

Towards Building a Foundation AI Model for Railway Safety

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): Evangelos Papalexakis (PI, University of California Riverside (UCR)), Jia Chen (Co-PI, UCR), and Yue Dong (Co-PI, UCR)

Project Partners: Ping Xu (Collaborator, UTRGV)

Research Project Funding: \$95,000 (Federal), \$47,500 (Non-Federal Cost Share)

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

Project Description: Foundation models, including large language models (LLMs), are revolutionizing multiple aspects of everyday life and work, with the use of LLMs such as ChatGPT being now commonplace and transforming life, work, and scientific discovery as we know it. Despite impressive performances in conversations, such systems still suffer from hallucinations and pose safety risks, which are critical for domain-specific applications, such as railway safety. In this project, we propose to harness the power of such foundation models in order to transform railway safety, by building a foundation model that can support various critical tasks of railway safety practice, such as understanding and summarizing possible causes for an accident, comparing different accidents and understanding commonalities and risk factors, and coming up with policy recommendations that can improve safety in a grade crossing or a locality at large. To do so, we outline a number of fascinating and hard research challenges that need to be addressed, and as part of this one-year project, we set out to build a prototype proof-of-concept that will demonstrate the viability of foundation models for railway safety.

US DOT Priorities: This project aligns with five USDOT strategic priorities: **(a) Safety:** One of the goals of our foundation model is to provide recommendations for improving the safety of crossings, thereby reducing the number of accidents. **(b) Economic Strength:** Our proposed foundation model can empower the automation of a lot of labor-intensive tasks. **(c) Equity:** UCR and UTRGV are minority serving institutions with an established record of training students from underrepresented groups and placing them in professional positions in the transportation industry. This project will directly employ one student, and indirectly support the employment of several others. **(d) Sustainability:** By empowering the quick and accurate processing of vast amounts of information, our project can help railway safety professionals to be more efficient in their work. **(e) Transformation:** Our proposed work sits in the cutting-edge of AI research and by carrying out our research plan we will have to innovate in ways that not only advance railway safety research but also the state of the art in AI.

Outputs: Expected results and products include:

1. Research publications, targeted to top-tier data science, machine learning, and artificial intelligence venues.
2. Publicly available source code for the methods developed. Typically, each publication will be accompanied by a link to publicly available source code on a widely used repository such as GitHub.
3. Publicly available model weights for the foundation model we develop.
4. A select number of bearing components will be subjected to laboratory service life testing to quantify the inspection approach.

5. Publicly available model weights for the foundation model we develop.
6. Dissemination via seminars at universities and companies.

Outcomes/Impacts: The project's broader impacts are multi-pronged: (1) From a social good point of view, our proposed work has the potential to improve railway safety; (2) From the point of view of human resources and sustainability, the project has the potential to improve the way in which railway safety professionals operate, in government and industry. Success in our project will enable them to heavily rely on our AI foundation models in order to come up with summaries of existing knowledge or policy recommendations, a fact which can transform their work and productivity; (3) the project will provide educational opportunities to graduate and undergraduate students to be involved in cutting-edge AI and machine learning research.

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