# Using AI and Machine Learning to enhance the safety and operational efficiency of Railroad- Highway Crossings

**ABSTRACT**

Railroad-highway grade crossings (RHGCs) remain critical points of interaction between rail, vehicular, and pedestrian traffic, posing significant safety risks despite advancements in infrastructure. To address these challenges, this study presents a comprehensive framework leveraging Artificial Intelligence (AI) and Machine Learning (ML) to enhance safety and operational efficiency. Utilizing computer vision technologies, our approach enables the detection of vehicles, pedestrians, and obstacles under varying visibility conditions. We propose an innovative system that facilitates real-time alerts for drivers and emergency responders regarding potential hazards via Vehicle-to-Infrastructure (V2X) communication. Additionally, we integrate digital twin technology to create dynamic simulations that evaluate traffic management strategies, thus mitigating delays during rail incidents. Our methodology encompasses the development of intelligent traffic models, the deployment of continuous condition-monitoring sensors, and the synthesis of multimodal data sources, resulting in a data-driven operational framework. This multifaceted strategy not only aims to enhance safety but also prepares for the seamless integration of autonomous vehicles within the existing transportation infrastructure. Deliverables will include prototypes of advanced detection and notification systems, an extensive traffic simulation model, and evidence-based recommendations for technology implementation. Anticipated outcomes include a significant reduction in accident rates, enhanced traffic flow, and alignment with the Federal Railroad Administration's objectives for safer railroad-highway crossings.