

The traffic safety analysis with the simulation based approach

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1. Introduction

The traffic simulator would be created for considering the specific traffic safety measures to the intersection. Even though the overall accidents can be estimated statistically, the essential factors would be pointed out from the observation of individual accidents. Traffic flow in the black spot intersection can be simulated through the detail description of individual vehicles. The serious elements for traffic safety measure would be discussed from the observations in virtual intersection.

2. The statistics in the intersection

The black spots on urban network of Gifu have been summarized for prevention of traffic accidents. The intersection can be specified as a typical black spot among the accident database. The target site, Mieji signalized intersection is located at the north end of city centre to connect the suburban area. The statistics of accident between 1998 and 2002 are shown in **Figure 1**.

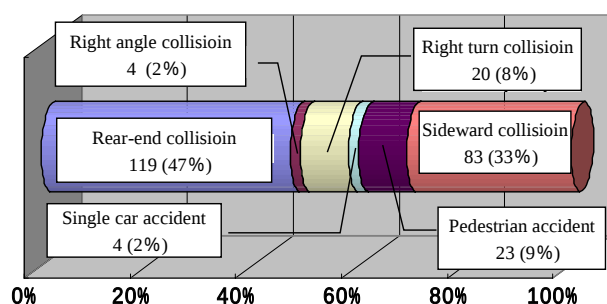


Figure 1 The statistics of traffic accidents

It should be known that rear-end collisions and sideward collisions are major types of accidents in the intersection. Particularly, the rear-end collisions are observed at the inflow points of intersection from every direction. On the other hand, the sideward collisions often occur because of the gap of line for north and south through traffic.

The observation data are collected on the spot. The survey site corresponds to $200 \times 200 \text{ m}^2$ area around the intersection. The structure of intersection can be physically determined from accumulated database of GIS. On the contrary, the dynamic change of traffic flow can be captured by video recording. Three video recorders are installed to trace the locus of individual vehicle. **Figure 2** indicates the distribution of locus in each direction for north bound vehicle.

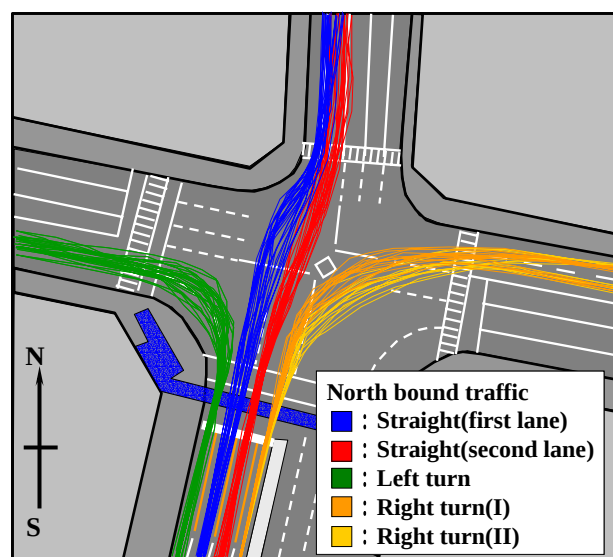


Figure 2 The database of videotape recording

The speeds of all vehicles are measured and memorized in the database as well to determine the characteristics.

3. The traffic simulation model

The individual traffic behaviour as well as accident in the intersection would be described by the simulation model. The poisson arrival is assumed to generate vehicles into the virtual intersection. All vehicles are assigned by each scanning time as 0.25 sec. As time series traffic demand is monthly varied, different conditions can be determined.

Key words: traffic accident, traffic simulation, virtual intersection, video recording, black spot, traffic safety

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A vehicle basically follows the initially determined path from the locus database. The acceleration of vehicle can be determined from the classical formulation of car following theory as follows:

$$\ddot{x}(t+T) = \lambda \frac{\dot{x}(t+T)}{x_n(t) - x_{n+1}(t)} [\dot{x}_n(t) - \dot{x}_{n+1}(t)] \quad (1)$$

Figure 3 indicates five decision points of driver to change the direction and the speed of vehicle.

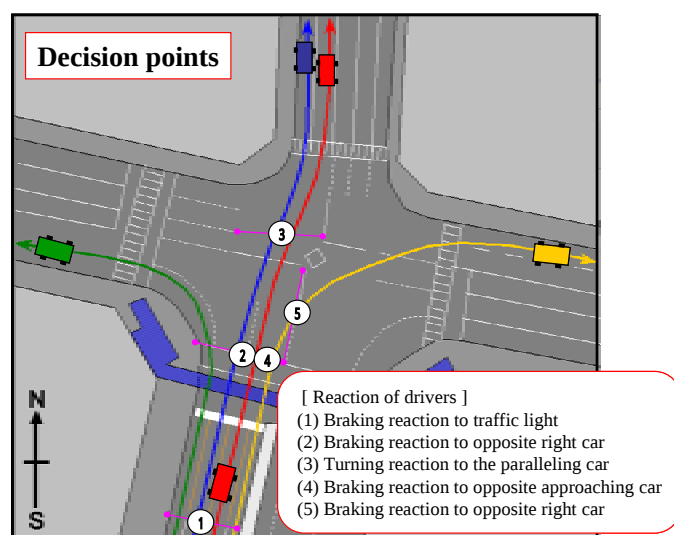


Figure 3 The decision points of drivers

The collision can be pointed out when the overlap of two vehicles is observed in the single scanning time. As a result, the characteristics of the accident pattern should be memorized into the accident database automatically.

4. Traffic safety analysis

The traffic simulator has produced traffic flow for one year corresponding to the initial condition of 2002. Thirty seven traffic accidents happen in the virtual intersection for the year. Three types of accident can be distinguished such as rear-end collision, sideward collision and right turn collision. **Figure 4** shows the distribution of the collisions. Even though small difference can be seen between the observation and the estimation, the overall number of accidents might be estimated significantly. Similar distribution can be observed in the other statistics. The distribution of rear-end collisions can be illustrated in **Figure 5**. A vehicle involving the accident should be traced with the locus and the initial conditions to know

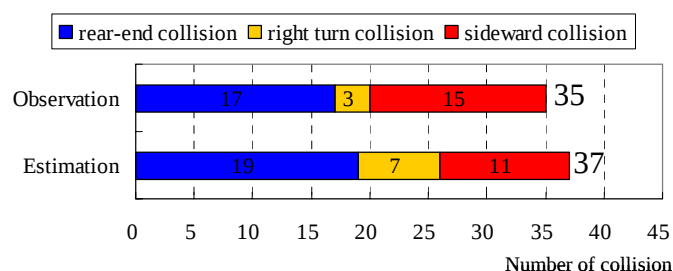


Figure 4 The distribution of collisions

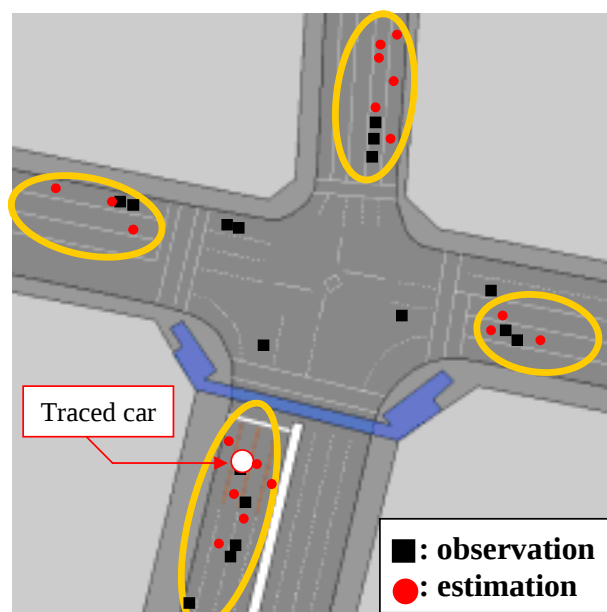


Figure 5 The distribution of rear-end collisions

the mechanism. It can be summarized from the tracing result that timing of brake and keeping distance should significantly affect to the risk of rear-end collisions.

5. Concluding Remarks

Traffic accidents can be realistically observed in the virtual intersection as results of traffic simulation. The mechanism of traffic accident would be analyzed to find the essential factors of traffic safety. Therefore, efficient traffic safety countermeasures can be summarized from the observation of virtual accidents in the simulation with different initial conditions for behaviour of vehicles. Further studies relating with determination of parameters and classification of traffic accident mechanism would be required to extend the applicability of the simulation.

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