| Request for Research Funding for FY 2021-2022 | | | |
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| **Requesting Office** | State Traffic Engineering and Operations Office | **Priority** | 5 of 15 |
| **Proposed Title** | Research on Artificial-Intelligence for Data Integration with Arterials and Freeways | | |
| **Justification** | Many urban areas suffer from congested arterial corridors and freeway interchanges. Detecting increasing demand levels as well as anticipating their evolution along freeways and arterials can help agencies quickly implement suitable traffic management strategies and significantly ameliorate their impact. An important motivation for this project is to collect data from various sensors around an interchange and freeway on-ramp and use them for improved network management by using a real-time coordinated approach.<br><br>The new breed of low-cost sensors can help realize the data collection and coordination required for this project. Video cameras are increasingly used at traffic intersections; and can be useful for tracking vehicles and their behavior within at ramp entry/exit points. Additionally, the new generation of signal controllers are capable of recording signal events as well as vehicle arrival and departure events at a very high resolution (10 Hz). This makes it now possible to compute traffic flows and performance metrics in near real-time. The use of novel information and communication technologies along with edge and cloud computing has enabled development of novel real-time systems for data collection and management for transportation applications. The goal of this project is to develop a system for alleviating congestion at interchanges and freeway on-ramps using data analytics and artificial intelligence.<br><br>Research Objectives:<br>Active traffic management implies the dynamic management of recurrent and non-recurrent congestion based on current and predicted traffic conditions. The goal of this project is to improve mobility and safety using data analytics and artificial intelligence applied in active traffic management for arterial freeway interactions. We will develop an integrated system that uses data collected from videos, RSUs and loop detectors and other sensors for this purpose. Using machine learning and artificial intelligence, we will develop techniques that will support real-time traffic management. The system developed can be expanded to other locations across Florida.<br><br>Proposed Tasks:<br>The research team will perform the following activities:<br>1. The research team will work with stakeholders in District 4 to identify interchanges of interest. The choice of interchanges will be dependent of availability of ramp metering information, loop detector data, cameras and expected impact.<br>2. The research team will develop software for collecting performance data from the ramp videos, highway videos, ramp meters, ground sensors on the highway and ramps. This system will be used to capture, process, and exchange information for both streaming and archived data.<br>3. The research team will use video cameras for tracking of vehicles at freeway entrance/exits. This information can then be used for 1) obtaining origin destination data at the interchange, 2) measuring travel time delays 2) obtaining queue lengths, and 3) estimating congestion-related measures for the interchange and the freeway.<br>4. The research team will simulate and validate the algorithms developed. They will use the data described and algorithms to conduct a sensitivity analysis, calibration, validation, and adjustment of the recommended traffic management strategies. It will evaluate the performance improvements that can potentially be achieved by using a real-time strategy for managing spillback<br>5. The research team will develop a visualization module to understand the underlying data. The user interface will allow operators to visualize the demand patterns, signalization, and operations, and to monitor emerging conditions and recommend plans for ameliorating congestion.<br>6. The research team develop real-time data collectors for loop controllers, ramp metering controllers and video processing to demonstrate the effectiveness of the system on a selected interchange | | |
| **Impact** | The new tools and methods have the potential to improve safety and mobility at interchanges. The study results will help FDOT District 1, District 5, District 7 and Florida's Turnpike Enterprise (FTE) to assess impacts of the deployed technologies and expand their implementation to similar locations statewide. | | |
| **Affected Offices** | State Traffic Engineering and Operations Office, State Safety Office, and District Traffic Operations Offices | | |
| **Existing Work** | Currently there is no Florida-specific published study focusing on the above-mentioned topics though there are some on-going studies for other types of locations. | | |

| Keywords Used In Existing Work Search **(Cannot leave blank)** | Connected vehicle, technology, Florida, Safety, Mobility. | | |
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| **Related Contracts (Give contract numbers)** | NA | | |
| **Funding Request** | $300,000 | **Anticipated Duration** | 22 Months |
| **Project Manager** | Project Manager: Raj Ponnaluri, PhD, PE, PTOE, PMP<br><br>Co-Project Manager: Mark Plass, PE | **Contracting Method** | Direct contract with the University of Florida (Dr. Sanjay Ranka) |
| **Urgency** | 1 | Arterial freeway interchanges regularly experience congestion. The proposed project will use real-world data to develop advanced traffic management tools for alleviating congestion for freeways and arterials. | |
| **Implementability** | 1 | The research results will be readily implementable. The results will be disseminated to all FDOT Districts, FHWA, with other state DOTs, and other stakeholders for immediate adoption and the realization of the benefits of such technological deployments. | |

**Project Benefits (Succinct, complete explanation)**

The research project will improve safety and mobility at arterial-freeway interchanges. The project will investigate reduction in crashes and improvement in overall reduction of motorist, pedestrian, and bicyclist collisions and conflicts.

| Project Benefits (Select all that apply and explain) | Quantifiable Benefits (units, dollars, etc…if applicable) | Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits |
|---|---|---|
| o   Materials Enhancement | | |
| o   Materials Savings | | |
| o   Time Savings | The project is expected to improve mobility of motorists. | This Project will potentially reduce delay for motorists at highway interchanges.<br><br>Data sources:<br>-   Ramp Meter Data<br>-   Video/ATSPM Dat |
| o   Lives Saved/Injuries Prevented | The project is expected to improve safety for all road users along the project limit. | This Project will potentially reduce number of crashes at highway entrances.<br>Data sources:<br>-   FDOT's crash data repository<br>-   Near Miss detection |
| o   Other (Explain) | | |

*Comments should explain and support urgency, financial benefit, and implementability scores