Track Intrusion Detection and Track Integrity Evaluation: Year 2

Deliverables and Reporting Requirements for UTC Grants Awarded in 2023 (June 2023)

Exhibit D

Recipient/Grant (Contract) Number: University of Texas Rio Grande Valley (UTRGV)/Grant No. 69A3552348340

Center Name: University Transportation Center for Railway Safety (UTCRS)

Research Priority: Promoting Safety

Principal Investigator(s): Yu Qian (PI, University of South Carolina (USC)), Dr. Dimitris Rizos (Co-PI, USC), and Dr. Nikolaos Vitzilaios (Co-PI, USC)

Project Partners: N/A

Research Project Funding: $69,705 (Federal), $33,568 (Non-Federal Cost Share)

Project Start and End Date: 06/01/2024 to 08/31/2025

Project Description: Other than train collisions, track intrusion (also referred to as track fouling) is the major factor causing railroad accidents, especially at the railroad-highway crossings. According to the Report to Congress "National Strategy to Prevent Trespassing on Railroad Property" issued by the Federal Railroad Administration, trespassing is currently the number one cause of all railroad-related deaths. The number of fatalities due to trespassing, including both illegally entering and remaining in the railroad right-of-way, is even higher than the number of fatalities due to collisions between vehicles and trains. The impact of loss of lives, but also the financial and societal impact associated with those accidents, is enormous. The FRA report indicated that the accidents during the period 2012-2016 have cost $43 billion to our nation. Unfortunately, at present there is no dedicated system to tackle the issues associated with trespassing or other anomalous situations (e.g., suicide) and enhance railroad safety. Instead, current track intrusion relies on high-rail inspection which is labor-intense and requires significant track time. Clearly, there is an urgent need to develop practical solutions to identify track intrusion and mitigate risks of potential accidents. Railroad crossings are the locations where most of the trespassing has taken place, and almost three quarters of all trespassing events were located within 1000 feet of a crossing. This is largely due to the fact that pedestrians and vehicles alike cross the track through grade crossings. Therefore, it is a higher priority to address trespassing within the grade crossing area. However, it should be noted that the proposed effort is also generally applicable to broader areas along the track that are far away from the crossings. With the development of UAVs, including autonomous UAVs, it is possible to develop an autonomous track intrusion detection and track integrity evaluation system to identify any track fouling conditions ahead of collision and share critical information to both railroads and local first responders in time to minimize loss due to a potential impact. The system will integrate a surveillance unit, a real-time communication unit, and a computer vision and deep-learning artificial intelligence (AI) unit on an edge computing platform. Furthermore, the proposed system will be integrated to the proposed Intelligent Aerial Drones for Traversability Assessment of Railroad Tracks project. The success of this research will significantly enhance situational awareness at the grade crossings or other installation locations, mitigate train collision risk, reduce local law enforcement workload, improve quality of life, and benefit all the stakeholders in industry and railroads, as well as local, state, and federal administration and legislation.

US DOT Priorities: This project implements robust measures to mitigate trespassing and track intrusion at railroad crossings that yield significant benefits across public safety, economic performance, and environmental sustainability. The following USDoT priorities are addressed: **(a) Safety**: By actively monitoring railroad crossings and nearby track segments, we can potentially reduce related accidents and fatalities, bolstering public confidence in rail transportation. **(b) Economic Strength:** These advancements can minimize costly service disruptions and maintenance requirements, and mitigate legal issues, thereby enhancing the efficiency of both freight and passenger operations. This also strengthens supply chain reliability, promoting a safer, more efficient

rail system.

Outputs: The expected products and deliverables include:

1. A tailored image training library for future track intrusion or track integrity detection model development.
2. An AI model that is customized to detect, classify, and track abnormal objects at the railroad crossing areas or the broader area along the track segment.
3. A prototype integrated hardware system for edge computing.
4. A report including performance validation results compared with other state-of-the-art models on track intrusion detection.
5. One or more conference or journal publications.

Outcomes/Impacts: The broader impact of this project implementing robust measures to mitigate trespassing and track intrusion at railroad crossings can yield significant benefits across public safety, economic performance, and environmental sustainability. By actively monitoring railroad crossings and nearby track segments, we can potentially reduce related accidents and fatalities, bolstering public confidence in rail transportation. Economically, these advancements can minimize costly service disruptions and maintenance requirements, and mitigate legal issues, thereby enhancing the efficiency of both freight and passenger operations. This also strengthens supply chain reliability, promoting a safer, more efficient rail system.

Final Research Report: Upon completion of the project, a URL link to the final report will be provided.