STRIDE | Southeastern Transportation Research, Innovation, Development and Education Center

Technology Transfer Final Report

STRIDE Project G2

Quantitatively Evaluate Work Zone Driver Behavior Using 2D Imaging, 3D LiDAR, and Artificial Intelligence in Support of Congestion Mitigation Model Calibration and Validation

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THE STRIDE CENTER

The STRIDE Center is the 2016 USDOT Region 4 (Southeast) University Transportation Center (UTC) housed at the University of Florida Transportation Institute (UFTI). Our mission is to develop novel strategies for Reducing Congestion. The Center has nine partners, representing seven states in the Southeastern U.S. The UFTI and its partners in the STRIDE Center are recognized leaders at state, regional, national, and international levels. The STRIDE Center is focused on assembling and integrating research projects throughout the region in a way that maximizes contributions to solving current and future transportation problems as well as strengthening expertise and developing new technologies. For more information see https://stride.ce.ufl.edu/.

DISCLAIMER

ACKNOWLEDGEMENT OF SPONSORSHIP AND STAKEHOLDERS

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1. Project Overview

Roadway work zones reduce road capacity, increase traffic delays, and create dangerous situations for drivers and construction workers. There is a need to study real-world work zone traffic and driver behavior in response to different work zone scenarios using widely available 2D camera footages a) to understand a work zone's impacts on traffic and driver behavior, and b) to develop appropriate traffic control strategies to manage and/or mitigate these impacts.

Work zone traffic simulation models have been used to quantitatively evaluate the impacts of various work zone scenarios on traffic and driver behaviors. However, the lack of real-world traffic and driver behavior data is forcing simulations to use default parameter values, which may not be representative of the actual traffic and driver behavior, hindering the accuracy and reliability of traffic simulation results. Therefore, in this research project, a preliminary version of an AI-based work zone traffic and driver behavior information extraction system using widely available 2D camera footage, machine learning, and computer vision has been proposed and developed to extract real-world traffic and driver behavior information, including vehicle count, vehicle classification, vehicle speed, time headway, and lane change location.

A case study involving two 30-minute work zone videos was used to 1) demonstrate the feasibility of using the proposed AI-system for region-specific traffic and driver behavior information extraction, 2) demonstrate the benefits of extracted information in work zone traffic simulation for more accurate and reliable simulation outcomes. A separate effort with a pilot study with a large diverse data set is strongly recommended in the future to further validate, refine and implement the proposed method. Software development will then be carried out to implement the developed technologies for transportation agencies.

2. Research Goals

The goal of this research is to develop an AI-based work zone traffic and driver behavior information extraction system that uses widely available traffic cameras, machine learning, and computer vision to extract real-world traffic and driver behavior information, including vehicle count, classification, speed, time headway, and lane change locations.

3. Findings

This research demonstrated the feasibility of using the proposed AI-based system to extract real-world traffic and driver behavior information from widely available traffic camera footage, and the benefits of using region-specific traffic and driver behavior information extracted using the proposed system.

4. Performance Metrics

Metric	# Completed
OUTPUTS	
Product(s): Number of new or improved tools, technologies, products, methods, practices, and processes created or improved	Feasibility study findings
Technical Report: Number of client-based technical reports published	STRIDE Final Report

OUTCOMES	
Body of Knowledge: Number of trainings for transportation professionals	1
Professionals Trained: Number of professionals participating in trainings	40 (plus 106 views)
IMPACTS	
Stakeholders: Number of stakeholders you met with to encourage adoption or implementation of product(s)	GDOT and FDOT
Adoption/Implementation: Number of incidences outputs of research have been implemented or adopted	None

5. Product

Preliminary version of an AI-based work zone traffic and driver behavior information extraction system

The product extracts real-world work zone driver behavior and traffic information including, traffic count, classification, speed, time headway, and merging locations using widely available traffic camera footage, machine learning, and computer vision. The extracted data can be used to enhance the work zone traffic simulation to improve work zone management and to reduce work zone-related congestion.

6. Who benefits/will benefit from your product(s)?

Transportation agencies, especially local transportation agencies (counties and cities) with limited resources can be beneficiaries of this product as it allows agencies to leverage their existing traffic cameras to extract traffic and driver behavior information. This information can be used for traffic operations and work zones related traffic simulations to optimize traffic flow and minimize traffic congestion.

7. Body of Knowledge & Professionals Trained

1) STRIDE Webinar: Yichang (James) Tsai, Ph.D., P.E., Georgia Institute of Technology and Rod Turochy, Ph.D., Auburn University presented "Work Zone Driver Behavior Extraction and Modelling using AI-system and Vissim" (40 attendees; 106 views)

8. Stakeholder Engagement

MEETING DETAILS		NARRATIVE DESCRIPTION
STRIDE rep.	*Dr. James Tsai*	Engaged Georgia Department of Transportation (GDOT) by discussing with Andrew Heath, Deputy Chief Engineer on getting the data from GDOT to study driver behavior and traffic information in work zone.
Date of Activity	*11, November 2019*	
Type of Activity	*in-person meeting*	
Location	*Atlanta*	
Stakeholder	*Andrew Heath, P.E.* *State Traffic Engineer, GDOT*	
STRIDE rep.	*Dr. James Tsai*	Robert Baker from GDOT showed Georgia Tech research team through the GDOT's Traffic Management Center and gave hands on demo on Navigator site containing the live streams of widely
Date of Activity	*28, January 2020*	

Type of Activity	*in-person meeting*	available GDOT's traffic cameras and other traffic data sensors, Robert helped identify sites for the project's case study.
Location	*Atlanta*	
Stakeholder	*Robert Baker Jr., TMC Traffic Ops Manager, GDOT*	
STRIDE rep.	*Dr. James Tsai; Dr. Rod Turochy*	Discussed the outcomes of the study conducted by Georgia Tech on work zone driver behavior and merge locations, discussed impacts of external factors such as queue and gap on merge location distribution, and discussed the simulation inputs needed and the timeline for the next task in the project.
Date of Activity	*5, February 2020*	
Type of Activity	*phone meeting*	
Location		
Stakeholder	*Veronica Ramirez Transportation Engineer, Alabama Transportation Assistance Program*	
STRIDE rep.	*Dr. James Tsai*	Dr. Tsai served in the national expert panel of work zones for AV/CV to help guide the national research study on preparing work zones for AV/CV.
Date of Activity	*10-11, March 2020*	
Type of Activity	*in-person meeting*	
Location	*Washington D.C.*	
Stakeholder		
STRIDE rep.	*Dr. James Tsai; Dr. Rod Turochy*	Discussed the associated data needs for traffic simulation modeling.
Date of Activity	*21, July 2020*	
Type of Activity	*phone meeting*	
Location		
Stakeholder	*Nicholas Jehn Kinley-Horn*	

9. Adoption/Implementation

A small case study has been conducted and demonstrated the feasibility of using widely available camera images with computation and ML to extract real-world driver behavior and traffic information. A separate effort with a pilot study with a large diverse data set is required in the future to further validate, refine and implement the proposed method. Software development is essential to produce a product and implement it for transportation agencies.

10. Broader Impacts

The preliminary version of the AI-based traffic and driver behavior information extraction system can positively impact work zone safety and congestion as it allows transportation agencies ***to leverage their existing traffic cameras to extract traffic and driver behavior information***. This information can be used for traffic operations and work zones related traffic simulations to optimize traffic flow and minimize traffic congestion.