



Research Project Name: Enhancing Rural Roadway Safety through Geospatial Analysis and 2SFCA-Driven Rest Area Serviceability Optimization for Trucks

Recipient/Grant (Contract) Number: Florida A&M University; Florida State University

Center Name: Rural Safe Efficient Advanced Transportation (R-SEAT) Center

Research Priority: Improving Mobility of People and Goods/Promoting Safety

Principal Investigator(s): Eren Erman Ozguven, Ren Moses

Project Partners: N/A

Research Project Funding: \$126,873 (Federal request); \$67,935 (Non-Federal cost share)

Project Start and End Date: 6/1/2023 to 4/30/2025

Project Description:

Truck-involved crashes within the rural network pose a distinctive and multifaceted challenge that necessitates a specialized approach for comprehensive analysis and effective mitigation. Data from the Insurance Institute for Highway Safety (IIHS) indicates that fatal truck crashes frequently occur between 12:00 p.m. and 3:00 p.m., deviating from patterns observed in other vehicle crashes. This peculiarity arises from the distinct routines of truck drivers, often commencing journeys early, which amplifies the risk of driver fatigue and contributes to crashes during the early hours. These observations underscore the imperative to address driver fatigue and enhance rest area serviceability and functionality in rural contexts. Recognizing the unique characteristics of rural areas necessitates acknowledging that truck-involved crashes within these regions can have varied effects on groups such as older adults. These disparities emphasize the crucial need for an all-encompassing approach to enhance safety. Leveraging the context of Florida, this project endeavors to formulate a robust methodology that incorporates geospatial, optimization, and machine learning techniques. By incorporating these multifaceted techniques, the methodology aims to holistically evaluate the resilience of these communities, thereby contributing to a comprehensive comprehension of the repercussions of truck-involved accidents in rural areas.

The objective of this proposal is to improve rural roadway safety by enhancing the accessibility and facilities of rest areas for trucks along rural highways in Florida. By applying the specialized Two-Step Floating Catchment Area (2SFCA) method, this proposal aims to bridge the gap between rest area provisions, truck driver behavior, and rural truck-involved crashes. The data-driven insights generated through this project have the potential to significantly elevate rural roadway safety in Florida. This initiative intends to establish a clear correlation between the availability of rest areas, particularly truck parking lots, and the frequency of truck-involved crashes on rural roadways. The objective is to offer data-driven insights that guide strategic rest area development, thereby contributing to the reduction of truck-related accidents and fostering safer rural highways across Florida.

To meet this research demand, Signal4Analytics (S4A) and the Fatality Analysis Reporting System (FARS) serve as optimal platforms for collecting truck-involved crash data. Furthermore, the 2SFCA analysis acknowledges the distinctive features of trucking operations. It encompasses the delineation of catchment areas surrounding each rest area, adapting to rural travel conditions and operational constraints. Calculating accessibility scores for each rural catchment area factors in elements such as the availability of truck parking lots and the population density within each region. These scores provide insights into the potential utilization of rest areas by truck drivers in rural environments. The integration and analysis of truck-involved accident data from Florida's rural roadways hold pivotal importance. This process uncovers patterns and hotspot locations, linking these incidents with computed accessibility scores to unveil potential associations between rest area accessibility and rates of truck-involved accidents in rural settings.



US DOT Priorities: This research on truck-involved accidents aligns with the objectives outlined in the USDOT RD&T Strategic Plan 2022-2026, specifically under the themes of Data-driven System Safety on how technological innovations can reduce and mitigate crashes. It also directly ties to U.S. DOT's safety RD&T efforts that aim for a future transportation system where transportation-related serious injuries and fatalities are eliminated.

Outputs:

The proposed approach will be utilized to evaluate this susceptibility within the rural network, followed by the creation of an efficient strategy for executing corrective safety measures. The objectives encompass (a) identifying areas along rural highways in Florida with elevated occurrences of truck-involved crashes, (b) devising actionable recommendations for establishing novel rest areas or improving existing ones in high-risk rural regions, (c) designing well-appointed rest areas that cater to the needs of rural truck drivers, mitigating the risk of exhaustion-related accidents attributed to inadequate facilities, and (d) delivering these services with mindfulness toward the rural communities, including aging populations.

Outcomes/Impacts:

Devoted to augmenting safety along rural roadways by aligning rest area accessibility with truck-involved crash rates on Florida's rural highways, this proposal harnesses the specialized 2SFCA method. This methodology aims to comprehensively unveil the interrelation between rest area provisions and rural truck-involved accidents. Overlaying this insight with rest area accessibility scores will reveal inadequacies that could contribute to driver fatigue and accidents. By enriching rest area infrastructure in high-risk rural areas, our aim is to mitigate truck-related accidents, alleviate driver fatigue, and cultivate safer highways for all users. Importantly, this endeavor is in congruence with Florida's commitment to road safety across its rural network. The data gathered from this initiative serves a dual purpose. Apart from bolstering roadway safety, it will highlight pivotal concerns and exemplary practices, thus arming policymakers with insights for holistic and mobility strategies. Proposed enhancements encompass increasing truck parking capacity, refining directional signage, and optimizing facilities tailored for rural truck drivers. The implementation of these suggestions could lead to safer rural highways with diminished truck-involved accident rates. Additionally, the project's novel implementation ideas hold the potential to qualify for REAT funding consideration. This convergence of research, policy refinement, and practical execution underscores the profound capability of the project to contribute to Florida's road safety mission while propelling all-encompassing and transformative transportation systems.

Two papers were presented at 2025 TRB Conference:

- Kaya, M., Koloushani, M., Ozguven, E. E., (2024). A Data Driven Approach to Quantify Truck Rest Area Safety Performance based on the Associated Fatigue-related Crashes. Paper to be presented at the Annual Transportation Research Board Conference.
- Alisan, O., Ozguven, E. E., (2024). Spatial Variations in the Relationship between Built Environment and Severe Crashes: A Case Study in Florida. Paper to be presented at the Annual Transportation Research Board Conference.

One paper was published:

- Alisan, O., & Ozguven, E. E. (2024). An Analysis of the Spatial Variations in the Relationship Between Built Environment and Severe Crashes. ISPRS International Journal of Geo-Information, 13(12), Article 465.

Final Research Report: N/A