Optimizing Emergency Response: Intelligent Routing Decision Support System for First Responders at Rail Crossings

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): Yuche Chen (PI, University of South Carolina (USC)) and Yu Qian (Co-PI, USC)

Project Partners: N/A

Research Project Funding: $52,606 (Federal), $25,132 (Non-Federal Cost Share)

Project Start and End Date: 06/01/2024 to 05/31/2025

Project Description: This research project addresses critical challenges faced by emergency response teams operating at rail crossings, where suboptimal routing decisions can lead to increased risks and delays. Presently, a gap exists in dedicated Intelligent Routing Decision Support Systems designed for the unique challenges posed by incidents at rail crossings. The project recognizes the distinct characteristics of rail crossings, encompassing unpredictable train schedules, varied terrains, and potential traffic congestion, factors often overlooked by existing routing systems. In response, this research aims to develop and implement an Intelligent Routing Decision Support System, leveraging real-time data and advanced algorithms to provide first responders with optimized routes. The project focuses on mitigating inefficient routing, providing intelligent decision support tailored to rail crossing emergencies, and overcoming integration challenges associated with incorporating real-time data from rail systems, traffic conditions, and incident-specific information. By addressing these issues, the research project aspires to significantly enhance the overall effectiveness of emergency response teams, ensuring timely and safe interventions in incidents at rail crossings.

US DOT Priorities: This project aligns with the strategic goals outlined by the United States Department of Transportation, specifically addressing key facets: **(a) Safety:** The project focuses on enhancing the efficacy of routing decisions for first responding vehicles at rail crossings, with the potential to minimize time delays for responders and, consequently, contribute to life-saving outcomes. **(c) Equity:** The project directly involves the engagement of at least one minority student, fostering diversity within the research workforce and indirectly supporting the employment of several others. **(d) Sustainability:** The initiative aims to deliver an intelligent routing decision tool for first responders, incorporating an energy consumption calculation component for various routing paths. This information serves to enhance first responders' awareness of their vehicles' energy consumption. **(e) Transformation:** The project endeavors to develop an intelligent routing tool for first responders, specifically tailored for potential rail crossings. This tool seeks to revolutionize the current human decision-making paradigm, transitioning toward a data-driven approach to augment decision efficiency and reduce response times in the daily operations of first responders.

Outputs: The expected products and deliverables include:

1. A decision-making tool that is capable of estimating potential delay and travel time of first responding vehicles in different routes.
2. Final report including any DoT or UTCRS required information.
3. A prototype drone system with online processing capabilities.
4. One or more conference or journal publications. Submissions will be made to either the 2025 TRB

annual conference or Spring 2025 Joint Rail Conference (JRC) with intermediate results.

Outcomes/Impacts: This research itself, as well as the training of engineering students, will have impacts beyond the research outputs. **Research Impact:** Firstly, the development and implementation of an intelligent routing decision support system has the potential to substantially reduce response times for first responders at rail crossings. This, in turn, can enhance overall public safety by expediting the arrival of emergency services to critical incidents. Additionally, the project's focus on leveraging advanced technologies contributes to the evolution of intelligent transportation systems, setting a precedent for data-driven decision-making in emergency response scenarios. The dissemination of research findings through publications and conferences not only enriches the academic and professional discourse but also facilitates knowledge transfer to practitioners, influencing best practices in emergency response. Lastly, the potential incorporation of energy consumption considerations in routing decisions aligns with sustainability goals, offering insights into resource-efficient emergency response operations. **Educational Impact:** The project's commitment to diversity, as evidenced by the engagement of minority students, contributes to building a more inclusive research workforce. In summary, the project's broader impacts span improved public safety, advancements in intelligent transportation, knowledge dissemination, diversity enhancement, and alignment with sustainability objectives.

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