# Latest and Future Trends in Research and Development Utilizing ETC. 2.0

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## 1. Introduction

In recent years, the situation of Japan's society and economy is becoming more severe. Typical examples include a rapidly aging population with a declining birth rate, increased disaster risks caused by climate change, and fiercer global competition. Above all, the country's population peaked at 128 million in 2010 and started to decline. What is worse, the speed of the decline and aging is extremely high. This caused a rapid decrease in the workforce that supports the economy. To maintain the present economic growth, it is essential to improve productivity by cutting waste in society such as relieving traffic congestion.

For this purpose, wise use of roads, an intangible aspect, is important in addition to the improvement of road networks, a tangible aspect. What is especially needed is to identify the causes of road congestion based on data and take efficient measures precisely where they are needed, as well as to mitigate congestion and improve efficiency in the use of roads by using existing road networks and introducing a wise toll system with a focus on the rate of use. It is also necessary to disseminate nationwide a system to prevent accidents on a scientific basis by using data and identifying the points of high accident risk beforehand.

I would like to introduce NILIM's latest efforts to put into practice the policy of utilizing roads efficiently and effectively by using new ICT technologies, which are rapidly developing.

## 2. Road Traffic Investigation Using ETC. 2.0

In order to take efficient measures against congestion and effective measures for traffic safety, it is essential to grasp the current situation of road traffic accurately in the first place.

Major traffic censuses have been conducted by means of stationary observation. Typical examples are a once-in-five-year road traffic census and traffic measurement and investigation by the traffic counter. ETC. 2.0, however, can constantly monitor the moving points of an individual car as data and therefore can grasp the actual condition of the traffic directly and accurately. Significant advances are expected in both the accuracy of road traffic analysis and the provision of appropriate service for users.

Compared with the conventional investigations that use traffic counters and probing by private-sector businesses, traffic investigation using ETC. 2.0 has the following characteristics:

| | Traffic Counter | Probing by private-sector businesses | ETC. 2.0 Probing data |
|---|---|---|---|
| What to acquire | Speed at the point where a traffic counter is installed. | Interval velocity calculated from the measured location data | **Spot speed** at the point of measurement and **interval velocity** calculated from the measured location data |
| Type of speed acquired | Spot speed | Interval velocity | **Spot speed and interval velocity** |
| Interval | Between points where traffic counters are installed | By DRM section | Can be set arbitrarily (DRM section in principle) |
| Interval of collection | Five minutes or one hour | Fifteen minutes | **Can be set arbitrarily (fifteen minutes in principle)** |
| Immediacy | Quick estimation on the day. Fixed value can be analyzed about one month later. | Can be analyzed about one and a half month later. | **Quick estimation next day. Fixed value can be analyzed about one month later.** |
| Scope of investigation | Number of spots where the counter is installed: about 1,000 | Nationwide | Nationwide (expressway and directly-controlled national roads in the main) |

Schematic view

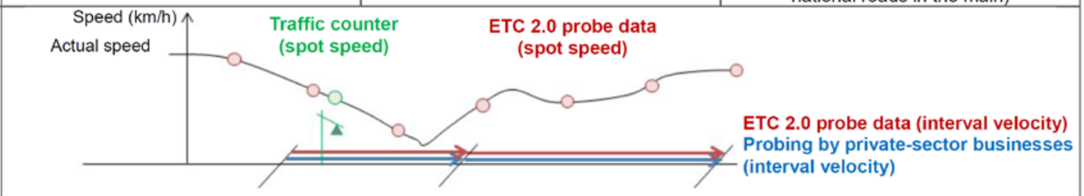



Figure 1: Comparison of the Characteristics of Research Methodologies

1. Able to grasp driving speed at a specific point
   (A traffic counter grasps data at a fixed point and probing grasps the average travel speed of a specific section.)
2. Able to grasp the momentary value at a specific point in time
   (The traffic census grasps an average of a day in five years, the traffic counter does an average for five minutes or one hour, and probing does average transit time of a specific sector.)
3. Immediacy
   (The traffic counter and probing at the end of the following month and ETC. 2.0 the following day)

## 3. Analysis of Investigation Data Using ETC. 2.0

Data of the coordinate position and speed of a car with ETC. 2.0 is obtained at 200 m pitch. By superposing the data in terms of space and time, the movement of the car could be reproduced as if it were continuously measured.

By analyzing the continued data, the current status of traffic can be grasped in detail. The following are concrete examples of analyses.

Example of analysis:

i More sophisticated and efficient investigation of the actual condition of congestion

ii Development of a method to grasp the traffic conditions of roads in residential areas

iii Analysis of the traffic for tourist cars in the Tsukuba-san area

iv Development of a method to grasp the traffic conditions of orbital expressways

As for the details of the analyzed cases, see the article of each case.

4. Possibility of the Measures using ETC 2.0

By using ETC. 2.0 data, we can implement PDCA promptly at the point where measures against congestion and for traffic safety were taken. NILIM believes that following measures will be possible by revising the specifications for ETC in-vehicle units to enable detailed analyses and building data of each traffic lane for road maps in anticipation of automated driving, while establishing a system that enables immediate analysis by improving the data analysis infrastructure such as servers.

i Introduction of real-time TDM

If it is possible to process ETC. 2.0 data from a specific area on a real-time basis, tolling, entrance restrictions, and lane control according to the degree of congestion will also be possible.

ii Prediction of danger based on the road structure and behavior of a car

If the accuracy of location data improves to the level of dozens centimeters from the improvement of a quasi-zenith satellite system and 3D data of road structure are easily obtained by the development of sensing technologies, it will be possible to grasp the cause-and-effect relationship between the road structure and the behavior of a car in detail and, therefore, to predict the occurrence of danger.

iii Automated driving based on the characteristics of traffic of each lane

If DRM is expanded to include the data of each traffic lane, it will be possible to grasp the running condition of each lane and support the optimization of automated driving.

We at the Road Traffic Department would like to continue to support the efforts that contribute to the mitigation of congestion or traffic safety in order to improve productivity.

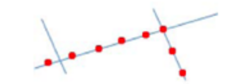
| Data classification / Data items | | Data of driving history | | Data of travel time by link | | Total of the data of travel time by link |
|---|---|---|---|---|---|---|
| Outline of data | → | Driving history of each car (Latitude and longitude) | | Travel time by driving link of each car | | Travel time in the unit of 15 minutes of each link (average, dispersion, etc.) |
| Car data (basic data) | Map matching of the latitude and longitude data obtained from a car navigation | Yes (model, purpose of use, etc.) | → | Yes (model, purpose of use, etc.) | | No (as the data is total) |
| Car location data (driving history) | | Latitude and longitude (by 100 m or 200 m) | Calculating the travel time and speed in the unit of link | In the unit of link (time of entrance and exist, travel time) | → Totaling | In the unit of link (average travel time, dispersion, etc.) |
| Expected purpose of use of the analysis | | Analysis of **spot speed and OD (origin and destination)** | | Analysis of a **driving route** | | Analysis of **travel time in a section** |
| Schematic view of data | | Driving history of each car (spots)  | | Driving route and travel time of each car  | | Average travel time of each link  |

Figure 2: Characteristics of ETC. 2.0 Data