Integrated Wheel/Rail Characterization through Advanced Monitoring and Analytics

Background

A multi-member collaborative research team led by the New York City Transit (NYCT) Office of Strategic Innovation and Technology and hosted by the NYCT Department of Subways Maintenance of Way Track Engineering and Car Equipment Engineering groups was awarded a multi-year research grant from the FTA Office of Research, Demonstration and Innovation to demonstrate machine-vision enabled wheel/rail characterization and analytics to enhance operational safety and system resiliency using a unique suite of state-of-the-art automated data collection equipment.

Objectives

The project goal was to prove the concept that it is both technically-feasible and cost-effective to implement and operate an automated, digital data-based information system incorporating analytics that provide information that can be used to foster decisionmaking associated with wheel and track condition monitoring and condition-based maintenance.

Findings

Use of automated data acquisition equipment can lead to the implementation of new and improved safety and maintenance standards and processes and enhance system safety and resiliency.

- A unique suite of state-of-the-art automated data acquisition equipment was employed for the project, including:
  In-track automated laser wheel scanning (WheelScan®) equipment at the Corona Car Wash on NYCT's #7 Flushing Line
- Wayside Lateral over Vertical forces (L/V) and Truck Bogie Optical Geometry Inspection (TBOGI) data acquisition devices located N/O 103rd St Station on the #7 Line
- On-board automated track inspection technology (existing) on the NYCT Track Geometry Car (TGC)
- An 11-car Research Data Collection Consist (DCC) in regular revenue service equipped with on-board accelerometers, acoustic and propulsion energy recording devices, and a bogie equipped with two instrumented wheel sets (IWS)

Selected specific findings of the research include the following:

- Two restraining rail climb derailments led to a focus on the interaction of new and worn wheels with restraining rail components.
- Higher train speeds through restrained curves and turnouts increase wheel forces and derailment risk.
- Review of the rail profiles suggest that the high rail is consistently over-relieved from the template at the gauge corner.
- High recurrence of rail grinding for removal of track corrugations can be eliminated.
- Significant reductions in wheel/rail forces and vibration amplitudes discovered during wet weather suggest that considerable benefit could be achieved through the use of friction modifiers and enhanced application of friction management approaches.

Research progress was disseminated at over a dozen presentations at US industry conferences, and through trade journal articles and open WebEx meetings. The University of Delaware's Railroad Engineering and Safety Program conducted an independent third-party evaluation of the project and concluded that it was a successful demonstration of the implementation and potential use of selected instrumentation and measurement systems; based on the results of the project, UD made a number of recommendations for follow-up research.

Benefits

Enhanced management of the subway car wheel set profiles, track maintenance, and knowledge of the conditions of the wheel/rail surface contact, the benefits identified as a result of using the analytics are improved operational safety, enhanced system resiliency, post-event system service recovery, condition-based maintenance, and optimized propulsion energy use. The value of the research and evidence of potential for swift recapture of the research project investment was demonstrated within the first two years following initiation of the research work. Follow-up research efforts will be needed to take full advantage of the findings and continued data collection and analysis.

Project Information

FTA Report No. 0145

This research project was conducted by New York City Transit. For more information, contact FTA Project Manager Raj Wagley at 202-366-5386 or Raj.Wagley@dot.gov. All research reports can be found at **https://www.transit.dot.gov/about/research-innovation**.