Research on Width of Traffic Securing in winter

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Abstract. This research work has focused on the examination and verification of the influence for road user that the presence of the width of a traffic securing in winter in the snowy region, by conducting several experiments using driving simulator and the real car. And then, the management widths for senses of safety and snow removal that the road users feel safe are discussed. Experiment results has shown that the evaluation of snow removal is overall strict than the senses of safety, and the management width for senses of safety and snow removal for which the road users feel safe is to be preferred 5 meters or more.

Introduction

The problem concerning the snow removal in the road management is various in winter in the snowy cold region. The snow bank narrows the width of the road and disturbs running of the vehicle remarkably [1]. Especially on the residential road, because the frequency of clearing snow is not enough, it will also cause the road user's dissatisfaction [2, 3]. For each road administrator, because the setting of clearing snow is vague in today's road management, it is difficult to say an original judgment has to be done and well considered to the road users [4, 5]. Therefore, to solve such problem, it is necessary to reflect road user's aspect in the level of management [6, 7].

In this research, we aims to examine the width of the road that road users feel relieved for the traffic securing in winter. As one of the effective tools for the research work, we applied Driving Simulator (Hereafter, DS) to study the influence for the road user that the presence of the width of a traffic securing [8]. The DS is developed for road surface evaluation and added some new functions such as inputting real road profiles and the friction coefficients, and allows the study of the driver's behaviors for various situations which sometimes difficult or impossible to reproduce in an actual road conditions [9]. In our research work, in order to verify the effectiveness of the free running function in DS, we compared with DS and a real car of the running behavior when the obstacle was evaded. As a result, for the lateral displacement when the obstacle is evaded, there are similar tendency with a real car and DS. Therefore, we consider that DS has the running behavior without the problem on practical use.

Verification of running behavior of DS

In the research that using the driving simulator, because driver's subjectivity index, action index and running behavior index of the vehicle is measured, it is preferable that the running behavior is equal to a real car. Also, it is necessary to verify the correspondence of the simulator driving and the real car driving. Especially in the experiment that uses "Free running function", because the driver does the driving operation, the influence that individual running behavior exerts on the experiment result is exist.

In our research work, the running behavior of DS was verified from the comparison of lateral displacement when evasion the obstacle on the DS and a real car at the same condition, by using the result of existing work by MICHAELS and COZAN [10] concerning lateral displacement when a real car running was reproduced with DS.

Experiment method. The running course that had been used for the verification was designed based on existing work. The type of the running course designed by 1500m in total length and 7.5m in width, and set up the center line of 30m at intervals of 1.5m.

Also, two obstacles were set up at intervals of 600m. The obstacle was set up from the center line to the point of 2.1, 2.34, 2.67, and 2.88m respectively. The running speed is four stages (24, 48, 72, 96km/h) and the testee runs the same speed along with the center line. 25 male and female testees aged from twenties to fifties were participated the experiment.

Experiment result. Fig. 1 shows lateral displacement by the running speed at the position of each obstacle. Result in an existing work [3] and result in DS were compared respectively.

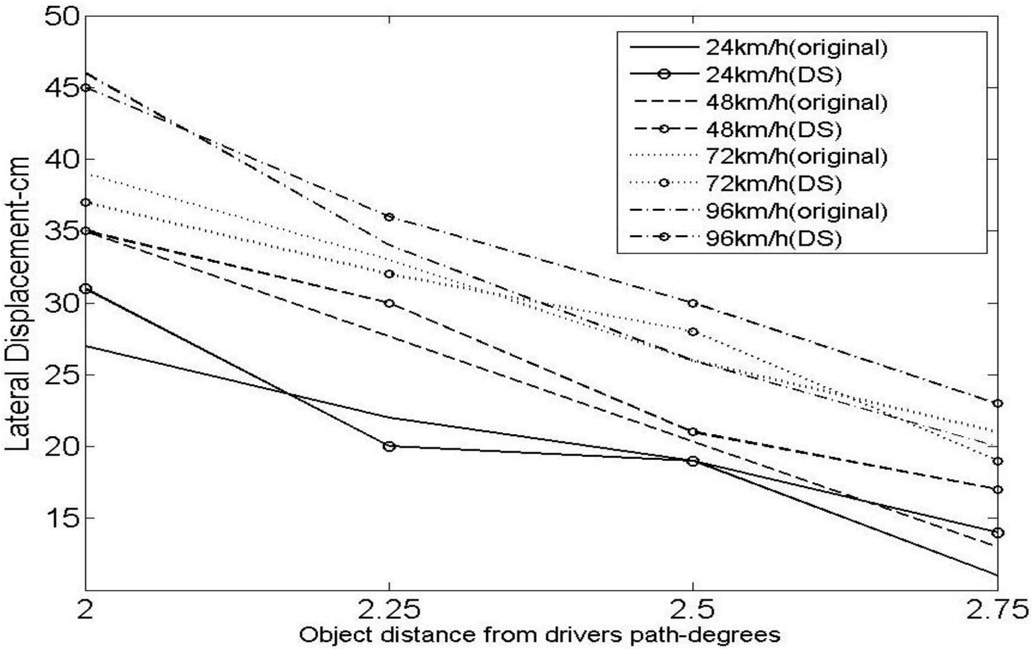


Fig. 1 Lateral displacement by position of obstacle at each running speed

The point where lateral displacement started by X.Y coordinates and the steering wheel steer corner of the log data when running was detected; lateral displacement was defined as the difference of X coordinates of the vehicle of passing over the position where X coordinates of the vehicle in the point and the obstacle were set up.

In Fig. 1, the result of DS is the same as the result of an original work: the lateral displacement becomes small when the obstacle is leaving from the center line. Also, the lateral displacement tends to grow when the running speed becoming high. Moreover, because the result of DS is the same as the result of an original work, we consider that DS has the running behavior without the problem on practical use.

The width of a traffic securing in winter in the residental road

We examined the width of the road that road users feel relieved for the traffic securing by using DS. The experiment was made when there is no obstacle in the road (experiment A), cars parked in the streets (experiment B), and the pedestrian on the road (experiment C). 25 male and female testees aged from twenties to fifties were participated the experiment.

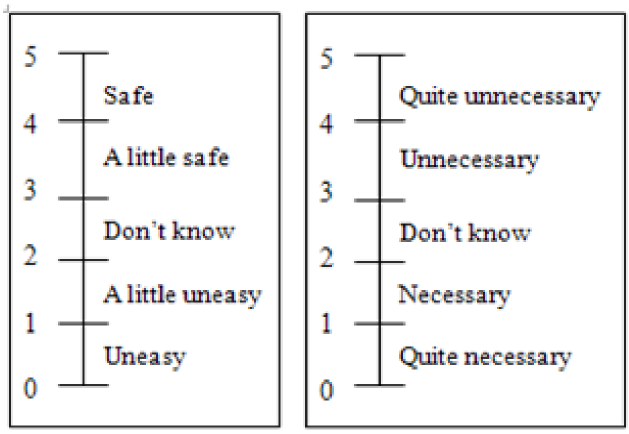
Experiment method. Experiment A: the residential road in one side lane was designed, and the running course is 500m in the evaluation section, 2.75m in width and 0.50m in the shoulder. A narrow road caused by the snow bank was assumed, the height of the snow bank was supposed as about 1.00m, and the width of a traffic securing was considered to be six patterns (6.0, 5.5, 5.0. 4.5, 4.0, and 3.5m). The vehicle used to experiment was a passenger car of 1.48m in width, and the running speed was assumed as about 30km/h that is the speed limit in the residential road. The state of the road is slippery road (friction coefficient is about 0.3).

Experiment B: at the same condition with experiment A, we made experiment with the passenger cars (1.48m in width) parked in the streets. The cars parked in the streets were arranged from the beginning point to the point of 250m, and the position was 0.2m from the roadside.

Experiment C: at the same condition with experiment A, we made experiment with the pedestrian on the road. The person (50cm of breadth of shoulders) was arranged from the beginning point to the point of 250m, and the position was 0.8m from the roadside. Moreover, in order to obtain running behavior near the reality or more in the experiment, the testee was directed that they may decelerate if feeling dangers.

After the experiment, the questionnaire survey has done. The evaluation items including the senses of safety (safe or uneasy) and the necessities of snow removal (necessary or unnecessary), as shown in Table 1. In addition to this, we also made to run in the summer road situation (the width of 6.5m and friction of 0.75) as a standard of the evaluation.

Table 1. Sense of safety and the necessity of snow removal



Experiment result and consideration. The experiment result for the relation between the senses of safety and width of traffic securing is shown in Fig. 2. Also, the relation between necessities of snow removal and width of traffic is shown in Fig. 3. The evaluation tended to decrease by narrowing of the width of a traffic securing. In addition to this, the evaluation has decreased about 30% when cars parked in the streets and the pedestrians exist, compared with the case of no obstacle in the road. Especially, the case the pedestrians existed was a lower evaluation of about 10% than cars parked in the streets. The evaluation of snow removal is overall strict than the senses of safety.

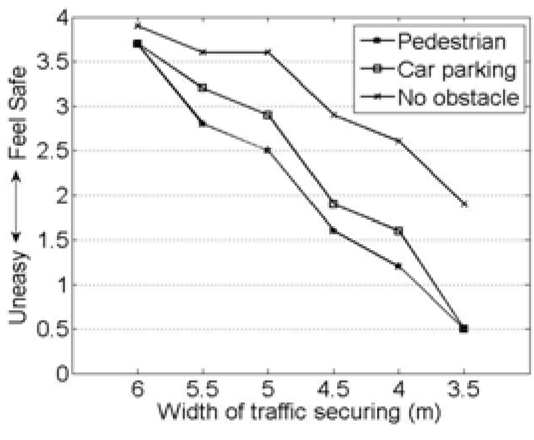


Fig. 2 Relation between senses of safety and width of traffic securing

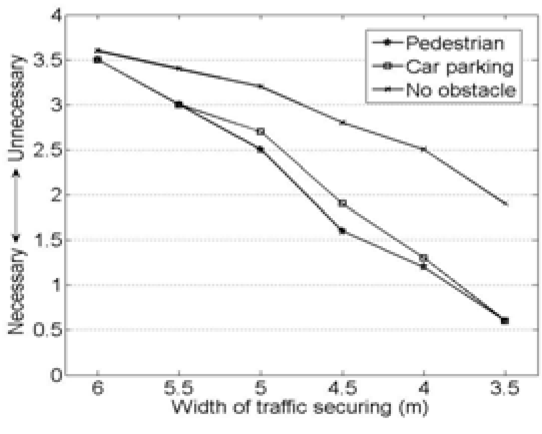


Fig. 3 Relation between necessities of snow removal and width of traffic securing

Also, from both figures we can learn that the management width for senses of safety and snow removal for which the road users feel safe is to be preferred 5 meters or more.

Moreover, the experiment results for the relation between the senses of safety and width of side room, and the relation between necessities of snow removal and width of side room, are shown in Fig. 4 and Fig. 5.

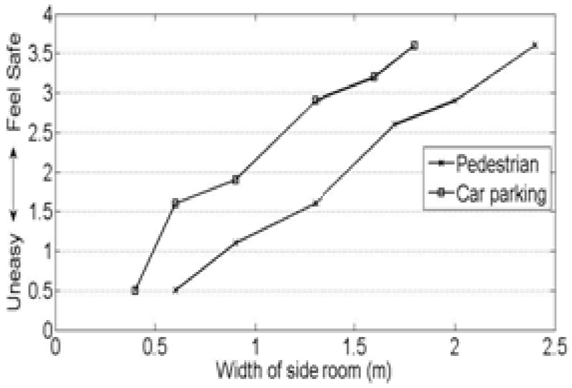


Fig. 4 Relation between senses of safety and width of side room

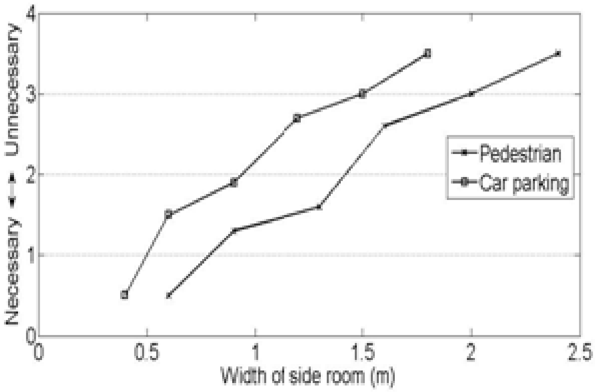


Fig. 5 Relation between necessities of snow removal and width of side room

Both the evaluations has increased when the width of side room becoming large. The width of side room tended to increase in the case that the pedestrians exist comparing with the case that the cars parked in the streets. In another words, the width of side room is about 0.5m larger when pedestrian exists than cars parked. This can be explained that the driver’s evasion to the pedestrian tends to considered more than the cars parked on the road.

Fig. 6 shows the relation between running speed and width of side room. From the figure we can also make some consideration as follows:

- The speed decreases by the width of the side room becoming small.
- The speed decreases 10% when pedestrian exists than cars parked.
- Width of side room is about 0.2m larger when pedestrian exists than cars parked.

There are also indicates that the driver’s evasion to the pedestrian tends to considered more than the cars parked on the streets.

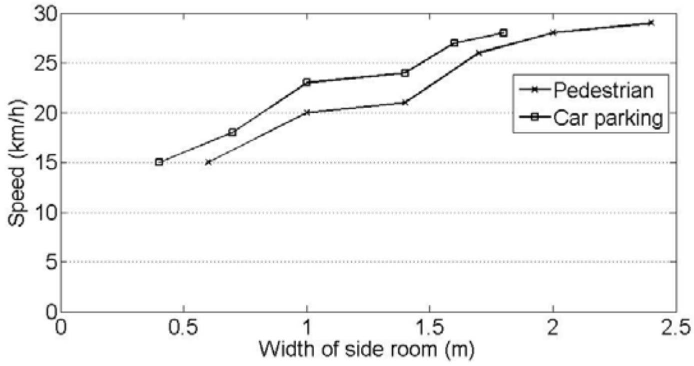


Fig. 6 Relation between speed and width of side room

Summary

This work has discussed about the influence of the width of a traffic securing in winter in the snowy region. We compared with DS and a real car of the running behavior, in order to verify the effectiveness of the free running function in DS. As a result, for the lateral displacement when the obstacle is evaded, there are similar tendency with a real car and DS. We also verified the influence for the road user that the presence of the width of a traffic securing in winter. Experiment results has shown that the management width for senses of safety and snow removal for which the road users feel safe is to be preferred 5 meters or more. Another interesting phenomenon that we have found is the driver’s evasion to the pedestrian tends to be considered more than the cars parked on the road.

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