

Review of Research Projects by National and Regional University Transportation Centers

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Applied Technology for Traffic Analysis Program This lecture is being **recorded**.

For the purpose of improving the lectures, the presentation of *this week* will be recorded.

The activities being recorded are:

- Lecturer's voice
- Computer screen

Introduction to the University Transportation Centers (UTCs)

UTCs

The **UTC Program** is a federal grant program "DOT [The Department of Transportation] invests in the future of transportation through its University Transportation Centers (UTC) Program, which awards and administers grants to consortia of colleges and universities across the United States." -

https://www.transportation.gov/content/university-transportation-centers

Consortium

A consortium consists of 3-8 universities

Centers Categorized by Fiscal Year (FY)

-FAST Act UTCs (FY 2016 to 2023) -MAP-21 UTCs (FY 2013 to 2018) -SAFETEA-LU Extension (FY 2011 to 2012) -SAFETEA-LU (FY 2005 to 2010)

List of Centers- (FAST Act UTCs)

National UTC for Congestion (1)

National UTC for Infrastructure (1)

National Centers (5)

Regional Centers (10)

Tier 1 [Project] Centers (4)

Tier 1 Centers (20)

7 National Centers and other regional centers

National University Transportation Center For Improving Mobility

National Institute for Transportation and Communities

National Center for Sustainable Transportation

Collaborative Sciences Center for Road Safety

Safety Through Disruption (Safe-D) National UTC

List of Centers- (FAST Act UTCs)

National UTC for Congestion (1)

National UTC for Infrastructure (1)

National Centers (5)

Regional Centers (10)

Tier 1 [Project] Centers (4)

Tier 1 Centers (20)

Région: 1 Transportation Infrastructure Durabilité Center

Region: 2 Center for Advanced Infrastructure and Transportation

Region: 3 Center for Integrated Asset Management for Multi-Modal Transportation Infrastructure Systems

Region: 4 Southeastern Transportation Research, Innovation, Development and Education Center

Region: 5 Center for Connected Automated Transportation

Region: 6 Transportation Consortium of Southcentral States

Region: 7 Mid-America Transportation Center

Region: 8 Mountains-Plains Consortium

Region: 9 Pacific Southwest Region University Transportation Center

Region: 10 Pacific Northwest Transportation Consortium (PACTRANS)

Map of UTCs



Source: https://www.google.com/maps/d/u/1/viewer?mid=1sbGZ1fdegwsP05h0JFBI2PIIcH4ivFn6&II=65.81073884569926%2C-133.5759818183068&z=4

Categories

- Operations
- 🏶 Control 🛛 🔶
- 🏶 Planning 📫
- 🏶 Safety 🔶
- Connected and autonomous vehicles (CAVs)
- Shared mobility
- Others
 - Freight
 - Maritime
 - Air traffic
 - Infrastructure

Category 1 OPERATIONS



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1) Effect of Disruptions on Megaregion Emergency Evacuations

- Purpose: To investigate the effect of disruptive events on megaregion emergency evacuations to support emergency planning and decision-making.
 - effect of network *disruptions* on emergency evacuations at the megaregional scale
 - traffic incidents; work zones; flooded roads; adverse weather; traffic signal failure
 - identify resources needed in the event of an evacuation
- Approach: Traffic simulation
- Potential applications:
 - To plan alternate evacuation routes with different scenarios during the evacuation



Louisiana State University

2) The Effect of Shadow Evacuation in Megaregion Disasters

Shadow evacuation

The evacuation of areas *not* under mandatory evacuation are referred to as shadow evacuation



Source: Wolshon et al. (2018)

Figure 3.1. - U.S. Gulf Coast Megaregion TAZs and Hurricane Track

- Purpose: To assess the effect of shadow evacuation in megaregion disasters.
- Approach: "TRANSIMS" simulations
 - A cellular automata-based microscopic simulator (by Los Alamos National Lab)

Source: https://www.fhwa.dot.gov/publications/publicroads/00marapr/transims.cfm



Evacuation

3) Use of Innovative Intersection Designs for Improving Mobility and Reducing Roadway Traffic Congestion

- Purpose: to systematically investigate the operational and design issues in the implementation of innovative designs and
 - to evaluate the operational benefits of these intersection designs.
- Potential application: tools and guidelines for appropriately selecting the right locations and costeffectively implementing different types of innovative intersection designs.
- What can we learn: the analysis of the unconventional intersection has been applied to intersections in Maryland
 - Single-point urban interchanges (SPUI)
 - "Michigan U"
 - Super Streets
 - Continuous flow intersections (CFI)

Texas Southern University

SPUI in Maryland

-I-695 & MD 140, Pikesville -MD 100 & MD 170, Severn -US 29 & Cherry Hill Rd., Silver Spring -MD 337 & MD 5, Camp Springs -MD 200 & MD 650, Colesville

Source: Rahwanji and Minseok Kim(2014)

CFI in Maryland -MD 210 & MD 228, Accokeek. -US 1 & MD 200

UAID



Benefit: - only **3 phases** needed for diamond interchange

- queues will not be accumulated on the bridge







4) Using Municipal Vehicles as Sensor Platforms to Monitor the Health and Performance of the Traffic Control System

- Purpose: To investigate the potential to obtain traffic data (volume) from sensors on municipal vehicles (buses) for transportation planning and design.
- Approach: To estimate traffic volumes using video obtained from transit buses, compare it with the volume obtained with tubes



5) Improving Rush Hour Traffic Flow by Computer-Vision-Based Parking Detection and Regulations

- Purpose: To provide accurate and real-time data to efficiently monitor parking in high-traffic areas and to figure out the optimal trade-off between parking availability and traffic flow.
- Approach: To develop a computer vision tool to accurately count moving and parked cars from videos taken from inside another moving vehicle





6) Real-time Detection of Crowded Buses via Mobile Phones

- Purpose: to investigate a new technique for recording information *about bus vehicle loading level* using participatory sensing, via a user's smartphone accelerometer and GPS.
- Approach:



Findings:

The model very accurately determines whether riders are standing on a bus.
 Therefore, the results of these models can produce an accurate estimate of the number of people standing on a bus.

Collection

7) Optimizing Snow Plowing Operations in Urban Road Networks

Purpose: to develop an alternative approach using a system for realtime dynamic optimization of municipal snow plowing operations

Approach: make revisions to the initial route by considering

- a set of street segments to be plowed
- a larger set of street segments that can be used for moving from one plow job to the next if necessary
- the set of vehicles that are available to handle plow jobs
- their plowing constraints and the location of other relevant resources
- * Findings: to produce routes that had fewer U-turns and are faster



8) Pedestrian Behavior Study to Advance Pedestrian Safety in Smart Transportation Systems Using Innovative LIDAR Sensors

Project Objective

- To investigate the *pedestrian behavior* at signalized intersections using the start-of-art *LIDAR* sensing technologies
- To apply the collected pedestrians' behavioral data along with vehicular data to develop a more effective *multimodal signal control system*

The tracked trajectories will be synchronized with highresolution *traffic signal event data* to examine pedestrian crossing patterns under different scenarios, such as:

- Distraction
- Perception-reaction time to traffic light changes
- Prevailing crossing speeds

University of Texas Arlington, Portland State University, University of Utah

Light Detection and Ranging, LiDAR A remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) source: National Ocean Service https://cceanservice.neus.gov/lacts.it/der.html



Source: Daniel L. Lu Creative Commons Attribution 4.0 International



9) Network Effects by Disruptive Traffic Events

Objective

To explore a *proactive approach to manage non-recurring congestion* by quantifying and modeling the effects of disruptive traffic events at a microscopic level using a comprehensive set of data sources

Data:

- High-resolution vehicle detection and traffic controller data
- I ive video feeds ٠
- Real-time weather data •
- Near real-time crash records •

Outcomes from this research:

Detailed event-based **Spatio-temporal congestion and safety models**, ٠ ultimately enabling informed and proactive traffic management and safety countermeasures Incident

Management

Network Resilience

University of Utah

10) Assessing and addressing deficiencies in the HCM Weaving segment analyses

Highway Capacity Manual 6th version

- Purpose: To identify, document, and address the major deficiencies in the HCM6 weaving method for uncongested freeways through improved modeling of key procedures and their calibration.
- Approach:





a. Ramp- weave: All weaving drivers must execute a lane change across the crown line

Output:

- . A new Capacity Analysis Method for ramp weave segn
- 2. Method for extracting high resolution video data
- 3. Computational engine to exercise the method

Type A weaving: all weaving vehicles must make one lane change to complete their maneuver successfully.



Major weave: Three or more entry/exit legs have multiple lanes



11) Active Traffic Monitoring through Camera Networks with Automatic Camera Calibration for Pan – Tilt – Zoom Cameras

- Purpose: to research and develop an active computer vision-based traffic monitoring system that has the potential to lead to a shift in the paradigm of collecting traffic data in the near term while supporting connected vehicle applications in the long term.
- Approach: distributed pan-tilt-zoom (PTZ) cameras acting as active vehicle sensors that will map the location of vehicles throughout a network in real-time. Precise mapping of vehicles combined with vehicle-to-camera communication will allow one-toone correspondence whereby the active camera will be able to connect with a vehicle and monitor its movement throughout a camera network.



12) Identify Potential Causes of Truck Bottlenecks on Freeways and Develop Mitigation Strategies

Purpose:

- 1) To identify *truck bottlenecks* and assess congestion impact,
- 2) To examine and analyze trucking activity nearby congested areas and investigate possible causes of recurring congestion
- 3) To develop and recommend potential mitigation solutions for improving system performance for all users
- 4) To develop a systematic reporting tool to rank truck bottlenecks and use the tool to evaluate the impact of deployed mitigation strategies.



Truck Bottlenecks on Freeways (cont'd)

- What can we learn: several mitigation measures
 - solid white line on the main roadway to discourage drivers from lane changing near the interchange bottlenecks.
 - concrete barriers can be effective in separating the on/off-ramp traffic from the mainline
 - real-time traveler information can be placed at locations prior to approaching the bottlenecks

Low-profile Concrete Barrier



Traveler Information



13) Super DDI Design to Improve the Performance of Failing Service Interchanges in Mountain-Plains Region

Purpose: To evaluate the performance of "Super DDI" regarding traffic service, safety, and pedestrian.



<University of Wyoming>

DDIs in Maryland -MD 295 @ Arundel (half DDI)

-MD 85 Buckeystown Pike @ I-270 (to complete 2022)



Source: Maji (2012), MD 85 at I 270 Interchange, MdQI Conference http://remlinedigital.com/mdgi/images/stories/mdgi_documents/2012_conference/topics/presentations/MDCatt/mdcattmd%2085%20at%20i%20270%20interchange.pdf

14) Freeway Incident Detection and Management using Unmanned Aircraft Systems

- Purpose: to investigate the benefits of automatic incident detection with thermal images.
- Approach: (expected) Evaluate the effectiveness of the proposed automatic incident detection algorithms for *thermal images* by comparing the data collected from fixed (mounted) and moving stations (UAV platforms)
- What we can learn: the application of thermal image to traffic operations

Thermal Image



Source: Iwasak et al., 2015



15) Cloud-based Collaborative Road Conditions Monitoring using In-Vehicle Smartphone Data and Deep Learning

Purpose: To develop a cost-effective approach to monitor the road conditions by cloud-based collaborative monitoring using in-vehicle smartphones which could be from any general public vehicle users.



16) Real Time Classification of Vehicle Types and Modes using Image Analysis and Data Fusion

Purpose: a feasibility study on the development of software and selection of hardware that will measure multiple transportation modes and classify vehicles by their Federal Highway Administration (FHWA) classification.



17) Traffic congestion identification and prediction based on Image processing and deep learning methods

- Purpose: To develop a congestion forecasting model in a road network by an image-based deep learning approach to provide accurate and real-time traffic information to mitigate congestion.
- Approach:



 Output: A map with colors representing the congestion levels for a whole road network.

What we can learn:

- 1. The derived congestion index
- 2. Imaged-based deep learning approach

<Jackson State University>



Operations - List of Projects

System Monitoring of Auto Traffic

 Corridor-Wide Surveillance Using Unmanned Aircraft Systems

- Freeway Incident Detection and Management using Unmanned Aircraft Systems
- Optimizing Service Areas to Reduce Congestion and Enhance Equity in Access to Transportation Systems
- Pilot Application of Biometric-based Vehicle
 Occupancy Detection on Managed Lanes For
 Congestion Reduction
- Super DDI Design to Improve the Performance of Failing Service Interchanges in Mountain-Plains Region
- Knowledge-Based Machine Learning for Freeway

 Design and Evaluate Coordinated Ramp Metering Strategies for Utah Freeways

Proposing New Speed Limit in Mountainous Areas
 Considering the Effect of Longitudinal Grades, Vehicle
 Characteristics, and the Weather Condition

 Route Planning for Enhanced Transportation Network Utilization

- Resilience-Based Recovery Planning of Transportation Network Following
- Assessing and Improving Efficiency of Snowplowing Operations via Data and Analytics
- Automated Image-Based Aircraft Tracking and Record-Keeping for Utah Airports
- Impact of Connected Vehicle Technology on Traffic Safety under Different Highway Geometric Designs
- Constrained System-Optimal Route Planning in support of Fleet Route Planning, Ridesourcing, and Ridesharing
- Developing a Prototype System for Establishing
 Passing and No-Passing Zones of Two-Lane Highways
- Exploratory Modeling and Analysis for Automated Vehicles in Utah
- Strategic Deployment of Drone Centers and Fleet
 Size Planning for Drone Delivery in Utah
- Testing Irrationality in Metered Parking Payment Compliance

 Optimal Deployment of Dynamic Charging Lanes for Plug-in Hybrid Trucks Identify Potential Causes of Truck Bottlenecks on Freeways and Develop Mitigation Strategies

Two-lane Highway Analysis Methodology
 Enhancements Considering Commercial Trucks

 Managing the Growth of Last-mile Deliveries and Curb Space Demand

 Evaluating Dynamic Curb Management Strategies in Urban Environments

Eco-Driving Study on Trucks Along a Signalized
 Arterial with Significant Freight Traffic

Truck Parking Needs in Tennessee

Artificial Intelligence Design for Trucks Passing
 Signalized Intersections Along a Corridor with Significant
 Freight Traffic

 Cloud-based Collaborative Road Condition
 Monitoring using In-Vehicle Smartphone Data and Deep Learning

 Active Traffic Monitoring through Camera Networks with Automatic Camera Calibration for Pan – Tilt – Zoom Cameras Framework for Accommodating Emerging Autonomous Vehicles

Real Time Classification of Vehicle Types and Modes using Image Analysis and Data Fusion

 Smart Monitoring and Warning System for Road/Lane(s) Closure for Connected and Non-connected Vehicles

 Assessment of Autonomous Vehicle Sharing for Evacuation and Disaster Relief

 Data Fusion to Improve the Accuracy of Multi-Modal Traffic Counts

 Use of Innovative Intersection Designs for Improving Mobility and Reducing Roadway Traffic Congestion

Impact of Connected and Autonomous Vehicles on Nontraditional Intersection Design: Superstreets

Short-Term Intersection Traffic Flow Forecasting

 Travel Time Forecasting on a Freeway Corridor: a Dynamic Information Fusion Model Based on the Random Forests Approach

- Use of Multisensor Data in Modeling Freeway Travel Time Reliability
- Machine Learning-based Trajectory Optimization of Connected and Autonomous Vehicles
- Modeling the Macroscopic Effects of Winter Maintenance Operations on Traffic Mobility on Washington Highways
- Development of Guidelines for Implementation of Contraflow Left-Turn Lanes at Signalized Intersections
- Effects of Incorporating Connected Vehicle
 Technologies into No-Notice Emergency Evacuation during Winter Weather
- Spatiotemporal Traffic Characteristics of Megaregion Mass Evacuation
- Effect of Disruptions on Megaregion Emergency
 Evacuations: A Pilot Study
- The Effect of Shadow Evacuation in Megaregion Disasters: A Pilot Study
- Assessment of Post-disaster Re-Entry in Megaregions: A Pilot Study
- Robustness of Transportation Networks under Megaregion Evacuations

- Effect of freeway incidents and diversionary behavior on transportation network resiliency
- Megaregional Traffic Impact of COVID-19 Pandemic: Analysis of Activity Restriction
- VRU-Personalized, Optimum, and Dynamic (POD)
 Routing
- Development, Design, and Calibration of the Vulnerable Road User Mobility Assistance Platform (VRU-MAP)
- Comparison of SHRP2 Naturalistic Driving Data to Geometric Design Speed Characteristics on Freeway Ramps (complete, PhD dissertation)
- Development of an Infrastructure Based Data
 Acquisition System (iDAS) to Naturalistically Collect the
 Roadway Environment
- Use of Disruptive Technologies to Support Safety Analysis and Meet New Federal Requirements (complete)

- Utilizing School Bus Meals to Deliver Meals to Families in Need
- Dynamic Management of Food Redistribution for 412 Food Rescue
- Data-driven mobility service design: a case study for Moon Township
- Optimizing Snow Plowing Operations in Urban Road Networks
- Personalized Trip Planner for Seniors
- Evaluation Of Cost-Effective Pavement
 Deformation Detection Technologies Using Mobile
 Lidar
- Evaluation Of Pavement Performance Using Remote Sensing Techniques

- Particle Dynamics Model for Hurricane
 Evacuation and Fuel Shortage: Model Based Policy
 Analysis
- Multiscale Model for Hurricane Evacuation and Fuel Shortage
- Dynamic Routing Of Unmanned-aerial and Emergency Team Incident Management
- Real-Time Recommendations for Traffic
 Control in an Intelligent Transportation System
 during an Emergency Evacuation
- Multi-agent Reinforcement Learning-based
 Pedestrian Dynamics Models for Emergency
 Evacuation
- Multi-scale and Collaborative Disaster
 Evacuation Planning Framework

- Investigation of LiDAR sensing technology to Improve Freeway
- New continuous approximation models for passenger and freight transportation
- Rapid and Accurate Assessment of Road Damage by Integrating Data from Mobile Camera Systems (MCS) and Mobile LiDAR Systems (MLS): Can we get the best of both worlds?
- Using Municipal Vehicles as Sensor Platforms to Monitor the Health and Performance of the Traffic Control System
- Bus On the Edge: Continuous Monitoring of Traffic and Infrastructure
- Improving Rush Hour Traffic Flow by Computer-Vision-Based Parking Detection and Regulations
- Improving Rush Hour Traffic Flow by Computer-Vision-Based Parking Detection and Regulations
- Modeling and Enhancing Freight Mobility in the Philadelphia Region

Category 2 CONTROL
Traffic Control Sub-categories



Sub-categories:

- Signalized intersection(s)
- Corridor control
- Freeway control
- Speed harmonization
- Transit signal priority (TSP)

Some other categories are often integrated multiple controls concurrently:

- Freight
- CAVs
- Machine learning



1) Fathoming the Maximum Potential for Freight Sensitive Intersection Control

- Purpose: to deepen the understanding of the tradeoffs for the right of way between the *different groups* of vehicles and to provide an according mechanism to *optimize the signal control.*
- Approaches:
 - Video cameras (used for actuated traffic control) can be used to differentiate freight vehicles from passenger cars with today's technology.
 - Design signal control by considering relevant factors such as economic values.
 - examine the optimal mechanism of the general intersection signal control when a mix of freight and passenger traffic is present.
 - Discuss with industry will be taken place for inputs and potential applications

Video detection for side street actuation MD 193@ Paint Branch Dr./ Metzerott Rd.



Source: Google map

Freight

Signal control

2) Dynamic Trajectory Control and Signal Coordination for a Signalized Arterial with Significant Freight Traffic

- Purpose: To investigate multiple trucks dynamic trajectories and their interactions with the passenger cars
 - Develop analytical tools for measuring traffic flow performance
 - Develop control strategies to schedule the *trajectories of trucks/cars* dynamically so as to improve the mobility of a corridor, assisted by the new *coordination* strategies of signals.

***** Approach:

- 1st level: optimize trajectories given signal phase and traffic conditions
- 2nd level: concurrently coordinate signals and trajectories

Freight

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3) Transit Priority

- Purpose: to trigger a modal shift from passenger cars to transit by providing priority
 - To offer signal priority to buses & emergency vehicles
 - To generate *priority treatments* for special vehicles that can coexist almost seamlessly with network-wide signal coordination for regular vehicles.
- Approach:
 - To develop conditional signal priority (TSP), where green lights are granted to buses arriving at signalized intersections as needed.
 - To optimize signal timing to maximize intersection performance weighted by vehicle occupancies in a connected and automated vehicle (CAV) environment.
- What we can learn: the signal optimization when CAV information is available

Conditional TSP Provides TSP only under certain

conditions (e.g. a bus that is behind the schedule)

4) Integrated corridor management: cooperative signal control with freeway operations and ramp metering

- Purpose: To improve the progression over the arterial corridor and the traffic performance on the freeway.
- Output:
 - 1. Software tools for optimizing signal control at *interchanges* and along the *arterial corridor*
 - 2. Software tools for establishing *cooperative signal* control and *ramp metering* at interchanges, the *arterial corridor*, and freeway *on-ramps*
 - Incorporate the developed method into an existing macroscopic tool (HCS) based on the results of NHCRP 15-57
- What we can learn: signal control strategy for both interchange and corridors.
 Corridor control





Signal control

Proposed Control Boundary

Freeway control

5) Coordinated Demand-side Management and Traffic Control for Tight Areas

Purpose: Maximizing the net travel benefits

- Approach:
 - Demand: Design time-dependent incentives/payment schemes to spread the demand during peak demand periods.
 - Supply: Design a *boundary control*, in the form of a *traffic signal control* and a *ramp metering.*
- What we can learn: Multi-optimization problem for traffic controls
- Potential related and promising topics: Coordinated demand-side management and traffic control for the corridor.



Corridor control

Freeway control



6) Leveraging Connected and Automated Vehicles for Participatory Traffic Control

Project Objective

- To establish the theoretical foundation of proactive, participatory traffic control where connected and automated vehicles (CAVs) are used as mobile actuators to regulate traffic flow across a traffic network
- To integrate traditional "anonymous" physical controllers (e.g., *traffic signals*) with personalized, targeted control of CAVs to improve traffic system efficiency

Methodology

- Enable CAVs to function as "traffic stream regulators" to regulate traffic stream
- Enable CAVs to behave as "travel demand distributors" to better distribute the traffic demand across time periods and transportation facilities
- The proposed control framework will be tested in "Mcity" or a signalized traffic network in the simulation

CAV

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7) Real-time Distributed Optimization of Traffic Signal Timings

Project Objective

Distributes the tasks to individual vehicles

To revolutionize real-time adaptive signal control via distributed optimization

Methodology

- Thrust 1 focuses on advancing *distributed optimization and parallel computing techniques* for solving *network-level signal optimization models* with discrete variables, nonconvex/nonlinear objective function, and constraints
- Thrust 2 distributes the computation task to individual vehicles, by further decomposing distributed intersection-level subproblems to smaller problems that can be solved at the vehicle level, or treating them as fully independent economic agents that negotiate the right-of-way
- Thrust 3 conducts simulation to validate the results and deploy the system in the city of Ann Arbor



8) Integrated Optimization of Vehicle Speed Control and Traffic Signal Timing: System Development and Testing

Project Objective: to develop an integrated optimization of vehicle speed control and signal timing and test in microscopic simulation software and a driving simulator

Methodology

- To develop a simple dual-optimization approach and use *heuristic algorithms* to locate an approximate optimum solution ensuring expedited computations
- The CAV and traffic signal control system will be implemented in microscopic simulations
- quantify the system-wide impacts of the proposed system on traffic mobility, energy consumption, and emission levels
- To consider the impacts of *human errors and perception reaction* times (PRTs) when implementing the CV control system in a driving simulator at MSU
- To compare the proposed dual-optimization CV control system with two other scenarios
 - adaptive traffic signal control and
 - an eco-driving system previously developed to optimize vehicle trajectories



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9) Optimum Connected Vehicle Speed Control on Signalized Roadways in Mixed Flows

Project Objective

 To develop an optimal speed control strategy for connected vehicles (CVs) considering mixed engine types including conventional internal combustion vehicles (ICEVs), battery electric vehicles (BEVs), and hybrid electric vehicles (HEVs), in the vicinity of signalized intersections

Methodology

- Use multi-agent modeling to develop a *general speed control strategy*, which calculates a compromised solution across different engine types but optimizes the mixed traffic flow in the entire network
- The proposed algorithm will be compared with the algorithms previously developed for each vehicle type so that one can investigate the performances of *system-optimized control versus individual-optimized control* in a simulated traffic network

<Virginia Tech, and Morgan State University>

10) Estimating Switching Times for Actuated Coordinated Traffic Signals: A Deep Learning Approach

Project Objective

 To utilize data from actuated coordinated signalized intersections in North Virginia along with multiple *deep learning and machine learning* techniques to provide estimates of traffic signal switching times from green to red and vice versa

Potential Extensions

- Enable technologies for Green Light Optimal Speed Advisory (GLOSA) leading to more sustainable and more full-efficient operations
- The model can be used to modify the signal phase and timing (SPaT) messages allowing for more efficient operations for connected vehicles (CV) when traversing signalized intersections



11) Integration of Autonomous Vehicles with Adaptive Signal Control to Enhance Mobility

Purpose: To demonstrate and evaluate vehicle-to-infrastructure (V2I) route sharing performance in the field to further optimize traffic signal control performance through the communication of real-time connected autonomous vehicle route information.

Approach:



Findings:

- Argo vehicles: 20% less delay when they shared their routes.
- Other vehicles: no essential change.



12) Supply-Side Management of Auto Traffic

- Purpose: to prevent traffic to back up to upstream signals under oversaturated conditions
- Approach: synchronizing green phases across neighboring traffic signals to the backward waves that propagate through queues.
- What can we learn: can develop signal control strategies for arterials with oversaturated conditions to prevent spillback to upstream intersections

Previous studies have either the following assumption:

- -Undersaturated
- -Queue length can be controlled within the link

Signal control

Control- List of Topics

- Supply-Side Management of Auto Traffic
- Transit Priority
- Pricing Mechanisms for Managed Lanes
- Proactive Congestion Management
- Fathoming the Maximum Potential for Freight Sensitive Intersection Control
- Dynamic Trajectory Control and Signal Coordination for a Signalized Arterial with Significant Freight Traffic
- Optimal and Robust Control of Vehicle
 Platooning on Signalized Arterial with Significant
 Freight Traffic
- Adaptive Signal Control Algorithms for Connected Vehicles
- Modeling Impact of Weather Conditions on
 5G Communication and Mitigation Measures on
 Control of Automated Intersections

- Corridor Level Adaptive Signal Control
- Signal Timing Strategy for Displaced Left Turn Intersections
- Dynamic Speed Harmonization in Connected Urban
 Street Networks: Improving Mobility
- Optimal Variable Speed Limit Control for the Mixed Traffic Flows in a Connected and Autonomous Vehicle Environment
- Evolution of Advanced Transit Signal Priority with Gap-Based Signal Recovery Strategy
- Trajectory Optimization of Connected and Autonomous Vehicles (CAVs) at Signalized Intersections
- Prioritizing People Mixed Equilibrium Assignment for AV Based on Occupancy
- Characterization of Bicycle Rider Behavior among Various Street Environments
- Collaborative Driving, Ramp Metering and Mean-field Controls
- A Multiscale Simulation Platform for Connected and Automated Transportation Systems

Control- List of Topics (cont'd)

 Assess Highway Construction Workers' Behavior while Driving through Work Zones in Comparison to General Drivers Sensitized Using Virtual Reality and a Driving Simulator

 Quantifying the Impacts of Situational Visual Clutter on Driving Performance Using Video Analysis and Eye Tracking

Investigation of Driving Behavior at Alternative
 Intersection Designs and Safety Improvement: A Driver
 Simulator Study

 Assessing the Effect of Drivers' Behavior in Rural Roads with Advanced Driver Assistance Systems Using a Driving Simulator

 Assessment of Drivers' Behavior and Workload while Interacting with E-scooters Using a Driving Simulator

 Driver and Pedestrian Behavior at Crosswalks in Modern Roundabouts using Virtual Reality

 Driver Attitudes and Behavior in the Presence of E-Scooters versus Bicyclists

 Quantifying Uncertainty and Distributed Control for Unanticipated Traffic Patterns as a Result of Natural and Man-Made Disruptions Integrated Optimization of Vehicle Speed Control and Traffic Signal Timing: System Development and Testing

 Estimating Switching Times for Actuated Coordinated Traffic Signals: A Deep Learning Approach

 Estimating Switching Times for Actuated Coordinated Traffic Signals: A Deep Learning Approach

 Access Control at Major-minor Intersection through CAV in Mixed Traffic

Development of Low-cost Radar-based Sensor for Multimodal Traffic Monitoring

Integrative Vehicle-Traffic Control in Connected/Automated Cities

 Design of Resilient Smart Highway Systems with Data-Driven Monitoring from Networked Cameras

 Development and Tech Transfer of an Integrated Robust Traffic State and Parameter Estimation and Adaptive Ramp Metering Control System

 Monitoring and Control of Overweight Trucks for Smart Mobility and Safety of Freight Operations

Category 3
PLANNING

Planning Sub-categories



1) Enhancement of Transportation Network Analysis Tools for Truckrelated Planning and Operations

- Purpose: to improve the state-of-the-art for accounting for the impact of trucks at the *network level*.
- Approach:
 - 1) extending the methodology for the multiclass *user- equilibrium* (UE) traffic assignment to account for flow-dependent PCEs of trucks
 - 2) using the *HCM freeway facility analysis methodology* to calculate travel time in the UE route choice methodology instead of the traditional *BPR (Bureau of Public Roads)* function.



2) How do car donation programs affect travel, income, and healthcare access among poor families?

Purpose: studying changes in living when families receive a car from the largest vehicle donation program in the country.

***** Approach:

- To interview 30 individuals living in Maryland and Virginia who received a subsidized car
- To situate the subsidized cars within interviewees' mobility history



Figure 1 Interviewee home locations, by ZIP Code (n=28)



3) Evaluating the Traffic and Emissions Impacts of New York City Cordon Pricing

- Purpose: To investigate potential travel behavior changes in response to cordon pricing in Manhattan, New York
- Approach:
 - To set up study area and cordon pricing boundary
 - Setting up The New York Best Practice Model (NYBPM) for people travel to participate in activities
 - To conduct air quality analysis for measuring the amount of pollutants in the air using emission factors which define the relationship between the amount of emissions and the amount of activity of vehicles
 - Mode Shift Analysis
 - Pricing Impact Analysis in the Network Level



4) Multi-Modal Optimization and Simulation



Optimization

Multi-Modal Optimization

<Georgia Tech>

- Purpose: To develop a model to generate an optimal set of transit routes and frequencies given the input demand and constraints
- Approach: To design coordinated microtransit systems in large congested cities; combine on-demand transit that serves low-density regions with high-occupancy vehicles (buses or trains) traveling along high-density corridors

Agent-Based Model (ABM)

computer simulations used to study the interactions between people, things, places, and time. ... built from the bottom up meaning individual agents are assigned certain attributes.

The agents are programmed to behave and interact with other agents and the environment in certain ways.

Source: https://www.publichealth.columbia.edu/research/population-health-methods/agent-based-modeling

Multi-Modal Optimization and Simulation (cont'd)

Multi-Agent Simulation

- Purpose: To develop a simulation model capable of representing tradeoffs between fixed-route transit, coordinated on-demand transit, independent ride-hail operators, and other travel modes
- Approach: open-source MATSim simulator; handle the intricate relationship between supply for and demand of ondemand transit and independent ride-hail services

MATSim

an open-source framework for implementing large-scale **agent-based** transport simulations.



Source: https://www.matsim.org/gallery/poznan



5) Optimal Charging Infrastructure Design for Battery Electric Buses

Project Objective

 To develop models, methods, and procedures to determine the *optimal locations* of charging stations for BEBs and apply them in collaboration with transit agencies

Methodology

 Integrate practical considerations and constraints such as the facilities and land (e.g., where the bus layover locations are) owned by transit agencies, the capacity of electricity grid networks, etc.



6) Improved Resiliency of Transportation Networks through Connected Mobility

- Purpose: to lay the necessary groundwork for the deployment of *intelligent transportation* infrastructure, with a focus on *extreme events* in complex transportation networks. The methodology is the fusing of remotely gathered *damage information* from critical components (bridges) with a rapid and reliable *assessment of the resiliency of transportation networks*.
- Approach: quantification for timely deployment of such systems and the resulting benefits - will serve as a tool to determine the most critical locations within the network
- What we can learn: for evacuation/ optimal sensor locations



7) Data-driven Multimodal Transportation Energy Consumption Prediction and Analysis Framework for Sustainable Transit and Transportation Planning

Purpose: to develop a high-resolution system-level transportation energy data analysis and a prediction framework for transit schedule/operation planning to improve energy efficiency.



8) Traffic Impact of CSX Pittsburgh Intermodal Rail Terminal and Mitigation Plans for McKees Rocks

- Purpose: To conduct an in-depth analysis of the potential traffic impact in high temporal and spatial resolutions.
- Approach: simulate individual cars and trucks, and model their route choices, travel time and mixed traffic flow conditions by using the data collected in the traffic impact study
 - identify various data sources for in-depth data analytics
 - model the existing traffic conditions without the terminal
 - model future traffic conditions with the presence of the terminal
 - model the potential benefits of traffic mitigation plans and examine the effectiveness of several potential traffic management strategies



<u>TIA</u>

The projection of the **impacts** for a proposed **development**. A consulting transportation engineer prepares the TIA according to department guidelines

Source: https://www.harfordcountymd.gov/2782/Traffic-Impact-Analysis-TIA

Simulations

Carnegie Mellon University

TIA

TIA (cont'd)

What we can learn:

 A very comprehensive list of scenarios has been tested, with various roadway access control plans and population increases.

Potential related and promising topics:

- Estimating traffic impacts of a work zone/ new traffic generators
- Developing a framework for predicting traffic conditions of various expected/proposed scenarios



9) Travel Impacts of a Complete Street Project in a Mixed Urban Corridor

- Purpose: To assess travel impacts from an urban corridor street redesign in Pittsburgh, PA.
- Approach:
 - Using audio, video, and other devices along the corridor, as well as *emission* and *air quality data*.
 - The redesign includes:
 - new traffic signals,
 - new pedestrian crossing,
 - reconfiguration and relocation of several intersections,
 - improved bus turnouts,
 - new pavement, and
 - street furniture.
- What we can learn: findings from field implementation of "Complete Streets"
- Potential extensions: findings can be useful to Montgomery county and Baltimore City, which are working on "Complete Streets" and just published a guideline



"Complete Street" (cont'd)

Complete Streets are roadways that are designed and operated to provide safe, accessible, and healthy travel for all users of the roadway system, including pedestrians, bicyclists, transit riders, and motorists.



Source:

- [1] Montgomery County Complete Streets (2021)
- [2] Baltimore Complete Street (2021)

[3] Montgomery Planning https://montgomeryplanning.org/planning/transportation/complete-streets/





Planning - List of Projects

- Heterogeneity in the Relationship Between the Built Environment and Bicycling
- The Role of Transport in How We Choose Where to Live: A Qualitative Investigation of Residential Location Choice in the Phoenix, AZ Region
- Latent Vehicle Type Propensity Segments: Considering the Influence of Household Vehicle Fleet Structure
- Real-Time Transportation Social Media Analytics Using Pulse
- An Integrated Model of Activity-Travel Behavior and Subjective Well-being
- Formulating Innovative Mobility Policies to Reduce Congestion
- Enhancing Equity and Access
- Influencing Travel Behavior via Open Source Platform
- Targeting Transit Incentives to Congestion Sources
- Enhancing Equitable Access to Opportunities Using Traveler Behavior Data
- Advancing Social/Racial Equity and Congestion Relief: Understanding the Travel Needs of Marginalized Populations that Rely on Transportation Network Companies

- Social Carpooling-based Road Congestion Mitigation: A Three-Level Analysis
- Integrated Strategic and Operational Planning for a Fast-Charging Battery Electric Bus System
- Expanding the Capabilities of Business Commute Optimization System to Model Additional Transportation Alternatives and On-Demand Needs
- The Impact of the Mobility as a Service Mode on Transit Access
- Where the Sidewalk Ends: Equity Disparities with Respect to Municipal Maintenance Policy
- Big Transportation Data Analytics
- Evaluating the Impacts of Deploying Automated
 Roads for Infrastructure-Enabled Autonomous Vehicles
- Incorporating Tourism Data in Traffic Estimation on Wyoming Low-Volume Roads
- Traffic Performance Assessment of Disrupted Roadway Networks Following Earthquakes

Truck Parking Study: Unveiling the Parking Space Density and Truck Volume Relationship

 Enhancement of Transportation Network Analysis Tools for Truck-related Planning and Operations

 Modeling Adoption of Autonomous Vehicle Technologies by Freight Organizations
 Sustainable Urban Freight Mobility Through Optimization of Logistics Facility Locations
 Disaggregation of Freight Flows for Tennessee

 Optimization of Winter Maintenance Stations for Safe and Efficient Freight Transportation

 Next Generation of Freight Planning and Operation Models to Incorporate Emerging Innovative Technologies

Analysis of Freight Movement Within Regional Evacuations

Identification and Evaluation of Critical Urban Freight Corridors Integrate Autonomous Delivery Vehicle into Sustainable Urban Logistics Planning and Optimization

 Incorporating Freight Regional Land Use Planning Models

Determination of Position and Operation Analysis of Emergency Freight Parking in Florida State

Optimal Refueling Gas Station Locations in Postevacuation Conditions

Identifying and Optimizing Electric Vehicle Corridor
 Charging Infrastructure for Medium and Heavy Duty Trucks

 Assessing Potential of Bike Share Networks and Active Transportation to Improve Urban Mobility, Physical Activity and Public Health Outcomes in South Carolina

Improved Resiliency of Transportation Networks through Connected Mobility

 Infrastructure and Policy Needs for Personal Electric Mobility Devices in a Connected Vehicle World

Development of a Tool to Assess Effectiveness of Intermodal Facility Locations and Designs

- Data-driven Multimodal Transportation Energy Consumption Prediction and Analysis Framework for Sustainable Transit and Transportation Planning
- Assessing the Experience of Providers and Users of Transportation Network Company Ridesharing Services
- Tool to Access Effectiveness of Intermodal Facility Location and Carrier Collaboration
- Improving Freight Transport Mobility and Efficiency via Synchronization
- Strategic Management of Limited Transportation Recourses to Support Mobility of Disadvantaged and Disabled Travelers during the COVID-19 Pandemic or Similar Situations
- Digital Twins to Increase Mobility in Rural South Carolina
- An enhanced systemic approach to safety
- Implementing Safe Systems in the United States:
 Guiding principles and lessons from international practice
- Traffic safety practices in U.S. cities: Survey and focus group results

- The influence of the built environment on crash risk in lower-income and higher-income communities
- Integrating spatial safety data into transportation planning processes
- Applying AI to data sources to improve driverpedestrian interactions at intersections
- Developing a framework to combine the different protective features of a Safe System
- Urban freight and road safety: Trends and innovative strategies
- COVID-19 streets: Mobility justice and the rapid rollout of pedestrian and bicyclist improvements
- Using Safe Systems approach to assess traffic impact and land development
- A Safe Systems approach to motorcycle safety
- Estimation of Pedestrian Volume Using Geospatial and Traffic Conflict Data
- Impact of Connected and Automated Vehicles (CAVs) on Freeway Capacity

- Impact of Connected and Automated Vehicles (CAVs) on Freeway Capacity
- Estimation of Origin-Destination Matrix and Identification of User Activities Using Public Transit Smart Card Data
- The impacts of COVID-19 on Public Transit
- Using Computational Biology to Mitigate Path Overlap in Transit Assignment
- Optimizing Transit Equity and Accessibility by Integrating Relevant GTFS Data Performance Metrics
- Investigating the Linkage Between Transit Access to Services and Affordable Housing Availability
- Using General Transit Feed Specification (GTFS)
 Data as a Basis for Evaluating and Improving Public
 Transit Equity
- Analyzing Cycling Behavior During Different Time Periods Using Crowdsourced Bicycle Data
- Impacts of Bicycling Corridor Improvements on Users' Behaviors in Large Cities

 Bicycle Network Connectivity and Accessibility: A Study on the Effects of Bike Infrastructures on Bicycle Sharing System Demand

Evaluating the Potential Use of Crowdsourced Bicycle Data in North Carolina

 Investigating the Impact of Different Attributes on Bicycling Mode Share as A Multimodal Connectivity Strategy in Large Cities: A Case Study in Houston

 Understanding the Surprising and Oversized Use of Ridesourcing Services in Poorer Neighborhoods in NYC

- Multimodal Connected Vehicle Pilot for Winter Travel
- Development of Continuous Time, Temporally Constrained and Behaviorally Consistent Tour Pattern Generation System for Modeling the Impacts of Autonomous Vehicle Future
- The Effect of Competition of Transport Modes on Mobility
- Stochastic Multimodal Network Modeling

 Are Transportation Network Companies Synergistic with Other Shared Ride Mode Offerings? An Exploratory Analysis of Demand Data from NYC Utilizing High Resolution Spatiotemporal Models

- Forecasting Ridership for Commuter Rail in Austin
- Improving the Movements of People and Freight: A Case Study of the Piedmont Atlantic Megaregion
- Disaster Resilience through Diverse Evacuation and Emergency Transportation Systems
- What Do We Want from Autonomous Vehicles (AVs)? Using Participatory Planning and Scenario Analysis of Alternative Features to Identify Stakeholders' Desired Outcomes from the Strategic Deployment of Emerging Transportation Technology
- Optimization of Long-Term Highway Work Zone Scheduling
- Effect of Connected and Autonomous Vehicles on Supply Chain Performance
- An Evaluation of the Transportation Equity Impacts of Uber and Lyft Usage in Chicago
- Multimodal Transportation Engineering Curriculum for Middle and High School Students
- Seizing the Opportunity: A Vision for CBD Tolling in New York City
- Assessing Electric Vehicle's Impact on Megaregion
 Expansion: Spatial Analysis of Beijing's Metropolitan Growth
 Based on Mobility Data

- Modeling Urban Growth of the Texas Triangle Megaregion
- An Alternative Approach to Analyzing Demand Potential for Travel by High-Speed Rail in the Texas Triangle
- Analyze the Spatial Inequality Trends in the U.S.
 Megaregions
- Who drives, where, and when? An evaluation of behavioral responses to license-plated based driving restrictions
- A Philadelphia rideshare story: An Investigation of rideshare's impact on transit
- Further Development of the Northeast Megaregion Multimodal Transportation Planning and Investment Model
- Are US cities and regions overbuilding roadway in the post-Interstate era?
- Multi-Modal Modelling: BIM Template for Hub Connectivity and Networks
- Incorporating active transport into the regional planning process to support first and last mile travel
- Megaregion Truck Flow Estimation Model

- Understanding Transportation Related
 Infrastructure Access in 52 Major US Cities
- Mobilizing Investment in America's Transportation Infrastructure
- The Effects of Transportation Infrastructure Investments on Freight Mobility: a Megaregion Perspective
- The Role of Transportation Networking Companies in Megaregion Mobility: Optimizing multimodality through the optimal combination and utilization of different modes for intra-megaregion travel
- Transportation and land use across US and Mexican cities and megaregions
- Beyond Political Boundaries: Constructing Network Models for Megaregion
- Creating Neighborhood Walkability Metrics that Represent the Needs of Older People; Developing Appropriate Infrastructure and Policy Interventions

- Megaregional Transportation System Resilience
 Planning
- MPO Roles in Supporting Local Smart Growth
- Coordination within a Megaregion for Freight Planning: Stakeholder Outreach
- Identifying Organizational Changes to Facilitate MPO Megaregion Planning
- Assessing Changes to Federal and State Law for Megaregion Planning
- Extracting Rural Crash Injury and Fatality Patterns Due to Changing Climates in RITI Communities Based on Enhanced Data Analysis and Visualization Tools (Phase II)
- Predicting congestion: The challenge of shifting travel behavior on Estimating trip generation, traffic and other system impacts
- Assessing and addressing deficiencies in the HCM Weaving segment analyses, part 2
- Identifying and mitigating congestion onset
- Identification of unpredictable sources of non-
- recurring congestion & mitigating strategies

 Integrated corridor management: cooperative signal control with freeway operation and ramp metering

 Traffic congestion identification and prediction based on Image processing and deep learning methods

Locating and costing congestion for school buses and public transportation

 Real-time data based decision support system for arterial traffic management

Spatial microanalysis and equity assessment of joint relationships among destination choice, activity duration, and mode choice

The Potential for Ride-Matching in Disadvantaged Communities

The Implications of Freeway Siting in California: An Equity, Geospatial, and Case Study Approach

Congestion Reduction via Personalized Incentives
 Developing Agent-Based Distributed Cooperative
 Vehicle-Infrastructure Systems in the Connected and
 Automated Vehicle Environment

Developing Agent-Based Distributed Cooperative
 Vehicle-Infrastructure Systems in the Connected and
 Automated Vehicle Environment

 Modeling Operational Performance of Urban Roads with Heterogeneous Traffic Conditions

 Curbside Management: Understanding Impacts of On-Demand Mobility on Public Transit Use and Vulnerable Road Users

Predicting Bus Travel Times in Washington, DC
 Using Artificial Neural Networks (ANNs)

Steps to Supplement Park-and-Ride Public Transit Access with Ride-and-Ride Shuttles

Impact of Dedicated Bus Lanes on Intersection Operations and Travel Time Model Development

Defining and Measuring Equity in Public
 Transportation

Examining the Development Effects of Modern-Era
 Streetcars: An Assessment of Portland and Seattle
- Transit Agency Short and Long-term
 Operational Flexibility
- Latest National Analysis of Ridership Trends
- Quantifying the Impact of New Mobility on Transit Ridership
- New Fare Payment Technology and Pricing Strategies for Mobility-as-a-Service (MaaS)
- Multi-Modal Optimization
- Multi-Agent Simulation
- Workforce Development
- Sensing and nondestructive evaluation
- Evaluation of the Driveway Assistance Device (DAD) Systems in One-Lane Two-Way Work Zones

- Bicyclist Longitudinal Motion Modeling
- Statistical Inference for Multimodal Travel Time Reliability
- Exploring Data Fusion Techniques to Derive
 Bicycle Volumes on a Network
- URBANO: A computational tool-kit for integrated urban design incorporating active transportation, pollution, and outdoor comfort models to facilitate the design of healthy and sustainable urban habitats
- Mobility-Aware Integrated Urban Design
- Sustainable and Healthy Communities through Integrating Mobility Simulations in the Urban Design Process
- How do car donation programs effect travel, income, and healthcare access among poor families?
- Evaluating the Traffic and Emissions Impacts of New York City Cordon Pricing

- Aligning Transportation Policy with Residential Location Preference Among Tradeoffs
- Designing Cross-Subsidy Mechanisms for Multi-Modal Transportation Systems
- Development of a Mobile Navigation Smartphone Application for Seniors in Urban Areas
- An Artificial Intelligence Platform for Network-wide Congestion Detection and Prediction Using Multi-source Data
- Understanding Mobility Patterns and Decisionmaking Using an Integrated, Multi-modal Sensing Platform in a Quantified Community
- A Trusted Data Platform for Transportation Data Sharing
- Integrated Analytics and Visualization for Multi-Modality Transportation Data
- Quantifying and Visualizing City Truck Route Network Efficiency Using a Virtual Testbed
- Assessing the Relative Risks of School Travel in Rural

- Promoting Positive Traffic Safety Culture in RITI
 Communities through Active Engagement:
 Implementation Guide and Outroach Activities
- Implementation Guide and Outreach Activities
- The Perception of Autonomous Driving in Rural Communities
- Advanced Vehicle Technology Simulation and Research Outreach to STEM Programs
- Automating the Transportation Design to Simulator Model Process
- Convoluted Gaussian Process (CGP): An Alternative to Facilitate Analysis and Predictions of Multiple DPMs under Several Driving Conditions Using Driving Simulators
- Cross-Platform Driving Simulator Scenarios to Use in the Roadway Design and Planning Process
- Deflection Angle Effect on Continuous Driver
 Performance Along Horizontal Curves
- Training to Improve Situational Awareness Regarding
 Operational Design Domain in Driving Automation Systems
 of shopping travel in the U.S

- Transportation workforce development for state DOTs to address equity, diversity and inclusion
- Overcoming barriers to freight and logistics firm collaboration with urban planning
- Utilization of connected and automated vehicles in support of transportation agencies' decision making
- Transportation workforce development for state DOTs to Address congestion for the southeast region
- Mobility-on-Demand Transit for smart, sustainable cities
- Barriers and facilitators of people with disabilities in accepting and adopting autonomous shared mobility services
- Mobility Justice: A New Framework for Transportation Researchers and Professionals
- Cross-Sectional Study of the Effects of Disability on the Mismatch of Desires versus Choices for Transportation Modes and Residential Location
- Redeveloping Failing Malls: Opportunities for Reducing VMT and GHG Emissions and Increasing the Housing Supply through Urban Villages
- Measuring the Evolution of California's Central Valley:
 Demographics, Supercommuting, and Fiscal Stress

- Developing an Artificial Neural Network (ANN) to Forecast EV's Trip Destinations and Charging Behavior
- Economic Analysis and Review of Commercial Vehicle Road User Charges
- Development of Instrumented Bikes: Toward Smart Cycling Infrastructure and Maintenance
- Institutional Obstacles to New Transportation Technology Adoption
- Cost of Plug-in Electric Vehicle Ownership: How the cost of ownership impacts the choice between conventional and plug-in electric vehicles
- Are Gender Differences in Early Electric Vehicle Markets Pervasive Across Policy and Market Contexts?
- Discontinuance Among California's Electric Vehicle Buyers: Why are some consumers abandoning their electric vehicles?
- Evaluating Accessibility of Los Angeles Metropolitan Area Using Data-Driven Time-Dependent Reachability Analysis
- The Implications of Freeway Siting in California: An Equity, Geospatial, and Case Study Approach
- Wired for Gasoline: Consumers and Value Construction in the Plugin Hybrid and Electric Vehicle Market
- Analysis of the Decision to Lease an Electric Vehicle and the Impact of Incentives on the Electric Vehicle Lease Market

- Barriers to Reducing the Carbon Footprint of Transportation
- Integrating Transit Paths and Transit Occupancy Data into Activity-Based Travel Demand Model Outputs to Support Sustainability Analysis across Modes
- Dynamic Routing for ridesharing
- Multi-scale models for transportation systems under emergency conditions
- Public Dialysis Transport Efficiency Using Digital Media
- Modeling Future Outbreaks of Covid-19 Using Traffic as Leading Indicator
- * Asymmetric Information Sharing in Dialysis Paratransit Using an Agency Approach
- Analysis of the Non-Driving Mobility Needs of People with Disabilities
- Travelers' Rationality in Online Anticipatory Emergency Response Model
- Evaluation of Web-Based Driving Feedback for Teens and their Parent
- Discrete Dynamics and Epidemiological Multi-Physics Models for Transportation Applications
- Equitable Dynamic Pricing for Express Lanes
- Assessing Complete Street Strategies Using Microscopic Traffic Simulation Models
- How Effective are Toll Roads in Improving Operational Performance?
- Congestion-Clearing Payments to Passengers
- Exploring Strategies to Improve Mobility and Safety on Roadway Segments in Urban Areas
- Modeling the Effect of Developments and Road Construction Projects on Transportation System

Performance

- Transportation for an Aging Population: Promoting Mobility and Equity for Low-Income Seniors
- The Potential for Autonomous Vehicle Technologies to Address Barriers to Driving for Individuals with Autism

Evaluating Alternative Measures of Bicycling Level of Traffic Stress Using Crowdsourced Route Satisfaction Data

- A Framework for Integrating Transportation Into Smart Cities
- How and Where Should I Ride This Thing? "Rules Of The Road" for Personal Transportation Devices
- Value Capture to Fund Public Transportation: The Impact of Warm Springs BART Station on the Value of Neighboring Residential Properties in Fremont, CA
- Researching Relationships Between Truck Travel Time Performance Measures and On-network and Offnetwork Characteristics
- Evaluating the Effectiveness of a School-based Intervention on Driving-related Carbon Emissions Using Realtime Transportation Data
- The Potential for Using Loyalty Rewards and Incentives Programs to Encourage Transit Ridership and Regional Transportation and Land Use Integration
- Evaluating San José's 4th Street Pop-up Bikeway: What Does the Public Think
- Urban Goods Movement and Local Climate Action Plans: Assessing Strategies to Reduce Greenhouse Gas Emissions from Urban Freight Transportation
- Older Adults' Perceptions Regarding Transportation Services in San Jose, CA: Access, Barriers, and

- Toward a Guide for Smart Mobility Corridors: Frameworks and Tools for Measuring, Understanding, and Realizing Transportation Land Use Coordination
- Will Ride-Hailing Enhance Mobility for Older Adults? A California Survey
- Cost-Benefit Analysis of Novel Access Modes: A Case Study in the San Francisco Bay Area
- Local Climate Action Planning as a Tool to Harness the Greenhouse Gas Emissions Mitigation and Equity Potential of Autonomous Vehicles and On-Demand Mobility
- Promoting Transit-Oriented Developments by Addressing Barriers Related to Land Use, Zoning, and Value Capture
- TOD and Park-and-Ride: Which is Appropriate Where?
- Caltrans Tribal Planning
- City Best Practices to Improve Transit Operations and Safety
- Characteristics of Effective Metropolitan Areawide Public Transit: A Comparison of European, Canadian, and Australian Case Studies
- Negotiating Transportation Insecurity; Local Responses and Coping Strategies in San Jose, CA
- Mileage Fee Research and Information Directory (MFRID)
- Comparing Twitter and LODES Data for Detecting Commuter Mobility Patterns
- How will State Motor Vehicle Violation Fines be Impacted by Widespread Use of Autonomous Vehicles?
- Does Transit Service Reliability Influence Ridership?
- Modeling and Evaluating Alternatives to Enhance Access to an Airport and Meet Future Expansion Needs
- Land Use Analysis on Vertiports Based on a Case Study of the San Francisco Bay Area
- Cycling Past 50: Nationwide Survey of Older Cyclists Now Underway
- The San José City (SJC) Bikeway Equity Web Map

INSPECTION AND MAINTENANCE RETROFIT AND RESILIENCE

Examining Senior Drivers' Adaptation to Mixed-Level Automated Vehicles: A Naturalistic Approach – Phase II Analysis of the Naturalistic Driving Data

- Investigating and Developing Methods for Traditional Participant-based Data Collection with Remote Experimenters
- Influences on Bicyclists and Motor Vehicles Operating Speed within a Corridor
- Data Driven Approach to the Development and Evaluation of Acoustic Electric Vehicle Alerting Systems for Vision Impaired Pedestrians
- Quantifying the Benefits and Harms of Connected and Automated Vehicle Technologies to Public Health and Equity
- Analysis of an Incentive-Based Smartphone App for Young Drivers
- Factors Surrounding Child Seat Usage in Ride-Share Services
- Spatial Attention Mechanism for Weakly Supervised Fire and Traffic Accident Scene Classification
- Traffic Impact of CSX Pittsburgh Intermodal Rail Terminal and Mitigation Plans for McKees Rocks
- Smart Multi-modal Transportation Solutions for North Huntingdon Township in Response to Roadway Construction Project on Route 30

Proactive Management of Mobility Impact of Interdependent Subsurface Utility and Roadway Construction Through Incentives

Travel Impacts of a Complete Street Project in a Mixed Urban Corridor

- Connecting Millvale to the River and the Region
- User-centric interdependent urban systems:
- using energy use data and social media data to improve mobility
- Assessment of Prospective Mileage-Based Fee System to Replace Fuel Taxes for Passenger Vehicles in Pennsylvania
- Latest Generation Data Portal for the Intelligent Mobility Meter
- The Intelligent Mobility Meter
- Quantifying the Environmental and Health Impacts of Curbside Management for Emerging Multi-modal Mobility Services
- Impacts of COVID-19 Induced Active Transportation Demand on the Built Environment and Public Health
- Understanding Modal Shift during the Pandemic and Quantifying its Public Health Impact
- Improved Vehicle Emissions and Near-Road Dispersion Modeling Tool for Project Evaluation: Integrating MOVES-Matrix, FEC, and AERMOD
- Development of an Emission-based Selection Algorithm to Optimize Variable Message Signs Location
- Quantifying Traffic Congestion-Induced Change of Near-Road Air Pollutant Concentration
- Association of Traffic and Related Air Pollutants on Cardiorespiratory Risk Factors from Low-Income Populations in EL Paso, TX

- Fourteen Pathways Between Urban Transportation and Health: Conceptual Model, Literature Review, and Burden of Disease Assessment
- Urban Policy Interventions to Reduce Traffic Emissions and Traffic-Related Air Pollution: A Systematic Evidence Map
- Energy and Emission Benefits Evaluation of Battery Electric/Plug-in Hybrid Electric Connected Drayage Trucks
- Dockless Mobility
- Energy and Emission Benefits Evaluation of Battery Electric/Plug-in Hybrid Electric Connected Drayage Trucks
- Pedal the Old Pueblo: A Naturalistic Study on Bicycling in Tucson, AZ
- Preparing Future Workforce For Electric Vehicle Infrastructure Deployment
- * Transportation Policies To Facilitate Electric Vehicle Adoption At The Local Government Level: A Preliminary Study
- Preparing For Progress: Establishing Guidelines For The Regulation, Safe Integration, And Equitable Usage Of Dockless Electric Scooters In American Cities
- Transportation Electrification Learning Module For Civil Engineering Students
- Institutions And Information Technology To Support Service Integration In Multimodal Employment Transportation
- Moving Communities Forward: Social Marketing And Social Change For Transportation
- Fast Reference-Free Crack Measurement (Racm) System In Transportation Infrastructures Using Noncontact Ultrasound
- Social Equity And Ecology: A Cross-System Partnership Promoting Transportation As A Transformative Tool For Client Mobility
- On-Demand Microtransit For Better Transit Station And Job Accessibility
- Equitable Transportation Planning Curriculum For Urban Planning And Transportation Programs
- Equity Assessment Of Plug-In Electric Vehicle Purchase Incentives

Campus As A Living Lab: Discovering The Comfort Of Wheelchair Users In The Pedestrian Network By Experiential Learning With High School Student

- Assisting New Transit Riders, Including Those With Disabilities, Via An App Designed For All
- Improving The Mobility Of Transportation Disadvantaged Older Adults: A Community-Based Intervention For Hispanic/Latino Older Adults
- * An Equity-Driven Approach To School Zone Safety To Inform Safe Routes To School (Srts) Programs
- Transportation Equity Curriculum, Phase Ii: Applied Learning Workbook
- Summer Multicultural And Interdisciplinary Learning For Engineering (Smile) In Transportation: Professional Development For Science Teachers Of Culturally And Linguistically Diverse Students
- Measuring Transportation Network Performance During Emergency Evacuations: A Case Study Of Hurricane Irma Camp Fire
- Embracing Emerging Internet-Based Traffic Big Data In Smart City Applications To Improve Transportation Systems Efficiency, Safety, And Equity
- Future @ Fort Worth: Capacity Analysis, Success Factors, And Growth Vision For The Fort Worth Medical Innovation District (Fw-Mid)
- Social Media Analysis For Transit Assessment
- Gender Analysis Tool For Complete Streets Policy Implementation: Mobility, Families, And Emerging Technologies
- Expanding Mobility Options For All: Optimizing And Extending The Biking Infrastructure To Generate Complete Street Networks In Atlanta
- Capacity-Flow Feature-Based Restoration Strategy Optimization For Resilient Transportation Systems To Enhance Mobility, Accessibility, And Equity After Disruptive Events
- Expanding Mobility Options For All: Optimizing And Extending The Biking Infrastructure To Generate Complete Street Networks In Atlanta

- Capacity-Flow Feature-Based Restoration Strategy Optimization For Resilient Transportation Systems To Enhance Mobility, Accessibility, And Equity After Disruptive Events
- Food & Flora Waste To Fleet Fuel (F4) Framework: Reaching The Next Technology Readiness Levels
- Gis Training In Transportation And Environmental Justice For Promoting Student Success In Steam Education
- Identifying, Weighting And Causality Modeling Of Social And Economic Barriers To Rapid Infrastructure Recovery From Natural Disasters: A Study Of Hurricanes Harvey, Irma And Maria
- Air quality implications of COVID-19 in California
- Potential impacts of electric vehicles on air quality and health endpoints in the Greater Houston Area in 2040
- The air quality and health impacts of projected long-haul truck and rail freight transportation in the United States in
 2050
- An Intersectoral Approach to Study Built Environment Factors Affecting Postpartum Depression and Children's Health
- Impacts of Transportation Emissions on the Risk of Mortality: Findings from the Literature and Policy Implications
- Active Transportation, Environment, and Health
- Examining Individual Health and Healthcare Utilization Patterns at the Intersection of Transportation, Environment and Communities
- City-scalable Destination Recommender System for On-demand Senior Mobility
- A Multi-Stakeholder Approach to Developing Effective Policies to Reduce the Impact Costs of Overweight Vehicles on Roads and Bridges

Integration and Operation of an Advanced Weigh-in-Motion (A-WIM) System for Autonomous Enforcement of Overweight Trucks

- A Comprehensive Analysis of the Air Quality in the NYC Subway System
- Equitable Access To Residential (EQUATOR) EV Charging
- Impact of Transportation on Air Quality at Elementary and Middle Schools in South Carolina
- Equitable Access To Residential (EQUATOR) EV Charging
- Field Application of a High-Power Density Electromagnetic Energy Harvester to Power

Wireless Sensors in Transportation Infrastructures

- Capital Program Resource Model (CPRM)
- Sustainability of Urban Consumption Practices
- C2SMART Urban Roadway Testbed in Brooklyn, New York
- Securing Intelligent Transportation Systems against Spoofing Attacks

Category 4



Safety sub-categories



<u>List</u>

1) Intelligent Camera Aided Railway Emergency System (i-CARES)

Purpose: to develop a first-of-its-kind, lowcost, field-deployable Intelligent i-CARES to improve multi-modal safety in the grade crossing, including pedestrians, vehicles, and trains in an efficient way.

Approach:

- (hardware) *image-based monitoring* and surveillance, quantitative situational awareness assessment, and direct "twoway" communication and information sharing.
- 2. To offer *automatic fault detection* and notification, *and imagery evidence* for *trespassing violation.*

What can we learn: methods to enhance safety of at-grade crossings

Other buses

Source: Google Maps



<University of South Carolina>

2) Examining Potential Safety Risks Associated with the Introduction of Light Rail Transit

Purpose: to examine potential risks with light rail transit (LRT)

- * Approach: before and after study from empirical data
 - Comparing before and after the introduction of LRT

Source: Dumbaugh et al. 2020



What we can learn: field data regarding LRT that might be valuable to future *PurpleLine*







3) Driver impairment detection and safety enhancement through comprehensive volatility analysis

- Purpose: to develop a framework for obtaining, processing, and analyzing high-frequency multidimensional large-scale data using sensors that monitor the driver, vehicle, and roadways.
- Approach: naturalistic driving (SHRP-2 program)
- Findings: three main groups of distraction and quantified the duration of distraction :
 - cellphone-oriented
 - object-oriented
 - activity-oriented distractions

The association of duration of distraction with *crash risk* is non-linear and with increased engagement with a *secondary task*.



Categorization of secondary tasks



What can we learn: the database with valuable information

- SHRP-2 (The second Strategic Highway Research Program (2006-2015))'s Naturalistic Driving Study (NDS) database (https://insight.shrp2nds.us/home)
 - Participants' actions on the real-world roads are recorded
 - Based on data acquisition system (DAS)
 - Acceleration, GPS, vision



4) Development of Al-based and Control-based systems for Safe and Efficient Operations of Connected and Autonomous Vehicles

Project Objective

- To recognize the range limitations of onboard sensors as *LIDAR* and cameras and to develop an AI control system that fuses sensed information and longer-range information to make CAV lane-changing decisions
- To develop a method to demonstrate a CAV's catalytic efficacy for addressing stop-and-go traffic perturbations
- To develop a *collision avoidance framework for CAVs*, to reduce the likelihood of collision with surrounding vehicles

Methodology

 Make good use of the joint decision-making protocols and the sharing of real-time information that is made available via vehicle connectivity



CAVs

5) A Comparative Study of Pedestrian Crossing Behavior and Safety in Baltimore and Washington, D.C., Using Video Surveillance

Project Objective

 To compare pedestrian-related travel behavior, using video surveillance of locations in Baltimore, Maryland, and Washington, D.C.

Methodology

- Using computer vision pipeline approach to extract key metrics such as waling speed, gap acceptance, and type of unsafe maneuvers
- Statistical analyses determine which factors, such as land use, infrastructure, etc. contribute to pedestrian travel behavior decisions and safety



<Morgan State University, University of Maryland, and U.S. DOT Office of the Secretary/Research>

Behavior

Vision-based

sensing

6) Assessment of Safety Benefits of Technologies to Reduce Pedestrian Crossing Fatalities at Midblock Locations

- Purpose: To assess safety benefits and shortcomings of new sensing technologies to reduce pedestrian crossing fatalities at midblock locations where they are most vulnerable to injury and death from motor vehicle crashes, and provide recommendations for cost-effective shortterm infrastructure and technology adoption.
- Approach: To deploy image detection technology on corridors with more frequent pedestrian crash patterns to determine the extent of the crossing maneuvers
- What can we learn: Currently, Baltimore Ave., College Park applies *physical fences* to prevent jaywalking. This might be an alternative countermeasure

< Clemson University>



Pedestrian

7) Prediction of Vehicle Trajectories at Intersections Using Inverse Reinforcement Learning

Purpose:

- To Investigate methodologies for vehicle trajectory prediction at intersections, and identify current challenges and opportunities.
- To explore the applicability of inverse reinforcement learning (IRL) in developing trajectory prediction models.

Approach:

- representing vehicle trajectories as curves and training a neural network model to predict the coefficients, generating curves with random perturbations
- To rank the candidate trajectories with IRL

Output:

 It is expected to build models that better capture the behavior of human drivers at intersections



8) Understanding micromobility safety behavior and standardizing safety metrics for transportation system integration

Purpose: to accelerate shared learning around micromobility safety impacts and to fast-track improvements to injury surveillance of emerging modes such as *e-scooters* and related micromobility devices





<University of Tennessee, Knoxville>

9) Development of ATMA/AIPV Deployment Guidelines Considering Traffic and Safety Impacts

Purpose: To develop a practical software tool that takes in DOT inputs such as roadway network GIS shapefile, traffic counts and ATMA/AIPV system characteristics, and outputs a set of *recommended deployment strategies* for Autonomous Truck Mounted Attenuator/Impact Protection Vehicle (ATMA/AIPV)

Approach:

- roadway maintenance sequence,
- staffing plan and needed resources,
- potential impacts to the traffic network
- any suggested traffic management plan to ensure a smooth and safe traffic flow while effectively maintaining the roadway facilities.



10) Connected Vehicle Safety Applications using V2X under Consideration of Bicycles, Pedestrians and Persons with Special Needs

- Project Objective
 - To investigates bicycle safety applications that use the same basic communication capabilities as vehicles, thus allowing vehicle-to-bicycle communication
- Methodology
 - Assume that bicycles have comparable communication capabilities as motor-vehicles and are therefore capable of V2V and V2I communication
 - A bicycle safety application to reduce accidents due to Right Hook Conflict is designed and implemented



Pedestrian

CAVs

11) Shared Bus/Bike Lane Safety Analysis: Assessing Multimodal Access and Conflicts

- Project Objective
 - To conduct a comprehensive study of shared-bus bike lanes (SBBLs) in Baltimore City that quantifies the efficiency and safety impacts of shared bus-bike lanes
- Critical Issues
 - What type of unsafe maneuvers commonly occurs along the bus-bike facilities?
 - How much are buses *delayed* by cyclists in a shared facility?
 - How will the design, enforcement, and education improve the safety of shared bus-bike facilities?
- Methodology
 - Using video observations and survey data
 - Comparing with separated bike facilities with adjacent bus routes





Source: Baltimore City Department of Transportation https://transportation.baltimorecity.go v/bike-baltimore/bike-lanes

Shared vehicle

Transit

12) Implementing Safe Systems in the United States: Guiding principles and lessons from international practice

- **Purpose:** examines the state-of-the-practice in Safe Systems
 - Examines the concept of Safe Systems, focusing on our emerging understanding of crash causation, as well as how this understanding may be applied to integrate safety considerations into transportation practice in the United States.
 - Review of the practices of the 4 countries (Sweden, the Netherlands, Australia, and New Zealand) with the most established Safe Systems programs



System

13) Forging a Path to Vision Zero in the US: A Critical Analysis of Road Safety in Australia

- Background: US and Australia has similarities in terms of transportation, but the yearly death toll is 5.4 people per 100,000 population, lower than US rate of 12.4.
- Purpose: to understand what is behind the road safety disparities between these two countries.

Findings:

- Australia's strategies related to seat belt usage and impaired driving
- Australia's efforts to help curb vehicle speeds
- Design-related differences include a much greater reliance on *roundabouts* and *narrower street cross-sections* as well as guidelines that encourage *selfenforcing* roads.





Education

14) Evaluation of Sidewalk Delivery Robot Interactions with Pedestrians and Bicyclists

- Purpose: To produce early evidence to help shape future mitigation strategies and transportation policies for safely operating automated sidewalk delivery robots in public settings.
- Approach: Analyze observed and self-reported data collected from
 - 1. Video cameras installed at five locations where the robot delivery fleet steadily interacts with high volumes of pedestrians and bicyclists to document interactions and conflicts.
 - 2. A tablet-based intercept survey instrument designed and administered by Spring 2022 at high-activity locations on the NAU campus.
- What we can learn: The evaluation and proposed surrogated safety measure for an unmanned robot.

Indices to show danger from near-misses, but not crashes

Safetv

Surrogate Safety Measures(SSM)

Time-to-collision(TTC)



Figure 11.3 Example of the coupling of information from the image and the curves. The top curve represents the speed of the right-turning Saab, the middle curve the speed of the car coming from above. The bottom one represents the TTC-curve. The vertical stripes give the running time (situation 121).

Source: Kraay et al. (2013) Manual conflict observation technique DOCTOR



Post-enchroachment time (PET)



Source: Kraay et al. (2013) Manual conflict observation technique DOCTOR

Safety - List of Projects

- Work Zone Safety: Calibration of Safety Notifications through Reinforcement Learning and Eye Tracking
- An Exploration of Contemporary Issues in Highway Safety, Evolving Transportation Alternatives, and Activity and Travel Behavior Modelling
- Connected-Autonomous Traffic Signal Control Algorithms for Trucks and Fleet Vehicles
- Utilizing Traffic Signal Pedestrian Push-Button Data for Planning and Safety Analysis
- Exploration of Alternative Spatio-Temporal Methods of Traffic Safety Network Screening
- Impact of Regulatory Hybrid Changeable Message Sign on Traffic Safety under Different Freeway Geometric Designs
- Assessing the Effectiveness of the Wyoming Connected Vehicle Pilot Program
- A Systems-Level Analysis of Left-Turning Vehicle-Pedestrian Crashes
- Investigating Bicyclist Safety Perceptions and Behaviors at Roundabouts
- Safety Support System for Highway-Rail Grade Crossing
- Forging a Path to Vision Zero in the US: A Critical Analysis of Road Safety in Australia

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- Safety Support System for Highway-Rail Grade Crossing
- Forging a Path to Vision Zero in the US: A Critical Analysis of Road Safety in Australia

- Operational and Safety Analysis with Mitigation Strategies for Freeway Truck Traffic in WY
- Automated Real-Time Weather Detection System using Artificial Intelligence
- Enhancing Crash Data Reporting to Highway Safety Partners in Wyoming by Utilizing Big Data Analysis and Survey Techniques
- Crash Modeling of High-Profile Moving Vehicles under Strong Crosswinds Based on Computational Fluid Dynamics
- Reliability-Based Traffic Safety Risk Assessment of Traffic System in Hazardous Driving Conditions to Promote Community Resilience
- Local Road Safety Program Evaluation: Perceptions, Experiences & Implementation
- Improving Safety in Transit and Freight Operations:
- Development of a Safety Leadership Training Model to Improve Safety Culture
- Optimize the Work Zone Safety with Spatial Information Technology and Eye Tracker
- Supporting Tribal Crash Data Utilization and Strengthening Institutional Capacity for Effective Traffic Safety Programs

- Experiments and Modeling for Infrastructure Data-Derived Fuel Economy and Safety Improvements
- Safety Culture, Leadership& Fatigue in Transportation Operations
- The Effects of Autonomous Vehicles on Safety and Safety Culture in Freight Operations
- Reassessing Child Pedestrian Mode Choice & Safety via Perceived Parental Risk
- Does Cell Phone Use Impair Learning and Improvement in Driving performance?
- Fatigue, Health and CMV Driving Behavior during the COVID-19 Pandemic
- Validation of Smartphone Alert Meter Fatigue Assessment Device for Transportation Workers
- Attribution Theory and Collisions at Intersections
- Intelligent Camera Aided Railway Emergency System (i-CARES)
- Assessment of Safety Benefits of Technologies to Reduce Pedestrian Crossing Fatalities at Midblock

 Driver impairment detection and safety enhancement through comprehensive volatility analysis

Developing a taxonomy of human errors & violations that lead to crashes

 Safety enhancement by detecting driver impairment through analysis of real-time volatilities

Creating a CSCRS clearinghouse for bicyclist and pedestrian safety-related data

Data Integration

 Opioids at the health and transportation safety nexus

 Using integrated data to examine characteristics related to pedestrian and bicyclist injuries

 Laying the Groundwork for a National Pedestrian Injury Surveillance System

Structures of stakeholder relationships in making road safety decisions

 Development of resources to guide parents in helping teens learn to drive Strengthening existing and facilitating new Vision Zero plans

Reducing motorcyclist injuries: Engaging stakeholders to apply evidence-based countermeasures

Factors and frames that shape public discourse around road user safety

 Applying civic innovation methods to advance safety education: A pilot program

US Regional Vision Zero Implementation

Assessing how private beliefs conflict with public action on Safe Systems

Integrating systems thinking tools into Vision Zero and Safe Systems approaches

Advancing crash investigation with connected and automated vehicle data

 Estimation of Pedestrian Compliance at Signalized Intersections Considering Demographic and Geographic Factors

 Predicting Paths of Controlled Pedestrians at Intersections Using Deep Learning Models Pedestrian Behavior and Interaction with Autonomous Vehicles

 Optimizing Type and Location of Pedestrian Crossing Signs at Non-signalized Intersections

 Impacts of Speed on Dockless Electric Scooter Crashes

 Determination of Freeway Acceleration Lane Length for Smooth and Safe Truck Merging

 Deep-Learning Based Trajectory Forecast for Safety of Intersections with Multimodal Traffic

 Assessing the Transportation Adaptation Options to Sea Level Rise for Safety Enhancement in RITI Communities through a Structured Decision Making Framework

Drone-based Computer Vision-Enabled Vehicle
 Dynamic Safety Performance Monitoring for Crash
 Prediction in RITI Communities

 Machine Learning-based Fusion Convolutional Neural Network Approaches for Driver Injury Severity Prediction Using Highway Single-Vehicle Crash Data in RITI Communities Improving Safety for RITI Communities in Idaho – Documenting Crash Rates and Possible Intervention Measures

 Developing Data-Driven Pedestrian Safety Assessment Methods for RITI Communities

Safe Reinforcement Learning for Intersection
 Management in RITI Communities Under Rare Extreme
 Events

 Incorporating Use Inspired Design in Providing Safe Transportation Infrastructure for RITI Communities

- Drivers' Performance and Brain Workload Activities after Alcohol Consumption using Driving Simulation
- Augmented Reality for Safer Pedestrian-Vehicle Interactions

 Reinforcement Learning for Optimal Speed Limit Control Over Network

 Understanding Bicyclists' Behaviors Through Learning from Big Trip Data

 Using Augmented Reality to Help Older Adults Make Safe Road-Crossing Decisions

Turning-lane-related safety issue
- Bridge Monitoring through a hybrid approach leveraging a modal updating technique and an artificial intelligence (AI) method
- Risk Factors Associated with Crash Injury Severity Involving Trucks
- Analytical Model for Traffic Congestion and Accident Analysis
- Modeling and Predicting Geospatial Teen Crash Frequency
- An Evaluation of Road User Interactions with E-Scooters
- Exploring Crowdsourced Monitoring Data for Safety (complete)
- Data Fusion for Non-Motorized Safety Analysis (complete)
- Data Mining to Improve Planning for Pedestrian and Bicyclist Safety (complete)
- Big Data Methods for Simplifying Traffic Safety Analyses (complete, 3 publications)
- Evaluation of transportation safety against flooding in disadvantaged communities

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 Evaluation of transportation safety against flooding in disadvantaged communities

Exploring The Role Of Transportation On Cancer Patient Decision-Making Through Machine Learning Techniques

- Assisting Vision-Impaired Pedestrians To Cross Streets: An Innovative Acoustic Ranging Approach
- Development Of Automated Roadway Lighting Diagnosis Tools For Nighttime Traffic Safety Improvement, Phase II
- Enhancing Traffic Flow And Driving Safety Via Artificial Intelligence
- More Freight Vehicle Crashes On City Streets In Residential Areas: Why And To What Extent? A Case Study In Dallas-Fort Worth, TX
- Safety Effects Of Transit Signal Priority: Magnitude And Mechanism

- * A Comparison of Vehicle Miles of Travel Between Two Generations: Millennials versus Generation X
- Demand-Side Management of Auto Traffic
- Multimodal strategies for mitigating congestion from urban parcel delivery
- Tampa Bay Citizen Academy on Transportation (TB-CAT)
- MPO Governing Board Training on Congestion Reduction
- Safety Culture, Leadership & Fatigue in Transportation Operations
- Lifecycle Assessment Using Snowplow Trucks' Automatic Vehicle Location Data
- Optimal Deployment of Wireless Charging Facilities for an Electric Bus System
- Impacts of Ridesourcing on VMT, Parking Demand, Transportation Equity, and Travel
- Interactive Web-based Platform for Analyzing Freight Data Phase I
- Modeling the Impacts of Regulations and Safety Constraints on UAVs Costs and Emissions
- Modeling a Cooperative Location-routing Problem Under Multi-echelon Supply Chain Disruption Risks
- Railway Right of Way Monitoring and Early Warning System (RailMEWS) Based on Satellite and Aerial Imagery
- Unmanned Aircraft Systems Impact on Operational Efficiency and Connectivity
- Using advanced analytics to frame vulnerable road user scenarios with autonomous vehicles
- Machine learning tools for informing transportation technology design
- Investigating the vulnerability of motorcyclists to crashes and injury

- Concept of operations for an autonomous vehicle dispatch center
- Safety testing for connected and automated vehicles through physical and digital iterative deployment
- Studying the Impact of Pandemic Outbreaks on Maritime Transportation and Port Operation
- Analysis of Intermodal Vessel-to-Rail Connectivity
- Use of Vessel Automatic Information System Data to Improve Multi-modal Transportation in and around the Ports
- * Can Crowdsourcing Support Co-productive Transportation Planning in Megaregion? Evidence from Local Practice
- The Applications of GIS-based Megaregion Transportation Planning Model: A Case Study on the Impacts of Autonomous Vehicle (AV)
- Develop a GIS-based Megaregion Transportation Planning Model=
- Potential Impact Analysis of Driverless-Cars on Megaregion Traffic Flow Patterns
- Regional Opportunities and Challenges for Transit Oriented Development: The Case of Texas Triangle
- The Rise of Long-Distance Trips, in a World of Self-Driving Cars: Anticipating Trip Counts and Evolving Travel Patterns Across the Texas Triangle Megaregion
- * The Philadelphia Story: Urban Renaissance and Shifting Travel Behavior in a Northeast Region
- Utilize Crowd-Sourced Data and Machine Learning Technology to Enhance Planning for Transportation Resilience to Flooding
- * Application of the Equity Rubric for Purpose and Need to a Demonstration Corridor in the Texas Megaregion
- Mega-Travel in Megaregions: An Update on Growth Trends and Research Needs

- Megaregion (MR) Freight Mobility: Impact of Truck Technologies
- Using Technological Innovations Across the Megaregion to Enhance the Mobility and Access of Seniors
- Compilation: A Statement of Vulnerability Regarding Texas' Megaregion Corridors
- Vehicle travel and ownership among the US older adults in the digital era
- A Time-Series Analysis of Generational Variation in Vehicle Miles Traveled: Implications for Transportation Planning and Policies
- Do Millennials Differ from Other Generations in Long-Distance Travel? Implications for Megaregion Transportation Planning
- Advancing equity and justice in megaregions: A case law analysis on the challenges in developing disproportionality metrics for successful suits
- The Evolving Texas Megaregion: Developing a Sustainable Megaregion Mobility Planning Blueprint
- Estimating the Impact of COVID-19 on Travel Behavior and Perceptions: An Investigation of Commuting Travel and Intercity Travel in the Northeast Megaregion
- Virtually There: Estimating the Potential of Teleconference to Reduce Travel within and between Megaregions in the Aftermath of a Global Pandemic
- Freight Megaregional Planning and Financial Policy
- Global Transportation Megaregion/Megaproject Best Practices Manual
- Special Legislation and Megaregion Transit Planning
- * An Operational Platform for Modeling Multi-Modal Transportation Investments in the Northeast Corridor Megaregion
- Development of an Acoustic Method to Collect Studded Tire Traffic Data



Sub-categories in CAVs



1) Adaptive Signal Control Algorithms for Connected Vehicles

- Purpose: To explore deployment of connected vehicles (CVs) data for traffic signal control. This project aims at communication protocols both connectivity, type of data, data security, and detection.
- Approach: To develop signal control algorithms from connected roadway users (motorized and nonmotorized) considering the information shared in two-way communications (i.e., V2I, I2V, I2I, and V2V).



2) Hierarchical priority-based Control of Signalized Intersections in Semi-Connected Corridors

- Project Objective
 - To develop efficient distributed yet coordinated algorithms to control signalized intersections in connected and semi-connected (when not all vehicles have connectivity capability or refrain from sharing intentions for privacy reasons) corridors
- Major Components
 - Traffic signal optimization formulations to allow for the incorporation of connected vehicles and existing point detector data in the models
 - The *distribution of decisions* at both the *intersection* and the *corridor levels* to reduce computational complexity
 - The coordination of control decisions among various intersections by a distributed cloud-fog based communication network to push solutions towards global optimality







Signal control

3) Connected Streetcar Project

Objectives

- To create a foundation for deploying connected vehicle infrastructure and facilitating connected vehicle research
- To evaluate if a more extensive deployment of this technology could help improve streetcar system performance



Portland State University, University of Arizona, Portland State University

Network

Transit

4) Automatic safety diagnosis in connected vehicle environments

 Purpose: Construct a computational pipeline of Near-crash Diagnoses System to process the BSMs generated in the CV environment to identify near-crash events on the individual level

Basic Safety Message (BSM): a packet of data that contains information about vehicle position, heading, speed, and other information relating to a vehicle's state and predicted path

What we can learn:

- 1. The network of BSM
- 2. The criteria to identify the near-crashes events



The process of Process of BSM communication in a connected vehicle environment

Safety



Network

5) Assessment of Autonomous Vehicle Sharing for Evacuation and Disaster Relief

 Purpose: to help prepare transportation and emergency management agencies for the near future when autonomous vehicles are more prevalent.



Evacuation

6) Lane Change Hazard Analysis Using Radar Traces to Identify Conflicts and Time-To-Collision

- Purpose: Understand how drivers manage lane changes under manual driving situations
- Approach:
 - mine an existing set of radar data surrounding real-world lane change events executed by drivers relying on both conventional mirror and camera-based systems
 - develop computer-based algorithms for dealing with and managing radar traces to *identify normative lane changes as well as conflict-based events*
 - develop automated lane change systems that naturally mimic a good driver's performance
- Output: Understanding how drivers manage lane changes under manual driving situations can therefore greatly enhance and aid in the development and *implementation of automated lane change* and driver warning systems.

7) Cooperative Perception of Connected Vehicles for Safety

- Purpose: vision-based cooperative perception and accident (crash) avoidance trajectory plans two connected vehicles
 - the ego vehicle would face a potentially unseen hazard ahead but could receive safetycritical information from a vehicle in front and estimate/predict the trajectory of the potential hazard

Approach:

- a combination of algorithms and approaches based on *probabilistic random trees* (or similar) approaches and other intelligent algorithms to find the optimum ways of cooperating among the two vehicles
- Output: applicable to real-life vehicles



8) Reference Machine Vision for ADAS Functions

- Background: Lane Departure Warning (LDW) and Lane Keep Assist (LKA) systems are not yet popular because the systems are not robust due, in part, to the *lack of suitable standards for pavement markings* that enable reliable functionality of the sensor system.
- Purpose: To develop a reference Lane Detection (LD) system that will provide a benchmark for evaluating different lane markings and perception algorithms.
 - Statistical analysis of the effect of environmental factors, driving direction, lane marking material characteristics, lane making layouts, and evaluation characteristics on LD performance.

Output:

further benefit original equipment manufacturers (OEMs)

Lane Keeping

Trajectory control

9) Countermeasures to Detect and Combat Inattention While Driving Partially Automated Systems

- Purpose: To investigate and develop countermeasures for problems that can arise when human drivers are required to recognize a fault and assume manual control of a vehicle which is partially-automated
- Approach:
 - To develop and refine a *Driver Monitoring System (DMS)* for automated vehicles which will estimate the level of attentiveness the driver gives
 - To conduct a human subjects study to evaluate driving performance with and without various types of multisensory cues
- Output:
 - To validate the usefulness of the system in more realistic driving contexts designed to encourage inattentiveness



10) Cooperative Control Mechanism for Platoon Formation of Connected and Autonomous Vehicles

- Project Objective
 - To develop a novel CACC strategy, which explicitly factors CAV's acceleration and leverages it to enhance the *platoon performance* in an unreliable V2V communication context for a pure CAV platoon
 - To propose two deployable strategies to address the control delay issue
- Methodology
 - To analyze the impact of information delay and topology of information that is exchanged among vehicles on platoon dynamics
 - To determine the optimal time headway and platoon size that maximize fuel efficiency of the CAVs

Cooperative Adaptive Cruise Control



11) Using Virtual Reality Techniques to Investigating Interactions Between Fully Autonomous Vehicles and Vulnerable Road Users

- Background: Road-crossing pedestrians and bicyclists generally rely on informal communication methods, eye contact, facial expression and gestures, to interpret intentions of other road users and make decisions based on the information.
- Purpose: understand the interactions between these vulnerable road users and FAV and design proper external features of FAV to establish efficient communication method.



CAVs-List of Projects

- Emerging Approaches to Autonomous Vehicles in Transportation Policy and Planning
 Teaching the Travel Demand Flow Estimation Models: A New Deep-Learning Approach
 Using Multi-Source Data
- A Co-Simulation Study to Assess the Impacts of Connected and Autonomous Vehicles on Traffic Flow Stability during Hurricane Evacuation
- Automated Vehicle & Pedestrians' interaction
- Automated Vehicle & Drivers
- Evaluation of advanced vehicle and communication technologies through traffic microsimulation
- Automatic safety diagnosis in connected vehicle environment
- Smartphone-based incentive framework for dynamic network-level traffic congestion management
- Coordinated Demand-side Management and Traffic Control for Tight Areas

- Evaluation of Sidewalk Delivery Robot Interactions with Pedestrians and Bicyclists
- Automated Last Mile Connectivity for Vulnerable Road Users
- Assessing Pedestrians' Perceptions and Willingness to Interact with Autonomous Vehicles
- Connected Electric Vehicles: Vehicle-Pedestrian Communications to Enhance Vision Impaired Pedestrian Safety
- Machine Learning for Dynamic Airspace Configuration Towards Optimized Mobility in Emergency Situations
- Analysis of Disengagements in Semi-Autonomous Vehicles: Drivers' Takeover Performance and Operational Implications
- Exploring the Effects of Individual Differences on Tactile Display Perception in Automated Vehicles
- Towards a Smart World: Hazard Levels for Monitoring of Autonomous Vehicles' Swarms

- Impact of Smart Phones' Interaction Modality on Driving Performance for Conventional and Autonomous Vehicles
- Drivers' Response to Scenarios When Driving Connected and Autonomous Vehicles Compared to Vehicles With and Without Driver Assist Technology
- Estimating Impacts of Automated Shuttles
- Automated Vehicles Have Arrived: What's a Transit Agency to Do
- AUTONOMOUS SYSTEM
- Lane Change Hazard Analysis Using Radar Traces to Identify Conflicts and Time-To-Collision
- Cooperative Perception of Connected Vehicles for Safety
- Safety Impact Evaluation of a Narrow Automated Vehicle-Exclusive Reversible Lane on an Existing Smart Freeway
- Preventing Crashes in Mixed Traffic with Automated and Human-Driven Vehicles

Evaluation Tools for Automated Shuttle Transit Readiness of the Area ENDEAVRide
 Autonomous Delivery Vehicle as a Disruptive Technology: How to Shape the Future with a Focus on Safety?

Real-world Use of Automated Driving Systems and their Safety Consequences Analysis of Advanced Driver-Assistance Systems in Police Vehicles

- Impacts of Connected Vehicle Technology on Automated Vehicle Safety
- Creating a Smart Connected Corridor to Support Research into Connected and Automated Vehicles
- Standardized Performance Evaluation of Vehicles with Automated Capabilities
- Sensor Degradation Detection Algorithm for Automated Driving Systems
- A virtual framework will be developed to test degraded sensor states and the response of the vehicle control systems

- Improving Methods to Measure Attentiveness through Driver Monitoring
- Automated Shuttles and Buses for All Users
- Crashworthiness Compatibility Investigation of Autonomous Vehicles with Current Passenger Vehicles
- Impact of Automated Vehicle External Communication on Other Road User Behavior
- Radar and LiDAR Fusion for Scaled Vehicle Sensing
- A Sensor Fusion and Localization System for Improving Vehicle Safety In Challenging Weather Conditions
- Data Mining Twitter to Improve Automated Vehicle Safety
- Signal Awareness Applications
- Identification of Railroad Requirements for the Future Automated and Connected Vehicle (AV/CV) Environment
- Prediction of Vehicle Trajectories at Intersections Using Inverse Reinforcement Learning

Connected Vehicle Information for Improving Safety Related to Unknown or Inadequate Truck Parking

- Connected Vehicle Data Safety Applications
- Integration of Autonomous Vehicles with

Adaptive Signal Control to Enhance Mobility

- Labeling Roads with Different Types of Automated Driving Functional Requirements using Machine Learning
- Cost-Effective Designs of Smart City Technologies for Vehicular Communications
- Connected Vehicle Infrastructure for a Smart City
- Investigating the Effect of Connected Vehicles (CV) Route Guidance on Mobility and Equity

Optimum Connected Vehicle Speed Control on Signalized Roadways in Mixed Flow

- Connected-Vehicle Traffic Signal System Modeling Platform
- Connected Vehicle Safety Applications using V2X under Consideration of Bicycles, Pedestrians and Persons with Special Needs
- Optimal Charging Infrastructure Design for Battery Electric Buses
- Using Virtual Reality Techniques to Investigating Interactions Between Fully Autonomous Vehicles and Vulnerable Road users
- Cooperative Control Mechanism for Platoon Formation of Connected and Autonomous Vehicles
- Developing Decision-Making Models for AV Movements at the Unsignalized Intersections
- Development of AI-based and Control-based systems for Safe and Efficient Operations of Connected and Autonomous Vehicles
- Development of Dynamic Network Traffic Simulator for Mixed Traffic Flow under Connected and Autonomous Vehicles Phase 1+2

- Leveraging Connected and Automated Vehicles for Participatory Traffic Control
- Real-time Distributed Optimization of Traffic Signal Timing
- Trajectory Based Traffic Control with Low Penetration of Connected and Automated Vehicles
- Using Virtual Reality Techniques to Investigating Interactions Between Fully Autonomous Vehicles and Vulnerable Road users
- Exploring the Prospective Role of Connected Vehicles in Monitoring and Response to Pandemics and Disasters
- Pedestrian-Vehicle Interaction in a CAV Environment Explanatory Metrics
- Development of Machine-Learning Models for Autonomous Vehicle Decisions on Weaving Sections of Freeway Ramps

- Connected Streetcar Project
- Network Effects of Disruptive Traffic Events
- A Situation-Aware Sensing Environment For Cyclists: An Innovative And Cost-Effective Smartphone-Based Approach
- Where To? Origins And Destinations Of TNC And Transit Trips Based On Mobile Devices
- Transit In Flex: Examining Service Fragmentation Of New App-Based, On-Demand Transit Services
- Autonomous Vehicles And Their Potential To Shift Transit Ridership In Urban Areas
- Transportation Communication Tower Inspection Using Novel Uav Technologies
- Incorporating Mixed Automated Vehicle Traffic In Capacity Analysis And System Planning Decisions
- When And Where Are Dedicated Lanes Needed Under Mixed Traffic Of Automated And Non-Automated Vehicles For Optimal System Level Benefits?
- Development Of A Real-Time Roadway Debris Hazard Spotting Tool Using Connected Vehicle Data To Enhance Roadway Safety And System Efficiency
- Creative Utilization Of Urban Roadway Facilities With Predictive Safety Assessment Tool Phase 1
- Optimal driving of autonomous vehicle platoons on arterial streets to reduce fuel consumption

- Traffic Signal Optimization and Coordination in Connected Cities
- Modeling and Optimizing Ridesourcing Services in Connected and Automated Cities
- Automated Truck Lanes in Urban Area for Through and Cross Border Traffic
- Autonomous Vehicle Good Citizenry Standard
- Infrastructure Safety Support System for Smart Cities with Autonomous Vehicles
- Dynamically Adapting Driver Assistance Systems Using Driver Monitoring Technology
- Investigate the effects of V2X technologies for automated vehicles using virtual simulation and driving simulator experiments
- UF and UAB's Phase 2 demonstration study: Developing a model to support transportation system decision considering the experiences of drivers of all age groups with autonomous vehicle technology
- Perception Learning, Prediction and Motion Planning for Energy Efficient Driving of Connected and Automated Vehicles

Category 6

SHARED MOBILITY

Shared-mobility Sub-categories



List

1) New continuous approximation models for passenger and freight transportation

- Purpose: To discover new continuous approximation models for modern logistical problems, such as *last-mile delivery, the adoption of teleworking, and ridesharing.*
- Approach: To combine tools from geospatial optimization, computational geometry, and geometric probability theory to formulate
- What we can learn: How to use a small set of parameters to model a complex system, which results in a simple algebraic equation.



2) Philadelphia rideshare story: An Investigation of ride-share's impact on transit

- Purpose: to understand the impact of transportation network companies such as Uber and Lyft on public transit usage and travel behavior in the Philadelphia region.
 - I. Have UberX and Lyft increased or lowered transit ridership in the Philadelphia urbanized area? To what extent are they a complement to or substitute for transit?
 - 2. Who uses UberX and Lyft in the Philadelphia urbanized area and why?
 - 3. What *factors contribute* to the individual substitution between transit and ride-hail services in the Philadelphia urbanized area?

Approach:

- time series analyses using survey among 600 ride-hailing customers
- mixed logit to explore factors



Ride

Hailinc

3) Assessing Potential of Bike Share Networks and Active Transportation to Improve Urban Mobility, Physical Activity and Public Health Outcomes in South Carolina

- Purpose: to better understand how well the built environment infrastructure is meeting health, physical activity, and transportation needs of the Charleston community.
- Approach: Qualitative, quantitative, and geospatial methods will be used to evaluate active transportation, physical activity, and health outcomes.
 - evidence-based research and empirical measurements of active transportation mobility and perceptions of the built environment infrastructure in accommodating *short distance travel demand* in urbanized communities across the US.



4) Shared mobility services and their connection to roadway fatalities

- Purpose: investigate relations between usage of ride sourcing and road safety
- Approach: Collect real-time ride sourcing data to explain variation in road safety outcomes
 - Origin-destination data from the traffic TNC RideAustin, to examine the effect of ride sourcing exposure on road safety outcomes, including crashes, injuries, fatalities, and DWI offenses.
 - Analyzed by spatial econometrics (Spatial panel data with fixed effect)
- Findings: ride sourcing is beneficial in reducing crashes and DWI for every 10 percent increase in ride sourcing trips, expected
 - 0.12 % decrease in road crashes,
 - a 0.25 % decrease in road injuries,
 - and a 0.36 % decrease in DWI offenses,
 - not significantly associated with road fatalities



Ridesourcing: e.g. Uber, Lyft

5) Formulating Innovative Mobility Policies to Reduce Congestion

- Purpose: to leverage pooling strategies and more efficient Transportation network companies (TNC) routing to reduce deadheading and excess vehicle miles traveled (VMT).
- Approach:
 - Policy- users through promotional offers for *pooling* to *public transit stations*, employment centers, etc., and designated pickup/drop-off locations
 - Data collection- photovoice methodology: employ photographs taken by research subjects to enhance this study's assessment of designated *pickup/drop-off locations* to support [car] *pooling*

Photovoice: participatory action research that uses photography to capture the conditions in a community




6) Expanding the Capabilities of Business Commute Optimization System to Model Additional Transportation Alternatives and On-Demand Needs

- Purpose: to reducing negative environmental impacts of the transportation sector
- Approach: a travel attributes model, and a multi-objective optimization model.



Shared Mobility- List of Projects

- Incentive Design in Ride Sharing Platforms
- Shared Bus/Bike Lane Safety Analysis: Assessing Multimodal Access and Conflicts
- Ridesharing, Active Travel Behavior, and Personal Health: Implications for Shared Autonomous Vehicles
- Public Acceptance and Socio-Economic Analysis of Shared Autonomous Vehicles: Implications for Policy and Planning
- Data-Driven Optimization for E-Scooter System Design
- E-Bike Sharing And The Infrastructure Implications And Environmental Impacts Of New Technology In Transportation Systems
- Exploring A Novel Public-Private Partnership Data-Sharing Policy Through A Collaborative Arterial Traffic Management System
- Regulating The Ride: Lessons On The Evolution Of Dock-Less Bikeshare Policy In American Cities
- Incentive Design in Ride Sharing Platforms
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Others - Infrastructures

MPC-648Repairing Concrete Structures Using Near-Surface Mounted Composites with Inorganic Resins under Simulated Multi hazard Damage

- * Assessment of Safe Work Indicators in Transportation Construction Using Personal Monitoring Systems
- Improving Deep Learning Models for Bridge Management Using Physics-Based Deep Learning
- Development of LRFD Recommendations of Driven Piles on Intermediate Geo materials
- Nutrient Removal and Recovery from Storm water Using Water Treatment Residual Coated Woodchips
- Image-Based 3D Reconstruction of Utah Roadway Assets
- Loading and Wetting-Induced Settlement of Bridge Approach Embankment Materials
- Durable Bridges Using Glass Fiber Reinforced Polymer and Hybrid Reinforced Concrete Columns
- Field Performance of Asphalt Mixtures Based on Flexibility Index Result
- Studying the Use of Low-Cost Sensing Devices to Report Roadway Pavement Conditions
- Behavior of Composite-Strengthened Concrete Bridge Members under Multi-Hazard Loadings
- Learning from the Travel Experiences of Persons with Disabilities: Investigating Navigation Challenges Posed by Infrastructure
- A LiDAR-Based Approach to Quantitatively Assessing Streetscapes

Descriptive and Predictive Deep Learning Analytical Tools for Enhanced Bridge Management: Bridge
 Subtyping and Bridge Deterioration Forecasting

- Sensitivity and Accuracy Assessment of Vehicle Weigh-in-Motion System Measurement Errors Using In-Pavement Strain-Based Sensors
- Quantifying the Range of Variability in the Flexural Strength of Fiber Reinforced Concrete using Monte Carlo Simulation
- Study on Structural Performance Evaluation of Double-Tee Bridges
- Mitigation of Flooding-Related Traffic Disruptions with Green Infrastructure Stormwater Management
- Monitoring Transportation Structure Integrity Loss and Risk with Structure-From-Motion
- Sustainable Alternative to Structurally Deficient Bridges
- Uses and Challenges of Collecting LiDAR Data from a Growing Autonomous Vehicle Fleet: Implications for Infrastructure Planning and Inspection Practices
- Implementation of Precast Concrete Segments for Electrified Roadway
- Structural Fiber Reinforcement to Reduce Deck Reinforcement and Improve Long-Term Performance
- Composite Repair for Concrete Bridges Subjected to Alkali-Silica Reaction
- Development of Unmanned Aerial Vehicle (UAV) Bridge Inspection Procedures
- Development of Age and State Dependent Stochastic Model for Improved Bridge Deterioration Prediction
- Quantifying Mountain Basin Runoff Mechanisms for Better Hydrologic Design of Bridges and Culverts

- Ultra-accelerated Method to Evaluate Recycled Concrete Aggregate in New Construction
- Updating and Implementing the Grade Severity Rating System (GSRS) for Wyoming Mountain Passes
- Assessing Road Conditions for Wyoming County Gravel Roads
- Self-Centering Bridge Bent for Accelerated Bridge Construction in Seismic Regions
- Field Performance of Asphalt Pavements at Low and Intermediate Temperatures
- Development of Models for the Prediction of Shear Strength of Swelling Clays
- Composite-based Rehabilitation of Constructed Bridge Girders with Grooved Geometrics
- Rapid Set Cement for Precast Prestressed Bridge Girder Applications
- Reliability-Based Assessment of Landslide Risk Along Roadways
- Reliable Prediction of Shear Strength of Swelling Clays
- Automating Inspection and Damage Assessment of Transportation Infrastructure with Photographic Imaging
- Experimental Evaluation of a New Double Composite System for Steel Bridges
- Expansive Soil Mitigation for Transportation Earthworks by Polymer Amendment
- An Intelligent Transportation Systems Approach to Railroad Infrastructure Performance Evaluation

- Optimized Adhesive Performance in Electronic Transportation Sign Construction
- Mechanical Bar Splices for Accelerated Bridge Construction of Columns
- Pre-stress Losses and Development of Short-Term Data Acquisition System for Bridge Monitoring
- Innovative Strengthening for Deteriorated Concrete Bridges Using Embedded Composite Sheets Bonded with Polyester-silica
- Development of a Guideline for Selection of Tack Coats in South Dakota
- Methodology for Load Rating Double-Tee Bridges
- Development of Next Generation Liquefaction Database for Liquefaction-Induced Lateral Spread
- Seismic Repair of Concrete Wall Piers Using CFRP Active Confinement
- Hotspot and Sampling Analysis for Effective Maintenance Management and Performance Monitoring
- Alternative in-situ Water-Cement Meter Using a Parallel-Plate Capacitor Concept
- Screening of South Dakota Asphalt Mixes for Moisture Damage using Conventional and Innovative Approaches
- Flood Hydrograph Generation for Predicting Bridge Scour in Cohesive Soils

Bridge Monitoring through a hybrid approach leveraging a modal updating technique and an artificial intelligence (AI) method

Project Management/ Maritime/ Air Traffic

Project Management

- Guidelines for Developing and Reviewing Baseline Schedules for Wyoming Transportation Projects
 Maritime
- A New Method for Estimating Truck Queue Length at Marine Terminal Gates
- Emissions Factors Derived from Engine Load and Operating Mode Analysis; Marine Source Apportionment of Gaseous and Particulate Emissions

Air Traffic

- Airport Governance in U.S. Metro Regions: Institutional Models and their Implications for Megaregional Transport
- Remote and Virtual Air Traffic Control Tower (RVT): Safety Issues and Human Factors Considerations
- Analyzing the Role of Air-Transportation in COVID-19 Pandemic Disaster
- Usability of Urban Air Mobility: Quantitative and Qualitative Assessments of Usage in Emergency Situations
 Others
- Investigation and Improvement of the Effectiveness of a Gasoline Particle Filter

Thank you