Design and Testing of a Decision Support System for Deploying Weather Responsive Traffic Signal Operations in Texas

By

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Most traffic signal timing strategies are designed assuming ideal weather conditions. Traffic detection systems, vehicle clearance intervals, and coordination timing plans are all designed assuming ideal travel speeds (i.e., speeds at or above the posted speed limit); however, adverse weather conditions, particularly snow and ice, can cause traffic to perform differently than expected. Heavy snows and rainfall can cause vehicle travel speeds to be substantially less than those used to develop traffic signal timing plans as drivers compensate for poor driving conditions. Because of losses in pavement friction, vehicle stopping distances can be greater and vehicle start-up lost times can be longer. Fog, driving rain, and blowing snow can also affect visibility to traffic signal heads, making it more difficult for drivers to see signal indications.

The Texas A&M Transportation Institute, with assistance from the Texas Department of Transportation, is developing and testing a system for developing and deploying weather responsive traffic signal timings. The system takes information about roadway surface and weather conditions in real-time, and determines the changes to traffic signal timing and intersection detector settings to improve traffic flow and safety during inclement weather conditions. Weather and roadway surface condition information is integrated with traffic data and fed into the decision support system designed to assist the traffic signal system operator in: (1) assessing the potential impacts and effects of current (and projected) weather and roadway surface conditions on operations, and (2) determining the most appropriate type of traffic signal strategy to deploy in response to deteriorating conditions. Potential traffic signal timing strategies include altering traffic detector configurations and settings to account for obscured lane markings, or reduced travel speeds; lengthening all-red clearance intervals between conflicting movements to account for increased stopping distances and reduced visibility; altering phase patterns or phase splits to reduce the potential of stopping vehicles at locations where roadway surface conditions have diminished (i.e., at a crest of up-slopes where reduced pavement friction might make it difficult to accelerate from a stop or at the bottom of down-slopes where reduced pavement friction may cause drivers to slide through intersection during clearance intervals, etc.); and implementing new coordination plans designed to provide progressions for increased traffic demands at slower speeds prior to or during a severe weather event. These new settings are sensitive to the changes in vehicle operating characteristics caused by adverse weather. The vision is to use these strategies to better match signal timing plans and parameters to the prevailing travel conditions to promote more efficient traffic operations and reduce the potential of some weather-related vehicle crashes.