A REAL-TIME TRAFFIC INFORMATION SYSTEM (RTIS)
BASED ON GPS FLOATING VEHICLE TECHNOLOGY

Tianjiao Wang and Jianping Wu

Transportation Research Group, School of Civil Engineering and the Environment
University of Southampton, Southampton, United Kingdom
t.wang@soton.ac.uk

INTRODUCTION

Floating vehicle technology has long been considered as an extremely cost effective means of collecting real-time traffic information when compared with the alternative of installing fixed instruments and has been increasingly popular as essential data source for traffic information and for most Intelligent Transport Systems (ITS). Every appropriately equipped vehicle acts as a sensor for the road network. Based on these data, traffic jams can be identified, travel time can be calculated, and traffic reports can be instantly generated. (Simmons N. and others, 2002)

This paper introduces the framework, key algorithms and technologies of a Real-time Traffic Information System (RTIS) based on GPS floating vehicle data in Hangzhou, China. With GPS-based Floating Vehicle Data (FVD) from 3500 taxis and 2000 buses, the RTIS system can provide real-time traffic information of the urban road network, both to traffic police for traffic management and to the public, in a cost effective way.

Hangzhou is located 180 km southwest of Shanghai and is the capital of Zhejiang province. The central six urban districts occupy 682 km² and have 1,910,000 residents. The 2005 overall rank of Hangzhou among all the Chinese cities is No.5. In 2004, 2005, 2006 Forbes magazine ranked Hangzhou the number 1 city in China for business. (Hangzhou Statistics Online, 2007)

Public transport within Hangzhou city is primarily in the form of an extensive public bus network. Taxis are also very common. The city’s taxi service is rated among the top in China. In addition, 1200 buses from 69 lines and 3300 taxis have been equipped with GPS, forming an extensive floating vehicle data source.

SYSTEM CONFIGURATION

System Framework

Floating vehicle data from 3300 taxis and 1200 buses are collected in an interval of 15 or 30 seconds and then sent via wireless communication to a control centre where the GPS data is collated and analysed using traffic models (Figure 1).
The system has main functions as follows:

1. GPS floating vehicle data collection, transmission, and data fusion;
2. Database for GPS floating vehicle data;
3. Passenger O/D distribution matrix;
4. Journey time estimation and route optimisation;
5. Road incident detection; and

**Key Algorithms and Technologies**

GPS Data Mapping Algorithm: A Grid Mapping technique was developed to map discrete GPS data to vehicles’ actual positions on the road network. This unique technique uses “mapping grid” combined with “history memory” to quicken the mapping process so that vast GPS data can be processed within small time interval without losing precision.

Journey Time Estimation and Route Optimisation: Journey time estimation and route optimisation consider both real-time traffic information from floating vehicle data and data from historical database to make the result more reliable. An adaptive parameter estimation method was applied combining real-time data and time-of-day historical data for estimating road travel time. An improved shortest route algorithm for Hamilton Loop was developed for generating the optimum route. These two methods were justified from vast empirical data.

Road Incident Detection: Prompt and accurate detection of incidents is critical to the effective implementation of management strategies. This is achieved in RTIS by analysing traffic data with a bivariate analysis model using two variables: the average travel time of floating vehicles and the travel time differences between adjacent time intervals. Data from historical database were also applied to make the detection result more reliable.
SYSTEM VALIDATION

Various types of roads including arteries, sub arteries, minor roads and one-way streets were chosen for system validation. The main parameters chosen for validation are road section average speed and road section travel time. The two typical parameters for each road were collected by video cameras and then were compared to those generated by the system so that the accuracy and reliability of the system can be analysed and validated. The validation process considered different time-of-day including AM peak hours, PM peak hours and normal hours and lasted for months. Figure 2 shows a typical validation result. The system was validated to be effectual and reliable.

![Figure 2 A typical validation result](image)

FUTURE PLAN – THE PHASE 2 DEVELOPMENT

The RTIS system had gain significant success in the Phase 1 Research and Development and proved to be transferable for application in other cities. Recently the Phase 2 has started and focused on the integration of floating vehicle data with various existing data source such as inductive loops, video cameras to form a more holistic and robust real-time traffic information platform. More reliable data will be also stored in the historical database which is the basis for providing more complex services.

REFERENCES
