

# **A Development of Traffic Prediction System Based on Real-time Simulation**

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## **ABSTRACT**

The purpose of this research is to develop a traffic prediction system by using the real-time information (vehicle detector, VICS etc) and the existent traffic simulation. It is to watch conditions to change with the time always and to hold traffic control suitably. Recently, a traffic jam happens chronically frequently, and it is a big social problem in the urban expressway. To control this traffic safely and smoothly, it is important to give a plan more rapidly and suitably. We think that this system is useful as an examination and evaluation tool of the policy by predicting future short-term traffic conditions from the present traffic conditions.

## **1. INTRODUCTION**

Recently, chronic traffic jam often happens at the urban expressway in Japan. So, it is a big social problem. To control the traffic-flow safely and smoothly, it is important to take more

rapid and suitable measures. In this research, we developed a traffic prediction system based on the real-time simulation.

"Real-time simulation" is the system that using the real-time information such as a vehicles sensor and VICS always reproduces the present condition.

This traffic prediction system is a tool that predicts future short-term traffic conditions with estimating inflow traffic quantity to the network based on the present condition reproduced by this real-time simulation.

We think that road control service at the urban expressway can be supported by using this system.

## **2. REAL-TIME PREDICTION SYSTEM**

A real-time prediction system in this research has the following features.

This system acquires new information from the vehicle detectors and so on connected on-line and guesses present traffic condition.

This system rebuilds the present traffic condition that it guesses on the simulation, and predicts near future traffic conditions from that time.

Furthermore, the system has the following features to realize these.

"The OD ratio" of the vehicles that exist on the link in the prediction start time is estimated by using "the real-time simulation" which moves vehicles in accordance with a change in link trip time until that time of that day in this system. And, this system guesses present traffic conditions from "the OD ratio", and it has a "HOT START" function to read in "the prediction simulation" in the prediction start time.

A system has the "OD traffic prediction" function that time series predicts OD traffic quantity that it flows in to the network until a future moment to predict from the prediction start moment. The simulation models uses "SOUND (Simulation On Urban road Network with Dynamic route guidance)<sup>1),2)</sup>.

### 3. FRAMEWORK OF THE PREDICTION SYSTEM

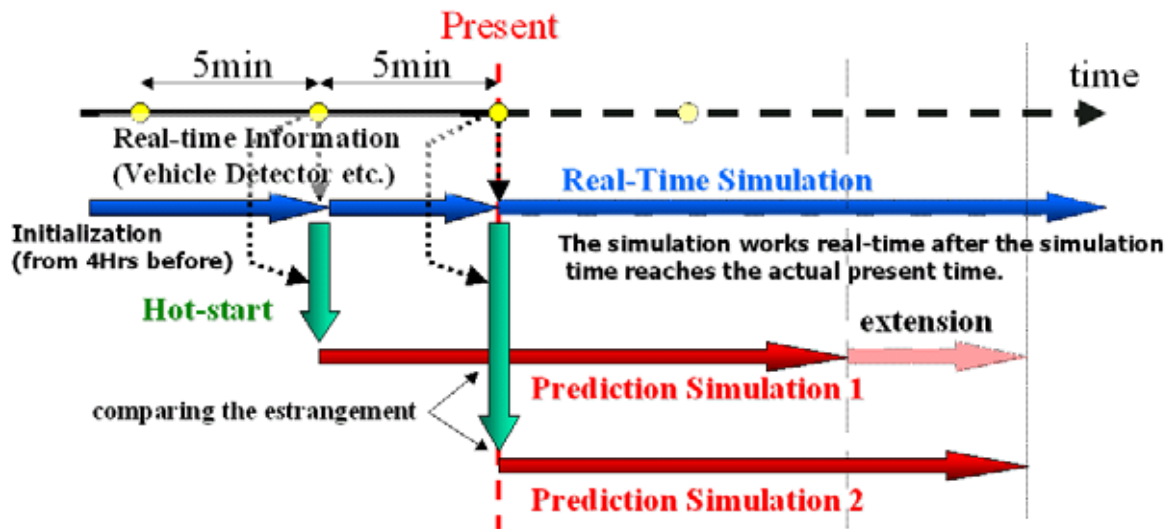


Fig. 1 Framework

The framework of the real-time prediction system is shown in Fig.1. It supposes that real-time information from the vehicle sensor is acquired in the interval of 5 minutes. The real-time simulation is initialized from before by 4 hours in the estimate opening time, and works real-time after the simulation time reaches the actual present time. When predicting, the present traffic condition is created by the hot start and is loaded in the prediction simulation as the input data of the simulation.

When the present is estimated by another simulation when executing a hot start, this system judges whether or not to start up an estimate simulation newly about whether it extends estimate by the estrangement of existing simulation and the traffic status which was created by the hot start.

#### a. Real-time Simulation

In the prediction system, the destination information of the individual vehicle that exists on the link is necessary. But, this can't be gotten from the real-time information. The real-time simulation estimates the destination information of Individual vehicle (Fig.2).

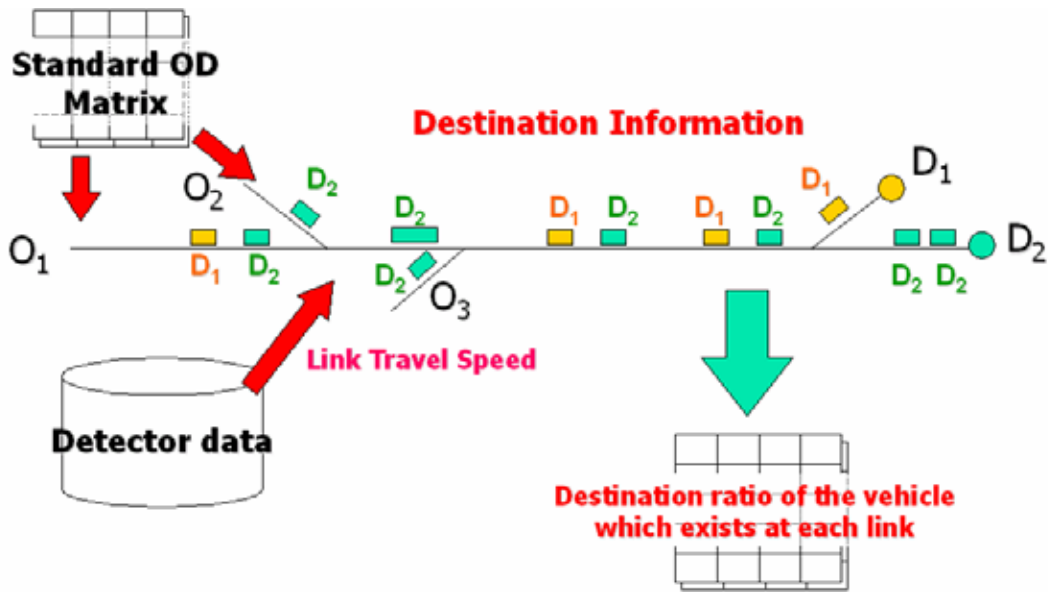


Fig. 2 Real-time Simulation

### b. Prediction Simulation

The prediction simulation is the function to predict traffic condition to the time in the future to want to estimate from the traffic status at the time of the prediction start. The prediction simulation is composed “Hot-Start” and “OD traffic quantity prediction”.

#### Hot-Start

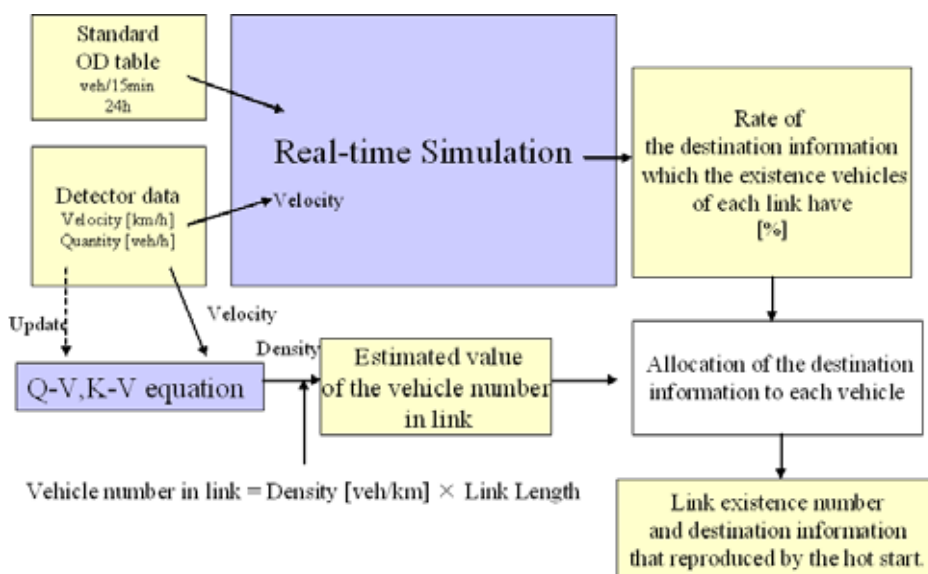


Fig. 3 Hot Start data flow

“Hot-Start” extends to suit actual traffic condition that can get from the real-time information and “the OD ratio” which is the output of the real-time simulation, and allocates destination information for each vehicle that exists at each link(Fig.3).

#### OD traffic quantity prediction

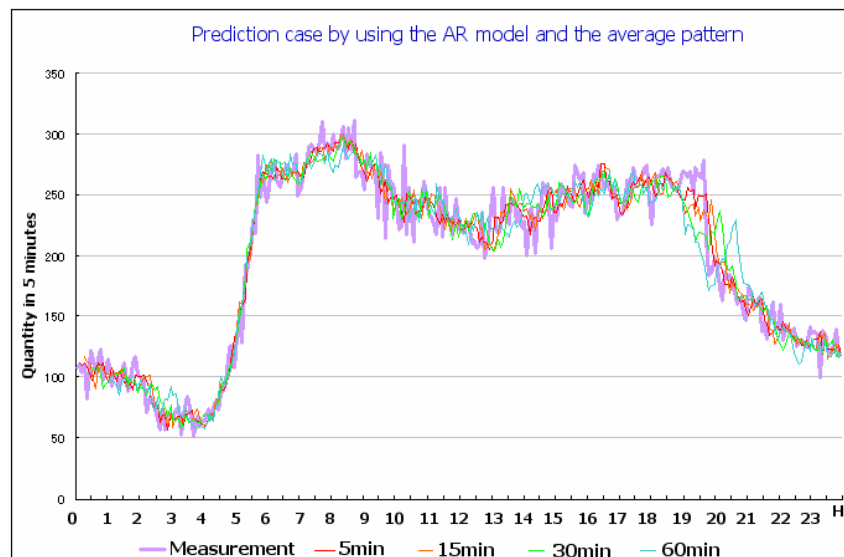
“OD traffic quantity prediction” is the function to predict the OD traffic that flows in to the network to the time in the future to want to predict from the prediction start time in the time series. It uses an average traffic quantity pattern and AR model in the past for the prediction of the OD traffic quantity (Fig.4).

$$X_t = \phi_1 X_{t-1} + \dots + \phi_p X_{t-p} + Z_t$$

$$t = 0, \pm 1, \dots$$

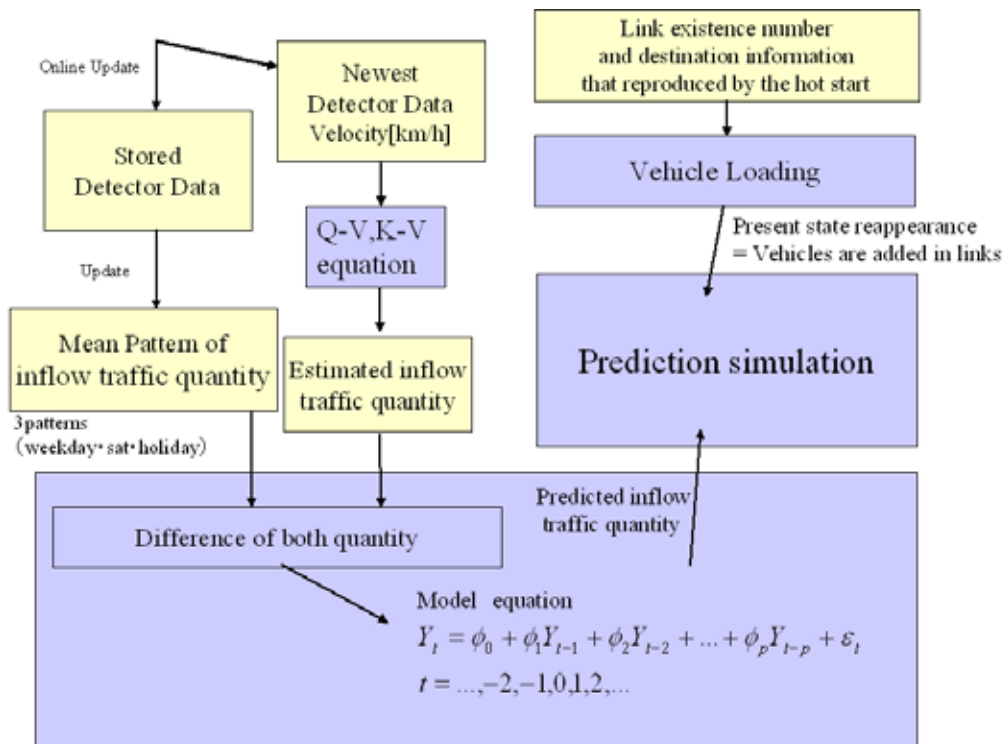
**Fig. 4 prediction equation (AR-model)**

The case that estimated traffic using this technique is shown in the fig.5.



**Fig. 5 The case that estimated traffic using AR Model and Average Pattern**

The following figure shows the data flow on the prediction system (Fig.6).



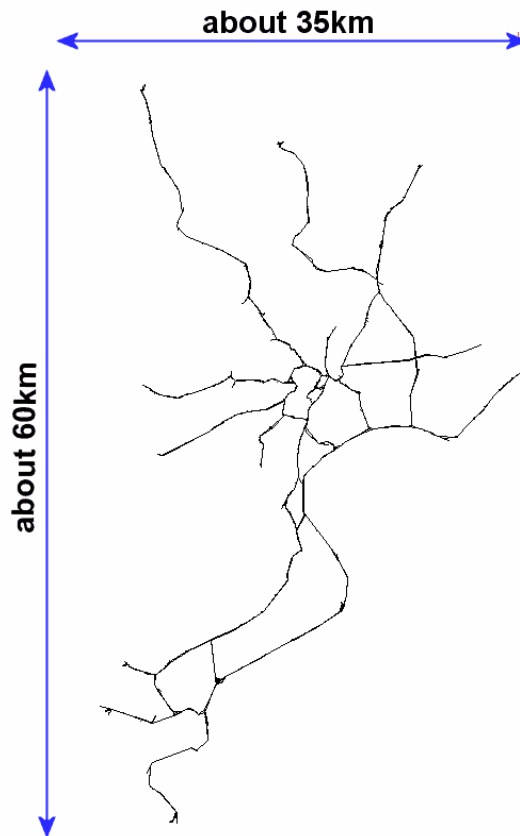
**Fig. 6 Prediction system data flow**

#### 4. Future Works

After system building is completed, we will try system verification. System verification is carried out in the all of MEX(Fig.7).

- Entire length: 283.3km
- Number of links to use for the simulation: 1388 Links
- Points: 368Points

And, the standard OD table was made based on the investigation that MEX carried it out.



**Fig. 7 Network for the system verification (All MEX roads)**

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