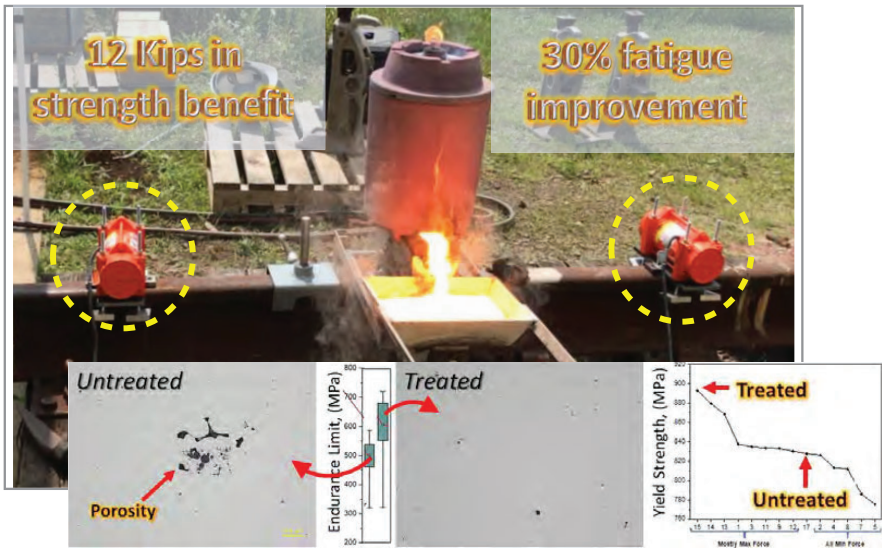
An In-Track Apparatus to Improve Thermite Weld and Rail Integrity

PROJECT DESCRIPTION

- Extend rail life and reduce weld failures through improvements of thermite welds with higher strength and fatigue performance.
- Minimize thermite weld porosity and refine grains by mechanical vibration during weld casting.
- Develop a prototype instrumented thermite weld treatment device for in-track use.
- Perform full-scale AREMA bend weld test and tensile test.
- Determine tensile, fatigue, fracture toughness, and wear properties under laboratory conditions.
- Test in-track at Union Pacific.



RAILROAD IMPACT

- Extend rail life and improve track safety through significant enhancement of thermite weld strength and fatigue life.
- Decrease track delays and labor costs with new methods to cast thermite welds.
- Develop an FRA/AREMA suitable device for easy in-track implementation.

COST & SCHEDULE

- Funding, FY22–23: $385,047
- Funding, FY24: $153,405 – option
- Project Duration: September 2022 – September 2024

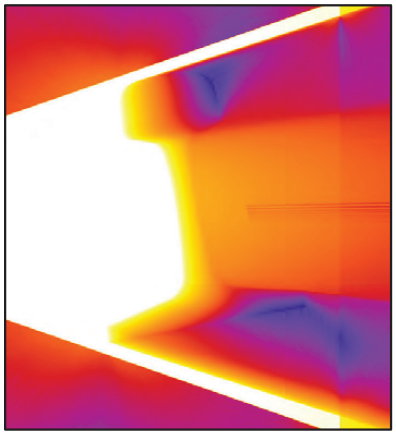
PROJECT PARTNERS

- University of Houston
- Orgo-Thermit, Inc.
- Union Pacific Railroad
- A & K Railroad Materials, Inc.

Radiographic Inspection of Rail Welds

PROJECT DESCRIPTION

- Detect and locate both voids and solid impurity defect nucleation sites within rail welds.
- Apply cutting-edge x-ray source and detector technologies.
- Research high resolution, high dynamic range, and dual energy X-ray inspection capabilities.
- Create a database of rail weld images for data-driven regulatory guidance of weld inspection.
- Create a reference design for a radiographic rail weld inspection system.



RAILROAD IMPACT

- Create a path for radiographic inspection of rail welds.
- Reduce rail weld failures and improve infrastructure by performing robust radiographic non-destructive testing on rail welds.

PROJECT PARTNERS

- University of Tennessee, Knoxville Nuclear and Radiological Engineering Department

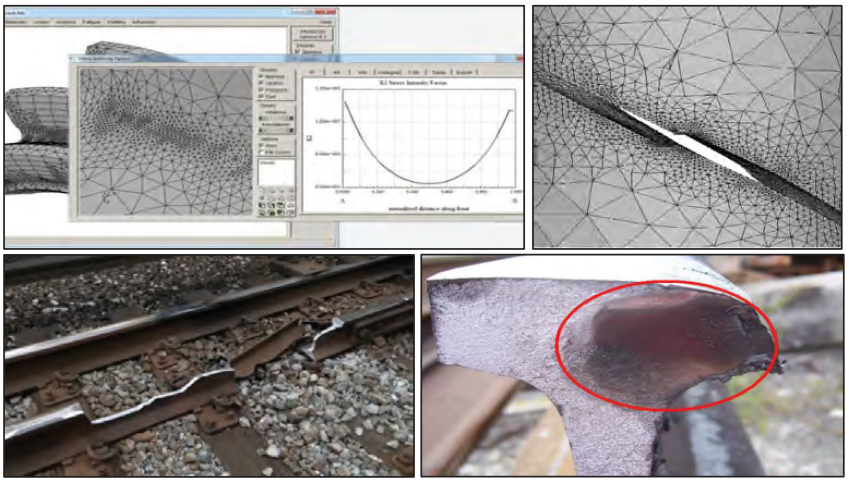
COST & SCHEDULE

- Funding, FY22–23: $384,816
- Project Duration: September 2022 – September 2024

Physics-based Predictive Modeling of Rail Failures Due to Internal Defects

PROJECT DESCRIPTION

- Develop an artificial intelligence-based predictive model of rail failures based on internal defect growth to enhance proactive maintenance strategies.
- Apply fracture mechanics modeling to determine regressor strengths.
- Integrate both physical contributors and external factors to forecast time to rail failure for a known defect size.
- Develop a plan for implementing the resulting predictive model as an additional component within the FRA's CWR-Risk software application.



RAILROAD IMPACT

- Effectively minimize the occurrence of service failures on the nation's rail network.
- Improve continuously welded rail management practices and enable more effective maintenance and capital planning.
- Provide a valuable tool to aid in future rail integrity rulemaking processes.

PROJECT PARTNERS

- ENSCO, Inc.
- Canadian Pacific Railway

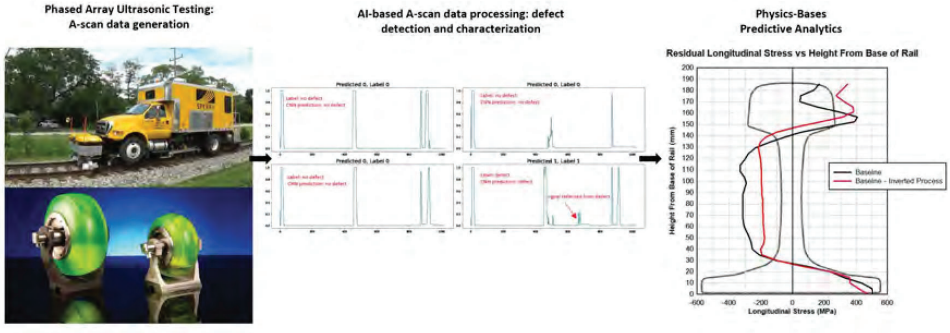
COST & SCHEDULE

- Funding: $354,531
- Project Duration: September 2022 – March 2024

Real-time Defect Characterization and Physics-based Remaining Life Prediction

PROJECT DESCRIPTION

- Develop a framework for real-time rail internal defect characterization and prediction of the remaining useful life of the rail. This entails:
  - Machine learning-based algorithms to automatically process ultrasonic A-scan data from inspection vehicles
  - A physics-based (i.e., fracture mechanics) analysis for the remaining useful life of the rail based on the current state of the internal defect
- Build upon previous FRA-funded efforts in rail internal defect modeling and simulation.
- Focus on transverse rail defects, which account for a large percentage of defects found in revenue service.



RAILROAD IMPACT

- Detect transverse defects in real time and characterize at track inspection speeds.
- Reduce human intervention and, in turn, improve overall efficiency and accuracy of transverse defect detection and characterization.
- Identify and prioritize repair of safety-critical defects to prevent rail-related failures and, in turn, derailments on the nation's railways.

PROJECT PARTNERS

- Thornton Tomasetti
- Sperry Rail Service
- David Jeong, Ph.D. (Independent Consultant)
- University of Utah

COST & SCHEDULE

- Funding: $475,003
- Project Duration: September 2022 – September 2024

Advances in Rail Integrity Inspection

PROJECT DESCRIPTION

- Evaluate, maintain, and support activities related to rail integrity efforts at FRA's Transportation Technology Center (TTC).
- Collect and add naturally occurring rail flaws (unbroken) to FRA's Rail Flaw Library and Rail Defect Testing Facility (RDTF) at TTC.
- Support lending of samples from Rail Flaw Library to requestors for the advancement of rail-flaw inspection technologies.
- Develop a new high-speed RDTF at TTC capable of supporting testing of new rail-flaw inspection technologies up to 90 mph.
- Build and maintain a world-class metallurgical laboratory at TTC.
- Support third-party rail integrity testing at TTC.

RAILROAD IMPACT

- Improve the reliability of non-destructive evaluation techniques for complete rail-flaw detection and characterization.
- Provide the industry with a safe, controlled, and realistic environment for developing and evaluating new and innovative rail-flaw inspection technologies.
- Support ground-breaking research aimed at improving rail-flaw inspection.
- Advance rail integrity research and metallurgical testing capabilities at TTC.
- Reduced broken rail derailments through better rail performance, defect detection, and operating practices.

PROJECT PARTNERS

- ENSCO, Inc.
- North American Class I and Shortline/Regional Railroads

COST & SCHEDULE

- Funding: $ 394,310
- Project Duration: October 2022 – October 2024