CURRENT STATUS OF TRANSPORTATION DATA ANALYTICS AND PILOT CASE STUDIES USING ARTIFICIAL INTELLIGENCE (AI)

AUTHORS: Yuanchang Xie, Ruifeng Liu, Zubin Bhuyan, Danjue Chen, Tingjian Ge, Ali Shirazi, Eduardo Vergara, and Juan Aviles-Ordonez

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ABSTRACT

Data is becoming increasingly important to state Departments of Transportation (DOTs) for strategic and day-to-day decision-making. This project aims to (1) provide DOTs with a clear and comprehensive picture of their data assets, needs, data analytics, and other data practices related to Transportation Systems Management and Operations (TSMO); (2) offer strategic and practical recommendations to prepare DOTs for future transportation data analytics; and (3) demonstrate the potential of Artificial Intelligence (AI) and emerging data sources through case studies to improve TSMO.

This research began with a comprehensive review of data and data sources, followed by interviews with domain experts. Based on the review and interviews, recommendations regarding transportation data analytics were provided. Three case studies were conducted to demonstrate how AI and data from advanced radar and thermal camera sensors, along with emerging sources, can help DOTs understand driver speed and lane-changing behavior on horizontal curves and prior to a highway work zone. The results can assist state DOTs in making informed decisions related to data analytics and guide DOTs in developing future work zone temporary traffic control plans and strategies to address speeding on curves and ramps.

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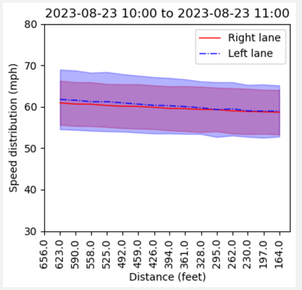
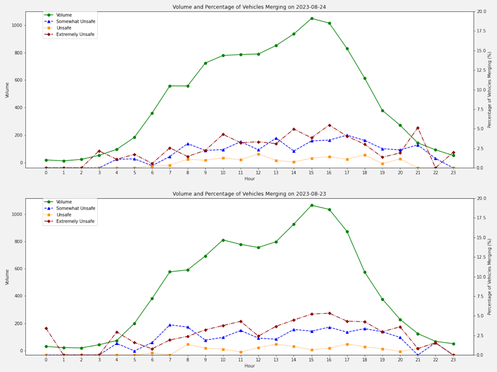
DATA

Thermal video data showing a vehicle merging at the last moment while approaching a work zone in Campton, NH

Thermal video data depicting a vehicle crossing the gore area unsafely in Tilton, NH



Average speeds for vehicles at various distances from the beginning of the lane closure taper in a work zone in Campton, NH



Numbers of vehicles merging at various locations when approaching a work zone in Campton, NH

ANALYSIS

Three case studies were conducted to demonstrate how AI can play a critical role in transportation data analytics.

- The first case study focused on speed behavior on highway horizontal curves. Ultra-high-definition radar and thermal cameras were used to collect traffic data at five sites along I-93 in New Hampshire. AI models were developed to analyze the data, generating vehicle counts, headways, and speed distributions and profiles. AI models also performed camera view change detection, risky behavior detection, and vehicle merging point analysis.
- The second case study investigated how drivers adjust speed and where they change lanes when approaching a work zone equipped with two flashing speed limit signs (FSLS) and a portable changeable message sign (PCMS). The radar speed data and the lane-changing data generated by AI models suggested that both FSLS and PCMS were effective in prompting vehicles to reduce speed and change lanes.
- The final case study integrated probe data and road inventory data to model speeding activities on horizontal curves and ramps at a network level. The results showed that speeding occurs more frequently (1) in rural compared to urban areas, (2) at curves with larger radii and superelevation, smaller arc angles, (3) on less congested curves and ramps, and (4) during the morning and evening peak hours and on weekends.

CONCLUSIONS

- Connected vehicles and mobile devices offer a maintenance-free option for collecting samples of detailed data elements, such as vehicle trajectories, at a large scale, while roadside sensors complement such data by focusing on specific sites but covering all passing vehicles.
- AI and edge computing will continue to expand their footprint in transportation data collection, reduction, analysis, and inference, requiring DOTs to invest in relevant capacity building and workforce development.
- The review and interview results can help state DOTs understand the current status and future trends of transportation data analytics and applications of AI.
- The case studies demonstrated the benefits of utilizing detailed vehicle trajectories collected by a portable platform and how datasets from various sources can complement each other, providing a comprehensive view of driver behavior to improve highway traffic operations and safety.