High-Resolution Micro Traffic Data from Roadside LiDAR Sensors for Connected-Vehicles and New Traffic Applications

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Abstract:

The connected-vehicle crash-avoidance applications rely on real-time (location, speed and direction) information of each vehicle, pedestrian and bicyclist at a frequency of at least 1 HZ. This traffic data is named as high-resolution micro traffic data in this proposed research, meaning high-frequency high-accuracy data of each individual. High-resolution micro traffic data can be collected by conventional probe vehicles with the GPS logging function. However, probe vehicles provide only sample data of the traffic fleet on roads, while the connected vehicle system needs the data of all road users. The current connected-vehicle deployment only receives high-resolution micro traffic data from the limit number of connected-vehicles. The traditional traffic sensors such as loop detectors, video detectors, Bluetooth sensors and radar sensors mainly provide macro traffic data such as traffic flow rates, average speeds and occupancy, so the existing sensors cannot provide the micro traffic data needed by connected vehicles. Even the crowdsourced data, such as real-time travel time data from Wave, is still the macro level traffic information. A new method to collect high-resolution micro traffic data for the connected-vehicle system is needed to help the current connected-vehicle deployment and the future connected-vehicle applications. The high-resolution micro traffic data will also change existing traffic safety engineering and traffic operation. For example, the micro-level trajectories of vehicles and pedestrians at intersections can be used to analyze intersection traffic safety and signal performance with much more details than the traditional safety and performance analysis. The existing Rectangular Rapid Flash Beacon (RRFB) for midblock pedestrian crosswalks can be upgraded to an automatic pedestrian signal with the real-time high-resolution micro traffic data. Warning of wildlife crossing highways can be automatically triggered when the real-time micro traffic data shows wildlife crossing. The high-resolution micro traffic data can also support adaptive traffic signal control systems. Unconnected vehicles and pedestrians can all benefit from the high-resolution micro traffic data.

The new LiDAR technology has the capability to detect the 360-degree surrounding objects with high accuracy (centimeter level) and long measuring distance (300 feet radius or longer). This proposed research project is to develop methodologies of
extracting high-resolution micro traffic data from the roadside LIDAR sensor data. The key objectives for the research are listed in the following:

1. Development of a method to extract location and speed trajectories of vehicles from the roadside LiDAR data.
2. Development of a method to extract location and speed trajectories of pedestrians from the roadside LiDAR data.
3. Development of a method to extract location and speed trajectories of bicyclists from the roadside LiDAR data.
4. Investigate possible applications of the high-resolution micro traffic data in traffic safety engineering, traffic operation and the connected-vehicle system with sample data generated by the developed methods.