathering and railroad operation characterization for all railroads required to implement PTC on their tracks.
  - RF propagation simulation, frequency and timeslot plan design for all Interoperable Train Control (ITC) sites (i.e., wayside interface units, or WIUs, and base stations).
  - Resolution of interference and radio desensing issues between ITC and ACSES radio sites and between ITC and incumbents that operate in the 220 MHz spectrum range.

RAILROAD IMPACT

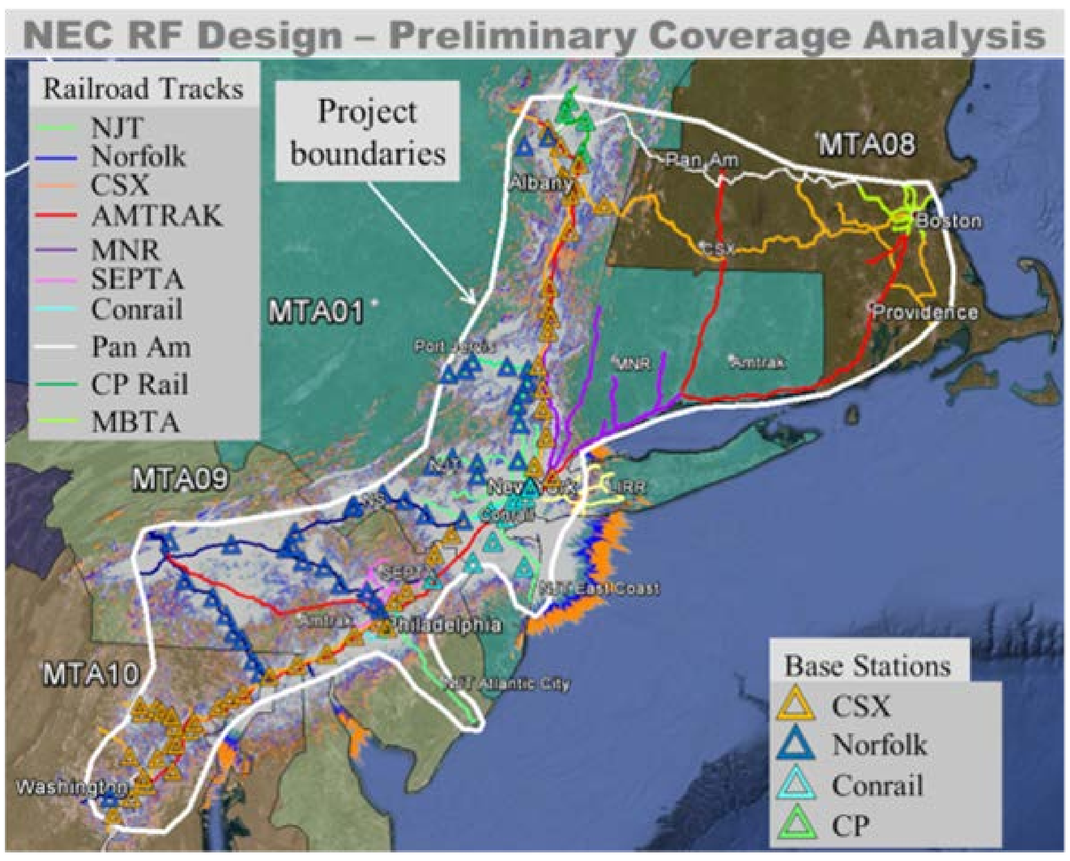
- Optimization of ITC 220 MHz radio resources (i.e., spectrum and base station sites).
- Prevention of operation downgrade due to inadequate ITC radio system design (e.g., coverage gaps and radio interference).
- Seamless and transparent ITC radio operation across multiple PTC-controlled territories controlled by different railroads.
- Prevention of interference with incumbents operating in the 220 MHz spectrum range and with ACSES radio systems.

PROJECT PARTNER(S)

- Transportation Technology Center, Inc. (TTCI)
- Class I freight railroads operating in the NEC
- Commuter and passenger railroads

PROJECT STATUS

- Completing the final report and Research Results, to be available on the FRA eLibrary soon.



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Federal Railroad Administration

FRA PROJECT MANAGER:

Richard Orcutt (719) 584-0507 richard.orcutt@dot.gov

TRAIN CONTROL & COMMUNICATIONS

FOCUS: APPLIED RESEARCH | **FRA FUNDING:** $813,361

Evaluation of Fiber Optic (FO) Broken Rail Detection Systems

PROJECT DESCRIPTION

- Identify vendors with FO-based broken rail detection systems.
- Install systems on FO test bed on the High Tonnage Loop (HTL).
- Evaluate systems during Facility for Accelerated Service Testing (FAST) operations.
    - Identify false negatives, false positives, detected broken rails.
- Perform gap analysis between conventional track circuits and FO systems.

RAILROAD IMPACT

- Gain an understanding of how current FO-based broken rail detection systems perform.
- Gap analysis that shows what current fiber optic systems can and cannot do with regards to conventional track circuits.
- Paths forward for fiber optic systems to fill in areas from gap analysis.

PROJECT PARTNER(S)

- Transportation Technology Center, Inc. (TTCI)
- Class I freight railroads
- Commuter and passenger railroads

PROJECT STATUS

- Completing the final report and Research Results, to be available on the FRA eLibrary soon.

U.S. Department of Transportation
Federal Railroad Administration

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

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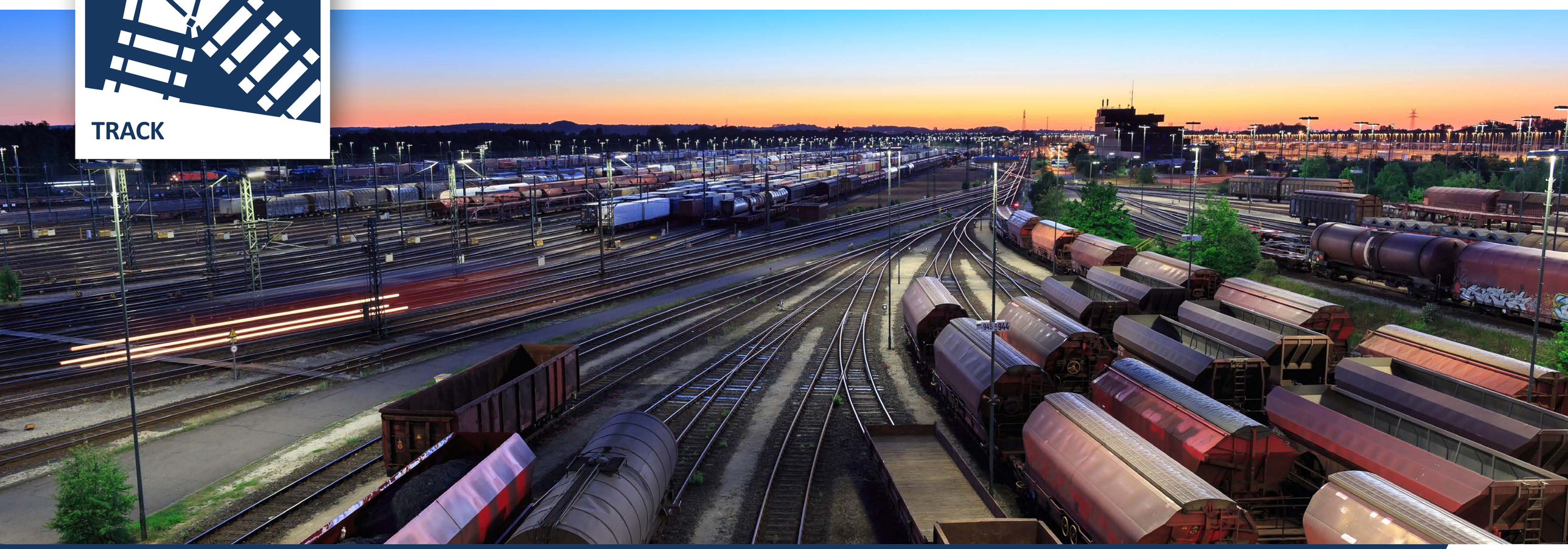


FOCUS: APPLIED RESEARCH | **FRA FUNDING:** $1,440,496

Reduced Performance Ballast Study

PROJECT DESCRIPTION

- Cooperative research project between the AAR and the FRA to better define reduced performance of fouled ballast through observation of the full ballast deterioration cycle while subject to controlled conditions and other safety measures.
- Investigate track geometry deterioration rates and determine criteria, including track geometry limits, that might be used to manage fouled ballast conditions in a class-specific manner.
- Research program has been implemented as part of a waiver from 49 C.F.R. § 213.103: Ballast on BNSF's Creston and St. Joseph subdivisions in the Heartland Division. BNSF began operations under the waiver on June 12, 2017.

RAILROAD IMPACT

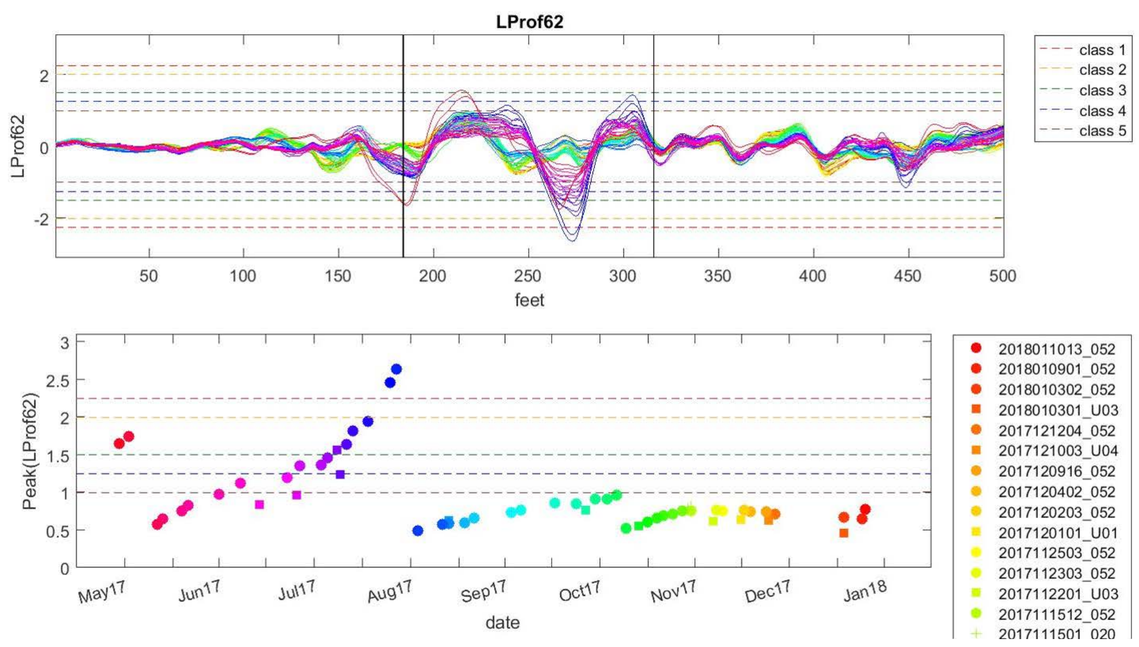
- Demonstration of an alternative class-specific approach to management of fouled ballast as opposed to the current enforcement mechanism that requires remedial action within 30 days.
- Better understanding of "reduced performance" or "fouled" ballast under a range of weather conditions and its affect on track performance and safety critical conditions.
- Produce information for data-driven recommendations related to enforcement and potential revision of §213.103 of the Track Safety Standards.
- Improve railroad safety and streamline maintenance practices.

PROJECT PARTNER(S)

- Burlington Northern Santa Fe railway (BSNF)
- Association of American Railroads (AAR)
- ENSCO, Inc.
- FRA Region 6
- Volpe National Transportation Systems Center
- University of Illinois at Urbana-Champaign (UIUC)

PROJECT STATUS

- BNSF started operations under the ballast waiver on June 12, 2017.
- Almost 300 fouled ballast locations have been documented and monitored.
- Almost 30,000 miles of track geometry measurements have been collected by FRA and BNSF track inspection vehicles on the waiver territory.
- Weekly track geometry reports are provided to BNSF and FRA to ensure safe operations.
- Six long-term wayside monitoring sites have been instrumented to provide a more comprehensive evaluation of the fouled ballast locations.



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Federal Railroad Administration

FRA PROJECT MANAGER:

Hugh Thompson (202) 493-6383 hugh.thompson@dot.gov

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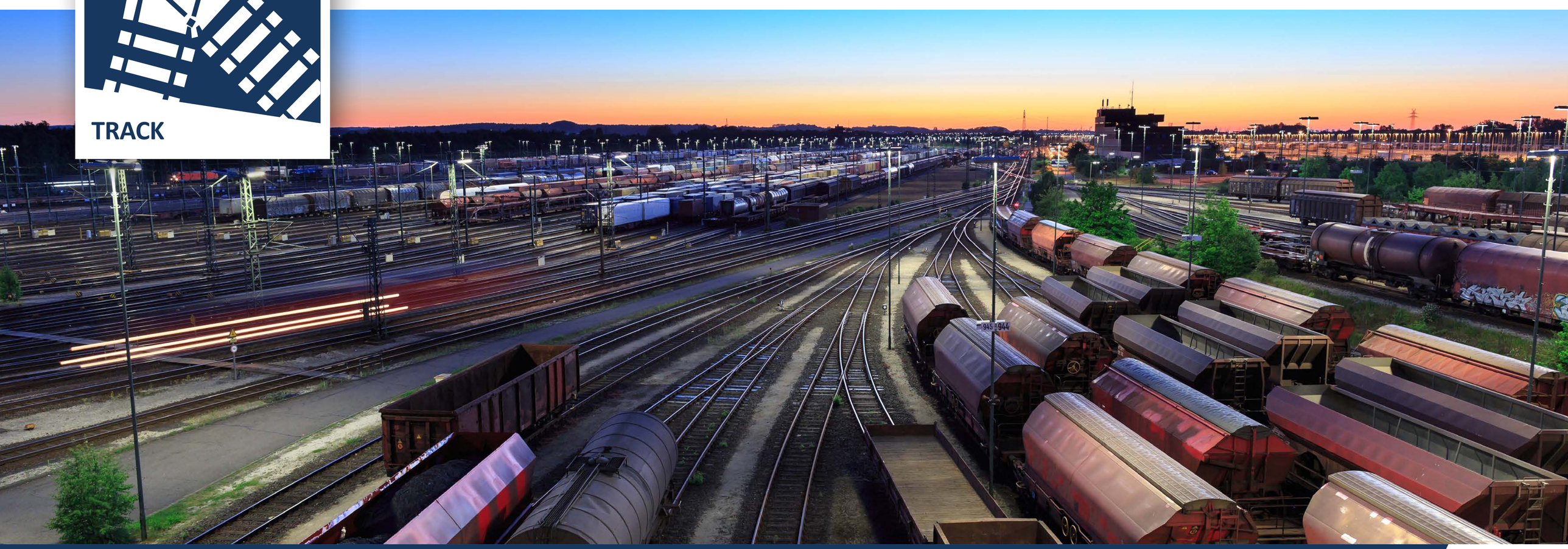
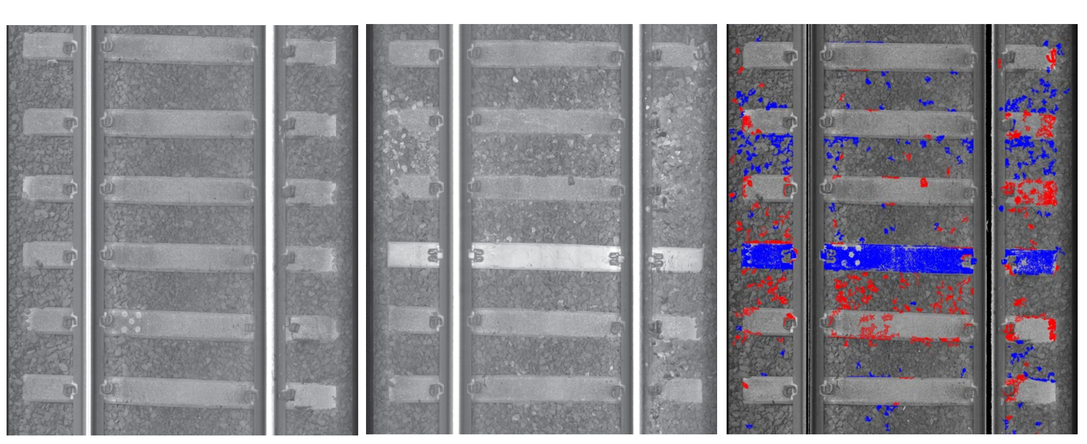


FOCUS: APPLIED RESEARCH | **FRA FUNDING:** $280,000

Automated Track Change Detecton

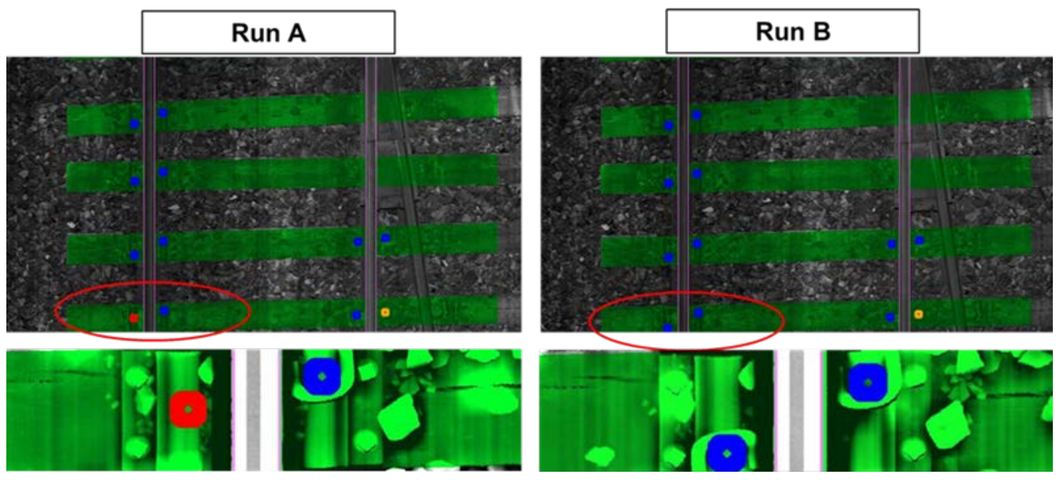
PROJECT DESCRIPTION

- Develop new technology to automatically detect relevant track condition changes and report these changes to decision makers.
- Leverage recent advancements in laser/camera measurement systems, image-capture technology, and automated processing algorithms to develop systems for feasibility testing.
- Develop technological framework for advancing change detection technology to practical application for track safety assurance.



RAILROAD IMPACT

- System reports safety-related changes in track condition that are not normally reported by metrology cars.
- Modern change detection technology allows for efficient development of generalized algorithms that can detect change on a broad range of safety parameters.
- Automatic (and, eventually, autonomous) change detection delivers important data to railroad personnel without the need for manual processing.
- Useful for post-maintenance inspection quality assurance in addition to track degradation change detection.



PROJECT PARTNER(S)

- ENSCO, Inc. • Amtrak
- Exelis Visual Information Systems (Harris Corporation)
- Pavemetrics Systems, Inc.

PROJECT STATUS

- Two pilot projects completed in 2017 with ENSCO and Pavemetrics. Additional development planned for 2018.

U.S. Department of Transportation

Federal Railroad Administration

FRA PROJECT MANAGERS:

Cameron Stuart (202) 306-5326 cameron.stuart@dot.gov

Jay Baillargeon (719) 584-7155 jay.baillargeon@dot.gov

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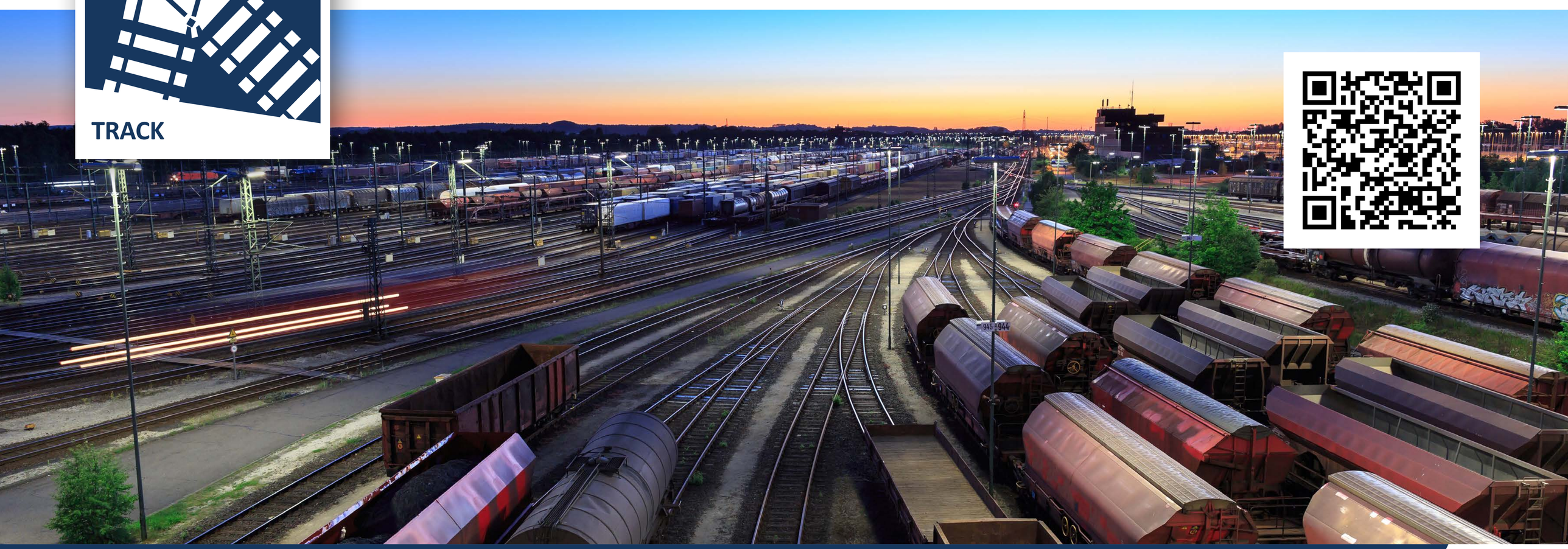


FOCUS: APPLIED RESEARCH | **FRA FUNDING:** $250,000

Improved Composite Tie Performance

PROJECT DESCRIPTION

- Developing and enhancing design, testing and performance guidelines for engineered-polymer composite (EPC) ties.
- Implementation into the AREMA Manual for Railway Engineering through collaboration with AREMA Committee 30 (Ties).
- Developing fatigue testing for EPC tie and fastener system.
- Material-level testing and characterization.
- NUCARS® and finite-element analysis (FEA) modeling of composite tie and fastener loading environment.
- In-track instrumentation and verification of models.

RAILROAD IMPACT

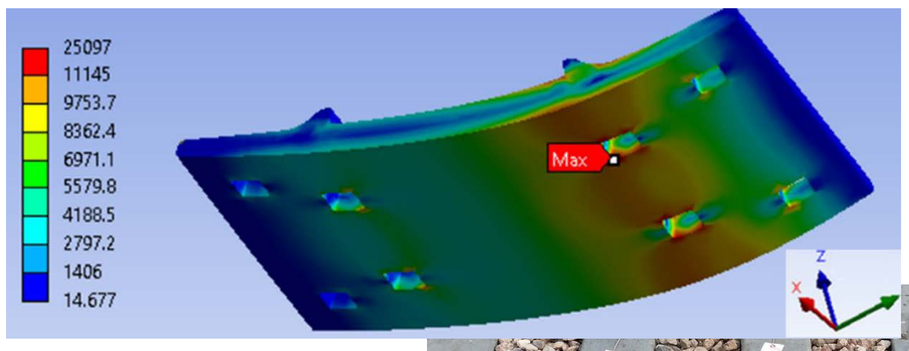
- Development of a safe alternative to wood crossties.
- Improved understanding of EPC tie performance in-track.
- Improved understanding of the integration with existing fasteners.
- Improved understanding of the EPC tie and fastener system loading environment.

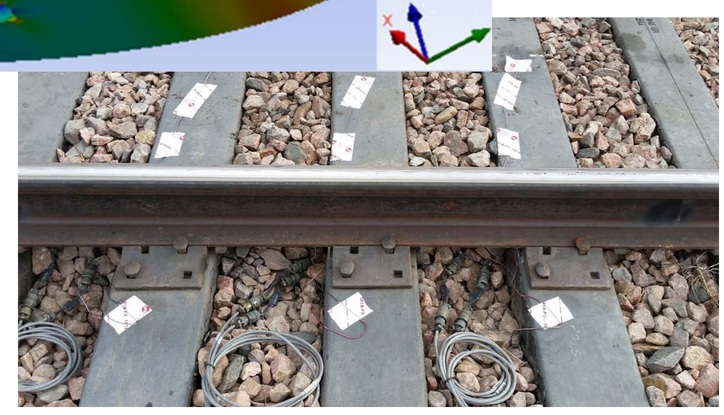
PROJECT PARTNER(S)

- Transportation Technology Center, Inc. (TTCI)
- Association of American Railroads

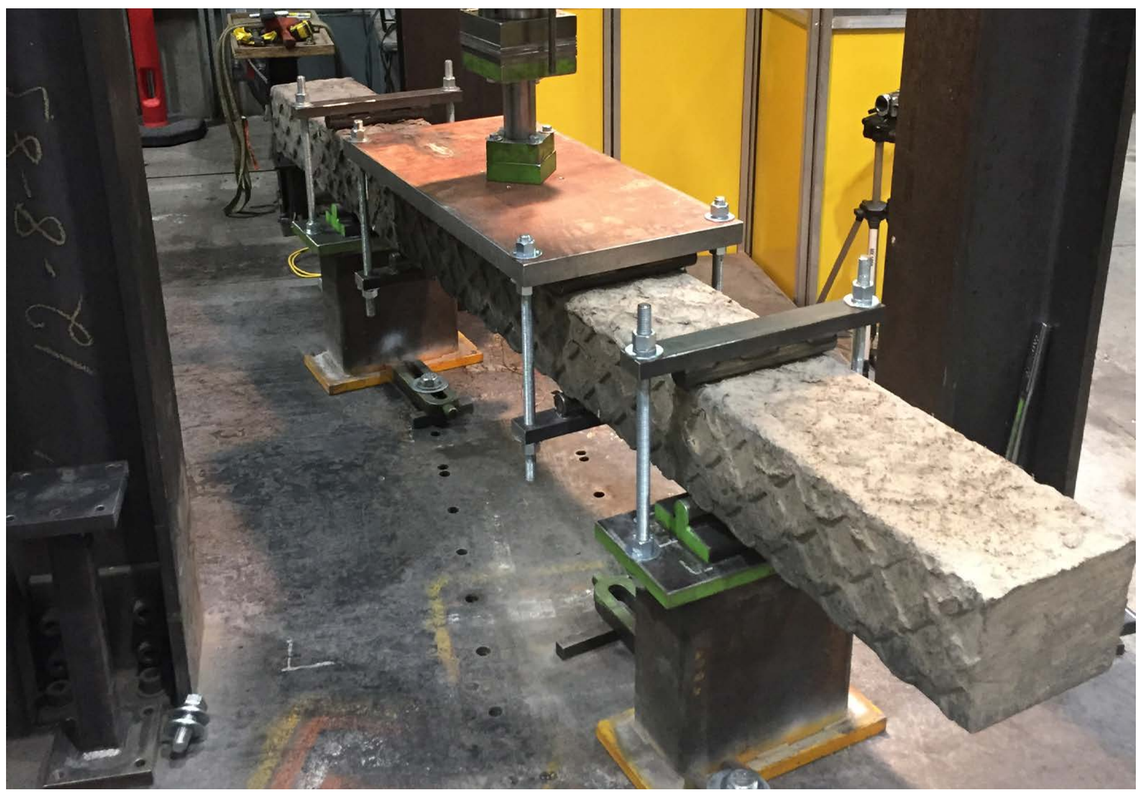
PROJECT STATUS

- Implemented improved bending stiffness/strength recommendations for EPC ties into AREMA Manual.
- Developing bending fatigue test recommendations for EPC ties.
- Completing the final report, to be available on the FRA eLibrary.





Typical location of peak stress in tie plate – 14-inch conventional AREMA tie plate on stiff EPC tie.



EPC Tie Fatigue Testing

U.S. Department of Transportation
Federal Railroad Administration

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

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OFFICE OF RESEARCH, DEVELOPMENT & TECHNOLOGY

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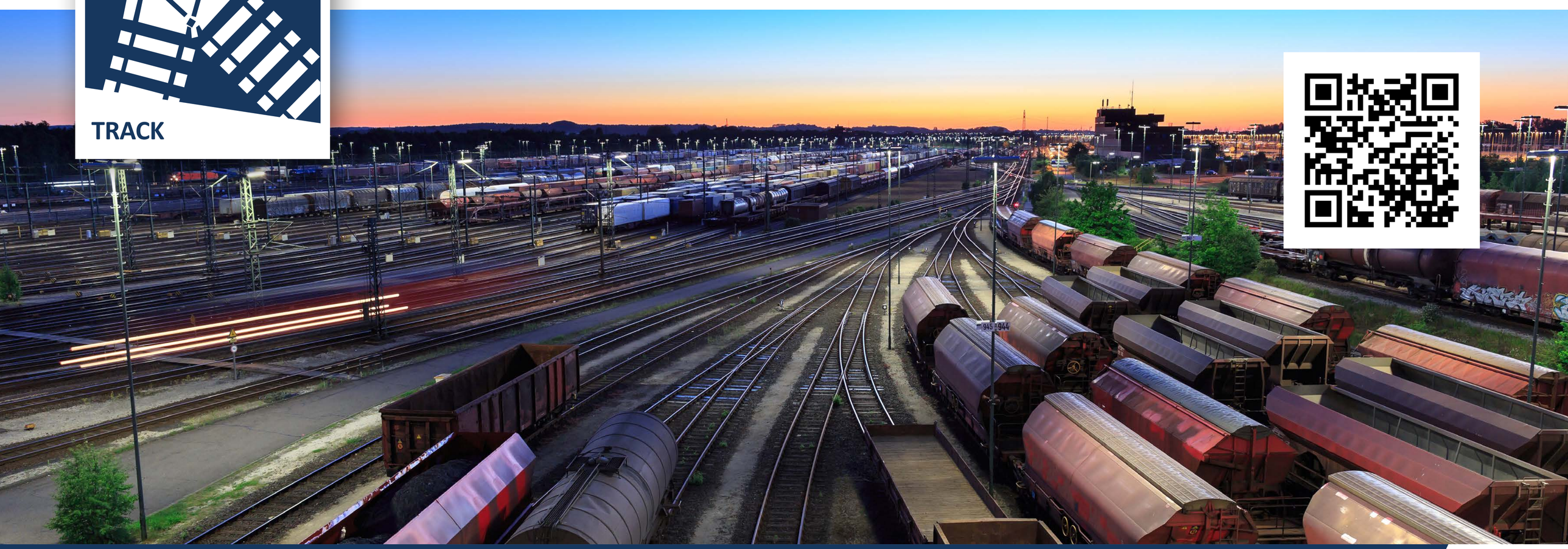


FOCUS: APPLIED RESEARCH | **FRA FUNDING:** $651,000

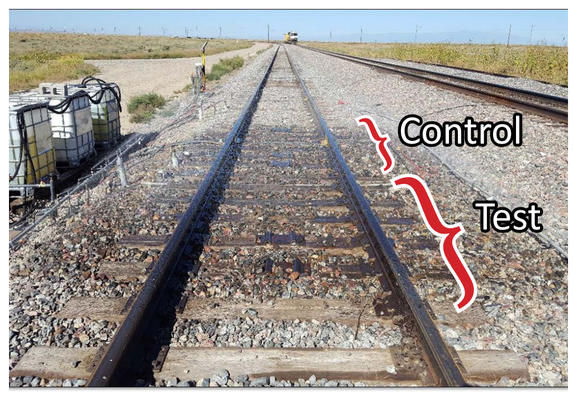
Heavy-Axle-Load (HAL) Research & In-Track Testing

PROJECT DESCRIPTION

- Provide an opportunity to evaluate HAL track infrastructure under a diverse range of track, operational and climatic conditions.
- Optimize the effectiveness of HAL testing by placing experiments in track segments with representative HAL operating environments.
- Current studies/experiments include:
  - Improved In-Track Weld Performance.
  - Demonstration of Railhead Repair Weld Technologies.
  - Effects and Characterization of Moisture on Degraded Ballast.
  - Performance of Improved Frog Designs and Repair Strategies.

PROJECT STATUS

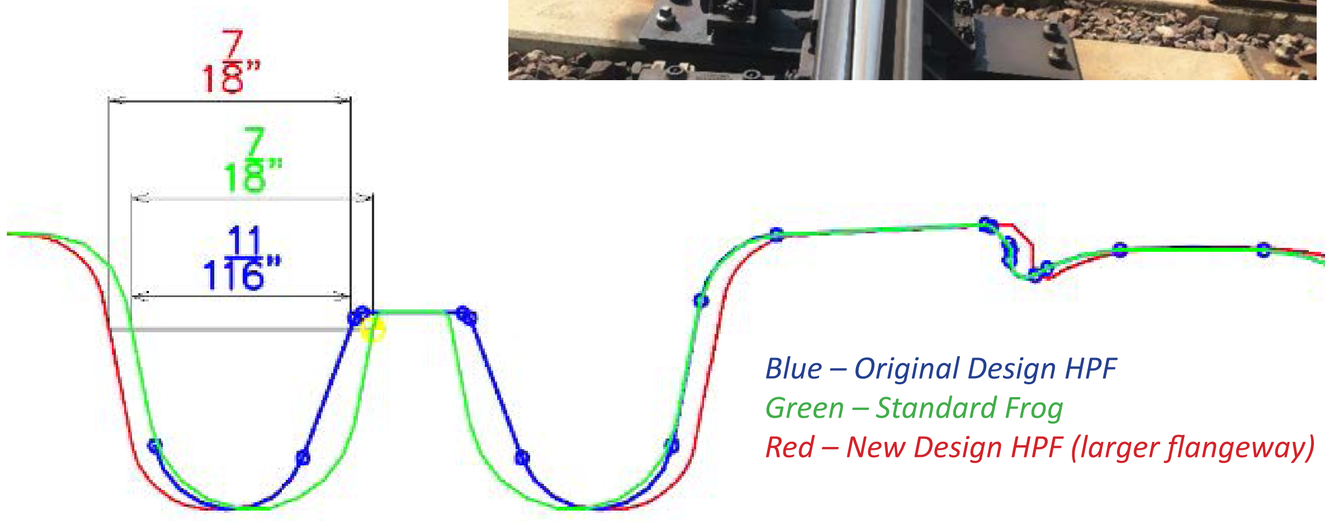
- Implementation of a new set of experiments at the Facility for Accelerated Service Testing (FAST) and the revenue service mega sites is currently underway.
- Two Research Results to be available on the FRA eLibrary:
  - "Settlement of Fines-Contaminated Ballast"
  - "Drainage Characteristics of Fines-Contaminated Ballast"



"Rainy Section" Test Layout to Mimic Mud Pumping Conditions

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-related accidents.
- Safer and more and reliable infrastructure for heavy-haul freight transportation.



Heavy-Point Frog (HPF) Performance Evaluation – Base Case and Modified Frogs

PROJECT PARTNER(S)

- Transportation Technology Center, Inc. (TTCI)
- Association of American Railroads
- Union Pacific Railroad
- Norfolk Southern Railway

U.S. Department of Transportation

Federal Railroad Administration

FRA PROJECT MANAGER:

Jay Baillargeon (719) 584-7155 jay.baillargeon@dot.gov

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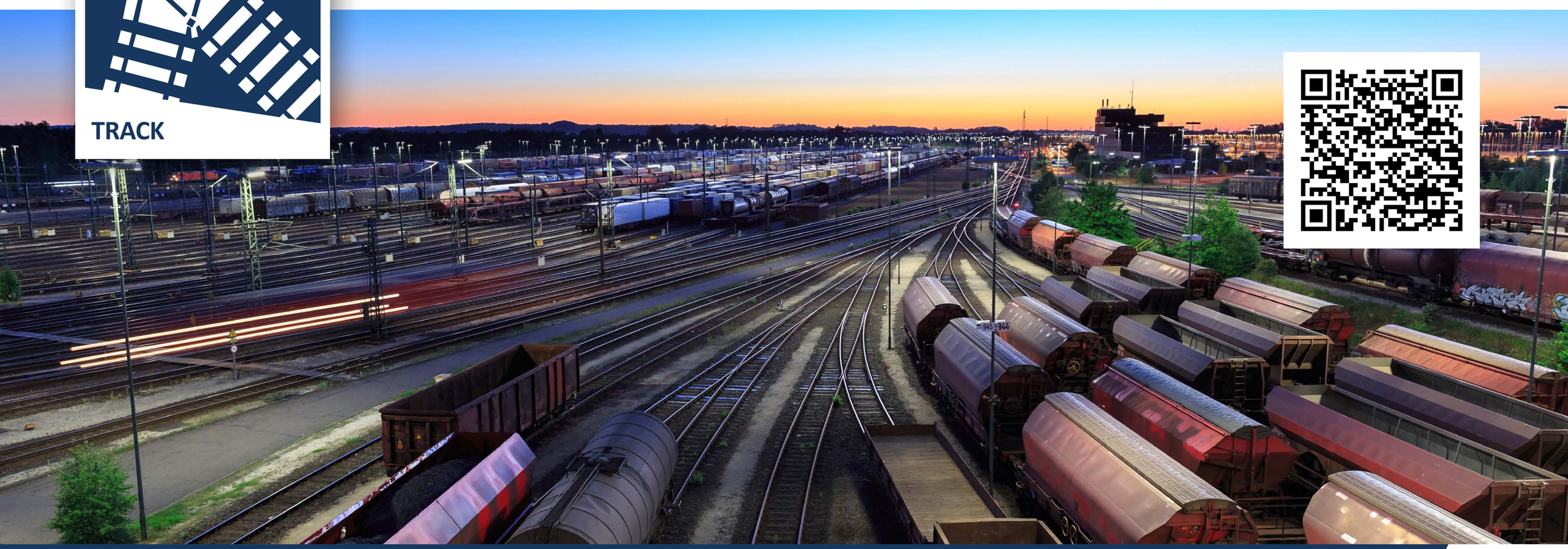


FOCUS: DEVELOPMENT | **FRA FUNDING:** $274,962

High-Speed Rail Inspection by Passive Acoustic Monitoring

PROJECT DESCRIPTION

- Uses non-contact acoustic sensors and signal processing algorithms to detect internal defects in rails by exploiting the acoustic excitations naturally induced in the rail by the wheels of a moving train.
- In 2016, tests were conducted on the Railroad Test Track (RTT) at the FRA's Transportation Technology Center (TTC) using a prototype designed by UCSD and installed under the DOTX-216 Test Car operated by ENSCO.

RAILROAD IMPACT

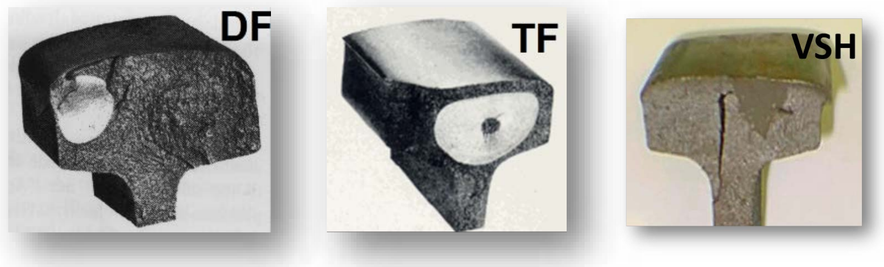
- This passive rail inspection technology would enable higher testing speeds, well beyond the ~ 25 mph maximum speed currently allowed by conventional (e.g., roller search unit, or RSU, based) rail inspection cars.
- This technology could be installed on regular trains to enable multiple redundant inspections of the same track, thereby improving the inspection reliability and, ultimately, the safety of transportation.

PROJECT PARTNER(S)

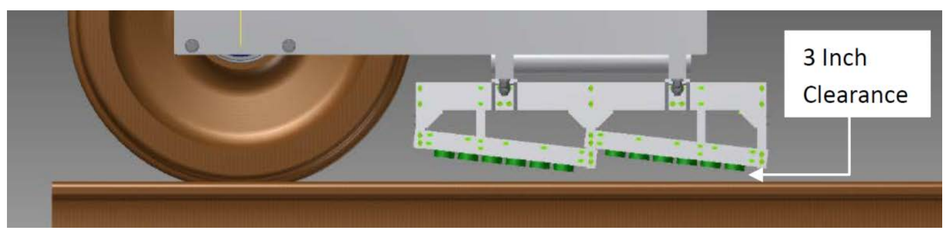
- University of California San Diego (UCSD) • ENSCO, Inc.
- Transportation Technology Center, Inc. (TTCI)

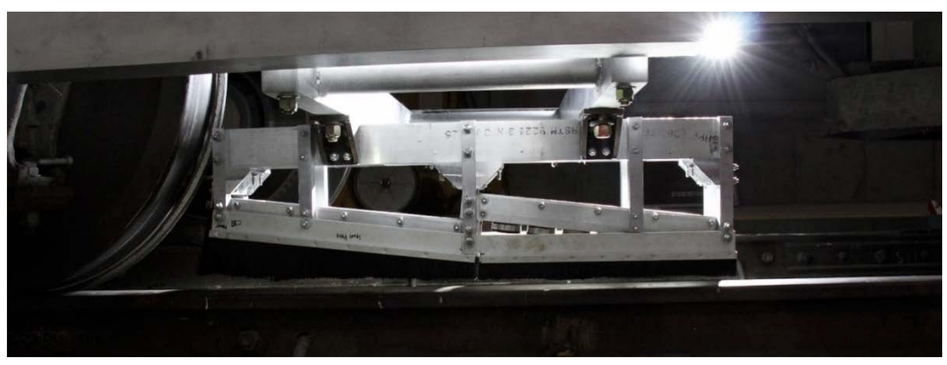
PROJECT STATUS

- Phase 2 is getting underway and will involve the construction of a second-generation prototype which will be extensively tested on the High Tonnage Loop (HTL) track at TTC.

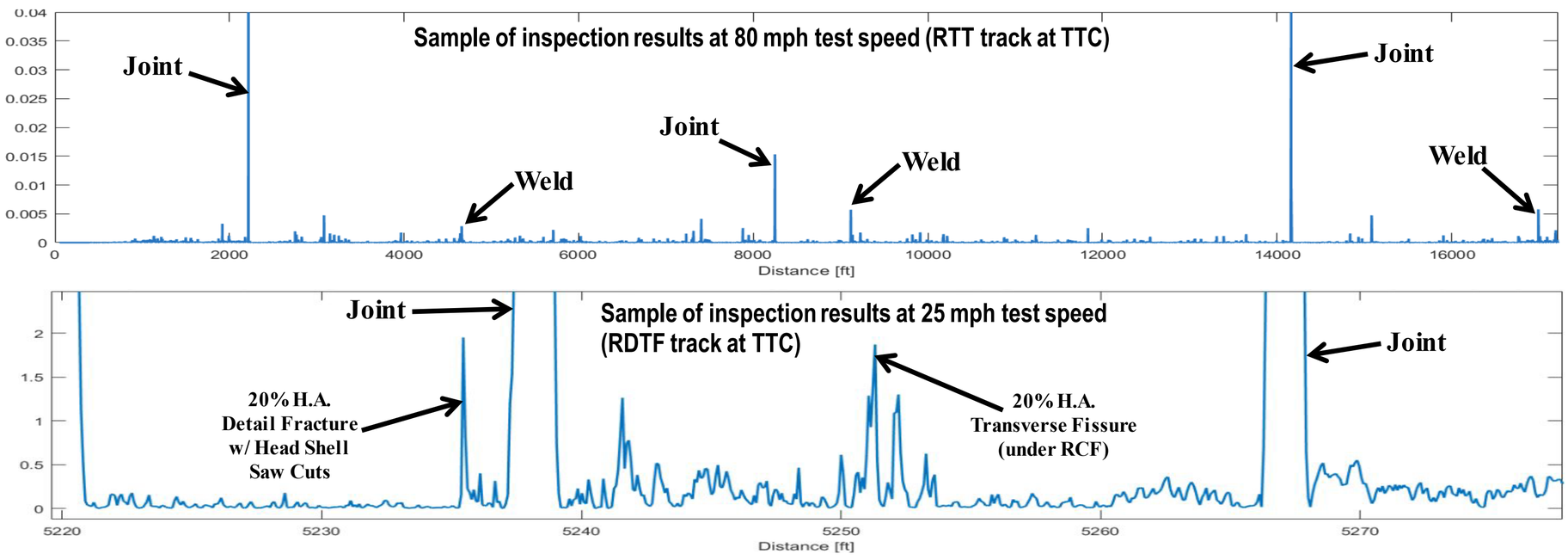


Examples of rail flaws relevant to safety (Left to right: Detail Fracture, Transverse Fissure, and Vertical Split Head)





2016 Passive-only rail inspection prototype on DOTX-216 car



U.S. Department of Transportation

Federal Railroad Administration

FRA PROJECT MANAGER:

Robert Wilson, Ph.D. (617) 494-2265 robert.wilson@dot.gov

FEDERAL RAILROAD ADMINISTRATION

OFFICE OF RESEARCH, DEVELOPMENT & TECHNOLOGY

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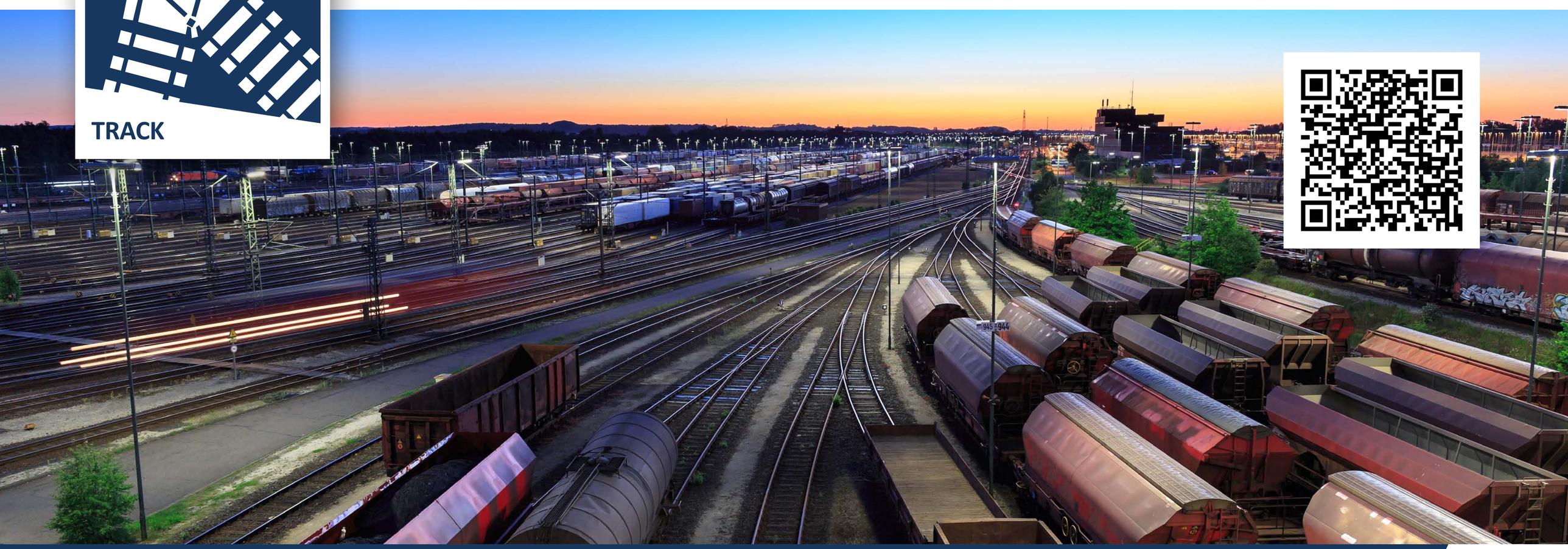


FOCUS: DEVELOPMENT | **FRA FUNDING:** $149,024

Rail Flaw Identification by Ultrasonic Imaging

PROJECT DESCRIPTION

- Developed a non-destructive evaluation tool to image internal rail flaws in quasi real-time for objective identification of defect size and orientation.
- Utilizes an improved Synthetic Aperture Focus Technique for quasi real-time ultrasonic imaging.
- Ultrasonic imaging algorithm was tested on four rail sections from FRA's Rail Defect Library at the Transportation Technology Center (TTC) with varying natural and man-made defect sizes, orientations, and locations.

RAILROAD IMPACT

- Improved current hand verification techniques (A-scan system) for robust rail flaw sizing.
- Increased safety through objective sizing of rail flaws for accurate defect severity categorization.
- Reduced maintenance cost from well-informed decision making in response to flaw severity.

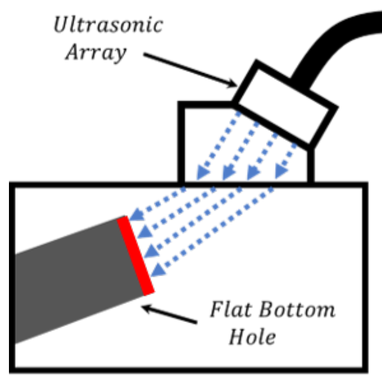
PROJECT PARTNER(S)

- University of California, San Diego (UCSD)
- Transportation Technology Center, Inc. (TTCI)

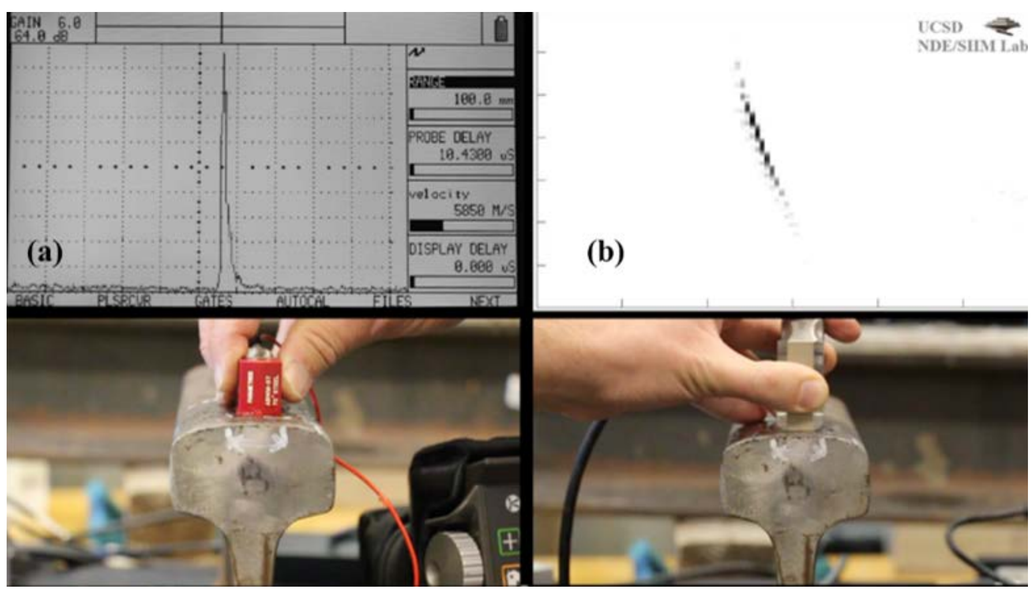
PROJECT STATUS

- Phase 3 is complete and 2-D rail flaw imaging has been demonstrated in real-time. Phase 4 is starting and will focus upon automatically generating 3-D flaw images.

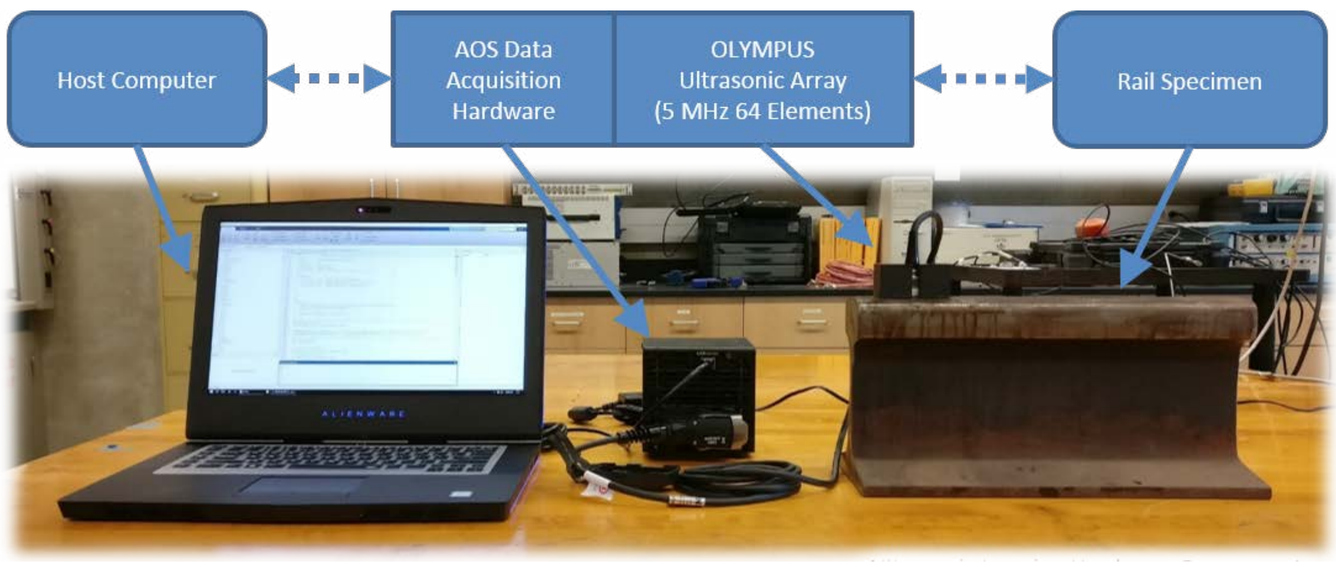
Rail Flaws to Image: Transverse Fissure



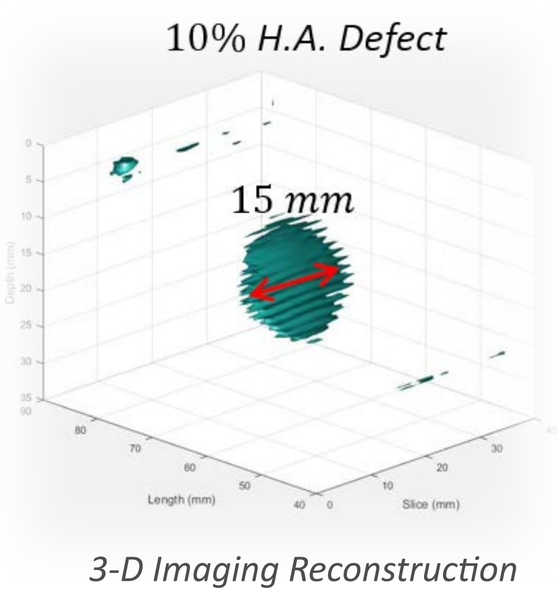
Imaging Schematic



(a) Traditional Ultrasonic A-Scan System and (b) Ultrasonic Imaging System



Ultrasonic Imaging Hardware Components



3-D Imaging Reconstruction

U.S. Department of Transportation

Federal Railroad Administration

FRA PROJECT MANAGER:

Robert Wilson, Ph.D. (617) 494-2265 robert.wilson@dot.gov