Development of the Method for Grasping the Traffic State of Orbital Expressways Utilizing ETC 2.0 Probe Information

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1. Introduction

As the development of expressway networks, such as three loop highways, in the Tokyo metropolitan area advances, the necessity of efforts for the smart use of road networks that fully fulfills the function of road networks through the operation of roads has been pointed out. In order to implement road operation measures effectively, it is necessary to monitor the traffic state daily to detect the occurrence of problems, such as traffic congestion, immediately. Although ETC 2.0 probe information and vehicle detector data are effective for the monitoring of traffic states, ETC 2.0 probe information generates a time lag until a vehicle passes a roadside device and vehicle detector data only grasps the traffic state in the section where it is installed. Therefore, NILIM is carrying out research and development on supplemental technologies for grasping the traffic state of orbital expressways on a real time basis by combining ETC 2.0 probe information, vehicle detector data, and simulation technology.

2. Outline of the Method for Grasping Traffic State

We collected traffic-related data, such as ETC 2.0 probe information, and vehicle detector data online and inputted it sequentially in order to consider the method for monitoring the traffic state at that time. Figure 1 shows the data fusion concept used in this method. This method estimates the traffic state where the traffic amount at the vehicle detector position (the number of vehicles which cross the horizontal axis of the figure on the right within five minutes) and the vehicular swept path of probe vehicles (heavy line in the figure) are consistent with the observed values (flow rate, velocity, and density) through the traffic simulation based on the kinematic wave theory. This method can determine the range of traffic congestion in more detail as shown in the figure (orange and red areas). Based on three loop highways in the Tokyo metropolitan area as a model, we created a prototype using ETC 2.0 probe information.

3. Confirmation of Reproducibility

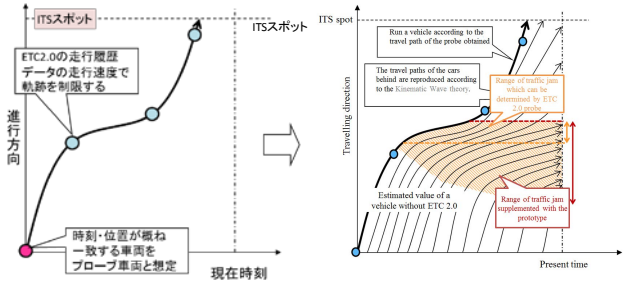

Figure 1　Fusion of ETC 2.0 data and vehicle detector data

As a result of confirming the reproducibility of the travel velocity of the prototype, it was confirmed that prominent traffic congestion sections were basically reproduced (Figure 2). On the other hand, the prototype has a tendency to calculate velocity higher than the actual velocity. Although ETC 2.0 probe information is introduced into the simulation, vehicle detector data is not considered, and the amount of traffic is not adjusted. Therefore, the overall traffic amount is on the decline.

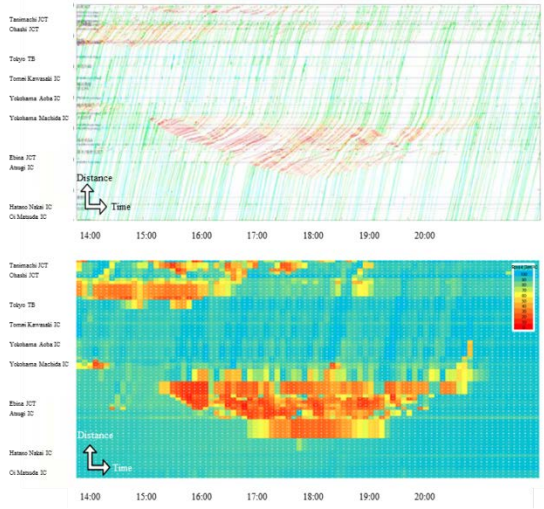

Figure 2 Comparison of time-space hodographs
(Upper one: ETC 2.0 probe travel history information,
Lower one: Result of the calculation using the prototype)

4. Future development

In the future, we are planning to introduce vehicle detector data in the prototype to enhance the reproducibility of quantitative index such as traffic amount. In addition, we will also work to conduct research on the traffic state monitoring indexes as required to take various road operation measures in order to visualize the indexes.