Potential Research Topics for FY 2012 NATSRL Program

Research Topics related with IntelliDrive

'IntelliDrive' is one of the current major ITS initiatives by US DOT. The main goal is to make real time two-way communication possible between vehicles and infrastructure (V2I) and vehicles to vehicles (V2V) through a wireless DSRC (Designated Short Range Communication) system. The types of data, expected to be available through the DSRC system, includes current speeds/locations of vehicles on the road and the operational status of vehicles, e.g., wiper activation condition, etc. Further, time-sensitive traffic/road condition information, such as accident location, ice/snow on the road, can be conveyed to the drivers in real time from Traffic Management Center through Roadside Units equipped with DSRC.

Currently in NATSRL, Dr. Imran Hayee, ECE, is working on developing a Vehicle-to-Vehicle communication system for work zone traffic conditions with a set of Roadside DSRC units.

The potential research issues with the DSRC system include:

- Smart Cruise Control (Eco-Drive)
- Smart Adaptive Traffic Signal Control
- Augmentation of existing Signal control
- Multimodal Signal Preemption and Priority Control
- Identification of Origin/Destination of traffic flows
- Automatic identification/reflection of road/weather conditions on traffic operations
- Automated Weather Alerts (in-vehicle, infrastructure-based)

Advanced Vehicle and Driver Safety Technologies/Strategies

- In-vehicle Virtual Traffic Sign system that can automatically warn drivers the upcoming traffic signs and their contents
- Automatic detection and warning systems for dangerous road, vehicle and driver conditions, including curves, lane departures/run off and driver fatigue/distraction.
- Automatic detection of deer presence/crossings on rural highways and freeways.
- New sensing technologies for detecting nearby vehicles for collision avoidance.
- New technologies for vehicle location identification including lateral position with/without GPS.
- Effective enforcement and countermeasures for red-light running at intersections.
- Automated incident/collision warning/detection systems at intersections and freeways.
- Low-cost rural highway-railroad intersection warning systems.
- Effective queue detection methods for traffic back up related to incidents and work zones.
- New strategies and devices that can improve the safety of work zones.
- New strategies/technologies for improving school zone safety.
- Intelligent stop sign that can automatically detect/warn drivers approaching an intersection.
- Driver merging assistance systems for improving the safety/efficiency of merging area.
- Identification/Forecasting of traffic conditions conducive to crashes at freeways and intersections.
- New methods for improving the safety of Pedestrians and Bicycles.

Road Weather Condition Monitoring/Prediction for Winter Road Maintenance/Traffic Management

- New sensing technologies, including vehicle-mounted sensors, for detecting and measuring snow/ice conditions on the roads including the proportion of 'bare pavement'.
- Improvement of the effectiveness of de-icing chemicals under various pavement/weather/traffic conditions
- Advanced decision support methods for optimum snow-ice treatment
- Dynamic snow plow fleet routing based upon real time weather conditions and AVL data.
- Improved anti/de-icing technologies including mobile automated anti-icing systems
- Effective strategies for improving the safety of snow plow operations, e.g., prevention of the plow truck-passenger vehicle collision under bad weather conditions
- Advanced pavement materials that can store/disseminate solar energy for anti/de-icing operations
- Reliable methods for forecasting road surface conditions for both Traveler Information and Maintenance Operations

Advanced Driver Information and Traffic Management/Operation Technologies

- New innovative wireless communication technologies, alternative to DSRC, to record and transmit real time traffic data/information for 'vehicle from/to Infrastructure' and 'vehicle to vehicle'
- Efficient methods to disseminate travel condition information to mobile devices
- Effects of online in-vehicle traffic information on drivers' response
- New technologies for traffic video data transmission
- Effective ways of representing traffic/road conditions on variable message signs, e.g., use of symbols
- New ways of Collecting and Predicting Travel time information for signalized arterials
- New technologies for obtaining real time traffic data/video in rural areas and other locations where traditional detection methods are not feasible or economical
- Improved vehicle sensing technologies, including infrastructure-based and vehicle-based, for collecting spatial data as well as spot measurements
- New traffic management strategies for freeways and arterials utilizing information technologies, e.g., social network.
- Application of vehicle signature data for intersection signal control
- Dynamic Automated Alternate Route Identification strategies for managing congestion.
- Automatic detection of vehicle occupancy, i.e., number of people inside a vehicle, for enforcing car-pool and HOT lane operations
- Traffic operational strategies incorporating non-ideal conditions, such as lane closures and emergencies

Incident/Emergency Management

- New wireless technologies to transmit and record real-time incident/emergency data
- New technologies/strategies for improved automatic incident identification and notification
- Strategies to improve incident response time in rural areas

- Effective strategies for real time coordination of multiple agencies for incident management
- Effective communication methods including variable sign languages for emergency evacuation management
- Improved strategies for emergency vehicle preemption of traffic signals
- Improvement of emergency vehicle response routing

Alternative Power Technologies for ITS Operations

- New technologies for improving efficiency of alternative power sources including solar/wind/fuel-cell systems.

Freight Transportation

- New technologies and strategies to process and move cargo and trucks more efficiently.
- Real-time identification of highway bottlenecks for truck flows and mitigation strategies
- Efficient information strategies for parking availability on key trucking corridors
- Improved sensing technologies for heavy vehicles and their weights, including weigh-in-motion detection, and applications of WIM/heavy vehicle data for enforcement/ bottleneck management