ROAD TRAFFIC CONTROL AND COMPUTER TECHNOLOGY

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1. Introduction

Road traffic control aims at disolution of traffic congestion, reduction of traffic accidents, air pollution, noise and fuel consumption. Road traffic control is applied to the major streets in cities or to the freeways intra and inter cities. The control methods include;

1. Traffic signal control
2. Variable speed regulation
3. Lane control
4. Inflow and outflow control
5. Route control

Presentation of traffic informations on congestion, accidents and route guidance is also a useful tool for traffic control, because these informations may change the decision of drivers on their action.

Computerized area control of traffic signals was first introduced at Tronto in Canada, and inflow control on the freeway was begun at Chicago in U.S.A. both in 1963. In 1970's, many major cities in the world adopted the computerized traffic signal control systems to releave the heavy traffic congestion by which they were confronted. Several new strategies for realizing the other objectives were also introduced in 1970's. Bus priority, car pooling, attatching importance to pedestrians, reducing air pollusion and noise were among them.

2. Traffic surveillance and control systems for streets

2.1 Control techniques

Time delay and stopping of vehicles at the intersections can be reduced by appropriate operations for traffic signals, such as coordination of signals in arterials and responding for traffic flow. The cycle, the split and offset are the three fundamental parameters for traffic signals, which determine the interval, the duration and the phase of the green period of signals.

Optimizing techniques on these parameters by using experimental formulae, dynamic programming or simulation have been developed, and the methods named SIGOP or TRANSYT are used. Optimization of signal parameters on many intersections in the two-dimentional network of arterials, as well as real-time adjustment of signal parameters responding the measured traffic flow achived by using computers.

2.2 Configuration of the system

The traffic surveillance and control system for streets is composed of the center system, the road-side equipments and the communication lines which connect them to the center system.

Vehicle detectors of the electromagnetic type or the ultrasonic type are installed usually at the links approaching to the intersections. They detect the presence of vehicles on them at the interval of about 100 msec. These data are modulated and sent through the transmission lines to the center system, and into the central processor unit(CPU) via the demodulating units and the communication control units(CCU).

They are processed by the CPU. The traffic volume and the mean speed of vehicles of the links in every 1~5 minutes are calculated, and the optimum signal parameters reflecting them are determined.

The data which give instructions for operation of the signals are sent through the transmission lines. The signal controllers at the road-side receive them and drive the signal lights.

The center system also has the control console for the operators and the display panel which indicates the situation of traffic flow.

2.3 The system for the Tokyo metropolitan area

The traffic surveillance and control system for the streets in the Tokyo metropolitan area in Japan has about 5,000 vehicle detectors and as many signal controllers. A huge computer system of the two-stage hierarchical composition is adopted. Many ITV cameras and changeable message signs are used. The boose for radio broadcasting are also installed inside the control center. The system started in 1970, and is increasing its scale continuously.

3. Traffic information and control systems for freeways

3.1 Control methods

Traffic control is also useful for freeways to improve bad or abnormal traffic situations due to over saturation or accidents. The freeways have usualy no traffic signals at the intersections, so inflow and outflow control or route control become the major control methods.

As the Q-K(traffic volume vs density) relation in the freeway section shows the characteristic like a parabolic function, which has the maximum traffic volume at the optimum density. By restricting inflow traffic volume at the entrances of the freeway(on-ramp) to keep the density less than the optimum volume, total delay time of vehicles in the system can be reduced. Ramp metering is the major technique for inflow control, in which the traffic signals at the on-ramp are operated to allow entrance of one or a few vehicles at the short cycle time. Lane closing at the entrance is also used.

3.2 Configuration of the system

The traffic information and control system for freeways has the configuration similar to the system for streets mentioned above. Instead of traffic signals at the intersection for streers, ramp metering equipments and variable message signs are used as the road-side equipments in the system.

Elaborate optimization of the signal parameters are not necessary in the system. Operation on ramp metering is localized in some systems. Presentation of traffic information with variable message signs are executed automatically in some systems and manually in the other systems.

3.3 The system for the Tokyo metropolitan expressway

The traffic control system for the Tokyo metropolitan expressway involves two subsystems, each of which was introduced in 1973 and in 1980 respectively. As the road-side equipments, vehicle detectors at about 700 sites, variable message signs at about 400 sites, 270 ITV cameras and 700 emergency telephones are installed in total. Lane closing in every 30 minutes at the toll gates are executed. Variable message signs with 10 Chinese characters are in fully automatic operation.

Improvement of the system is now being planned, in which replace of the old computer system to the new one is included.

4. Recent topics

4.1 The road-side radio

Presentation of the traffic informations by the radio broadcasting systems has the advantages of abundancy and frexibility on the informations, easiness to listen by the drivers and quickness in response to the emergent situations. Lackness of the continuous accessibility and of the locality can be covered with the road-side radio, in which the cable antennae or the small dipole antennae are installed at the road-side, and the localized traffic informations are presented by using the conventional carborne AM radio receiver.

The HAR system in U.S.A. is the typical example which is in operation. Testing with the several systems are undergoing in Japan.

4.2 The route guidance systems

Presentation of the traffic informations such as the estimated travel time along the route or the recommendation on the choice of the routes is expected to the traffic control systems in the near future.

Techniques for identification of the vehicles at the fixed locations are being developed. Travel time along the two routes from the Narita airport to the central district of Tokyo is being measured by the system with the road-side equipments and the car-borne equipments instlled in the buses. The information on the alternative routes are presented to the drivers via the variable message signs. Dynamic route guidance for each vehicles would be possible, when the car-borne equipments with displays are installed in them.