Traffic Signal Control API Based on Probe Data

1. Outline

Traffic signal control helps improve traffic safety, mitigate congestion, and reduce CO_2 emissions by appropriately determining the green light duration and other signal control parameters suitable for traffic condition of each direction at intersections. Conventionally, vehicle detectors have been used to know the traffic conditions. However, the cost incurred by their installation and maintenance has emerged as a challenge.

Meanwhile, in recent years, along with the widespread use of connected cars and smartphones, it has become possible to collect a tremendous amount of data, such as the locations and speeds of vehicles running on roads, and generate traffic information known as "probe data." The information sources of probe data are vehicles and roadside equipment are not required. Hence, probe data is superior to data collected by vehicle detectors in terms of cost and the area data can be collected and is anticipated as an effective means of knowing traffic conditions.

Against this backdrop, Sumitomo Electric Industries, Ltd. has developed a technology for knowing traffic conditions and computing signal control parameters based on probe data. The Company has also developed a probe data-based traffic signal control application programmable interface (API) with the aim of enabling traffic management agencies to improve traffic signal control using this technology with ease at a low cost, without the need to install a vehicle detector or other similar hardware, or to develop software from scratch (Fig. 1).
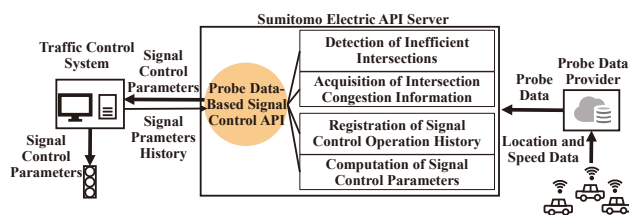

Fig. 1. Probe data-based signal control API and its usage

2. Functions

This API has the following functions. The probe data used in this API is provided by TomTom.

2-1 Detection of inefficient intersections

This function detects and returns such signalized intersections in the area specified by the user that the situation termed congestion on one side—congestion on one of the crossing roads and no congestion on the other frequently occurs. Congestion on one side is often caused by too short green light duration in the congestion direction and too long green light duration in the congestion-free direction. This type of congestion can be solved by appropriately retiming signal control parameters.

2-2 Acquisition of intersection congestion information

This function returns to the user information on the congestion on each approach at the intersection and times specified by the user.

2-3 Registration of signal control operation history

This function registers the history data of signal control parameters used to control at intersections on the API server. The registered history data is utilized together with probe data to compute optimum signal control parameters for the traffic conditions of the intersection.

2-4 Computation of signal control parameters

This function computes and returns optimum signal control parameters for the traffic conditions of the intersection specified by the user. Using real-time probe data, signal control parameters appropriate for the current traffic conditions can be computed. Also, using accumulated probe data, signal control parameters suitable for steady-state traffic conditions can be computed.

3. Features

3-1 Remote Detection of inefficient intersections

Use of this API facilitates the detection of inefficient intersections by checking signal control at all intersections in an area including intersections with no vehicle detector installed—this has been previously difficult due to personnel and budget reasons. By acquiring information on inefficient intersections to detect intersections creating congestion on one side and acquiring intersection congestion information to ascertain the time-series variation in congestion at those intersections, it becomes possible to identify and prioritize intersections needing improved signal control.

3-2 Retiming fixed-cycle control

Intersections with no vehicle detector installed adopt fixed-time control, choosing and implementing signal control parameters created and set in advance according to time of the day and days of the week. For inefficient intersections, by using the registration of signal control operation history and computation of signal control parameters, it becomes possible to compute a retiming plan of signal control parameters according to time of the day and days of the week without conducting a field survey.

3-3 Real-time signal control without using vehicle detectors

It is desirable at intersections with considerable fluctuations in traffic conditions to know the traffic conditions in real time and compute and implement signal control parameters. For these intersections, it is possible to carry out real-time signal control suitable for the traffic conditions without installing costly vehicle detectors by performing the registration of signal control operation history and computation of signal control parameters at short frequency. Furthermore, another viable solution is to use this API temporarily or permanently, not only at intersections with no vehicle detector installed but also at intersections with failed vehicle detectors.