没入型ドライビングシミュレータの実車との比較による運転行動分析システムとしての評価

Evaluation as Analyze System of Driving Behavior by Comparison between an Immersive Driving Simulator and a Real Car

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Abstract: We developed an immersive driving simulator as a driving behavior observation system. We conducted an experiment: first one was a driver drove a real car and second one was he drove a virtual car in the driving simulator. We analyzed both results and compared them. We found that two features were same in both immersive environment and real environment.

Keywords: Driving simulator, Virtual reality, CAVE, eye tracking

1. Introduction

In recent years, the number of accident that elder drivers aged 65 or more caused is increasing. We developed an immersive driving simulator to analyze driving behavior of elder drivers. Our immersive driving simulator [1] uses a Cave system [2] so a driver can feel depth sensation of virtual course and feel as if she/he is into the virtual world.

In order to evaluate effectiveness of the immersive driving simulator, we compared driving behavior between when a driver drove a car in the real world and when he drove a car in the simulator.

2. Our immersive driving simulator

We constructed the immersive driving simulator that was consisted of K-Cave, a precise force-feedback car cockpit simulator and an eye tracking system (Figure 1). The Virtual test course we used in a virtual experiment was designed from the real town: a part of Hiyoshi town in Yokohama city, Kanagawa Prefecture, Japan.

Figure 1. The immersive driving simulator

3. Experiment

We compared driving behavior of the driver real operation and simulator operation in order to evaluate the validity of the immersive driving simulator. We measured the driving behavior of the driver using eye movement measuring device: EMR-9, nac Image Technology, Inc (Figure 2). The eye movement measured with this device is recorded on an image as the position of the look of a left eye, a right eye and both eyes. We set a course a right turn to a narrow way: point1 and a right turn of a crossing with bad visibility (point2) around Hiyoshi town (Figure 3, Figure4).

Figure 2. EMR-9

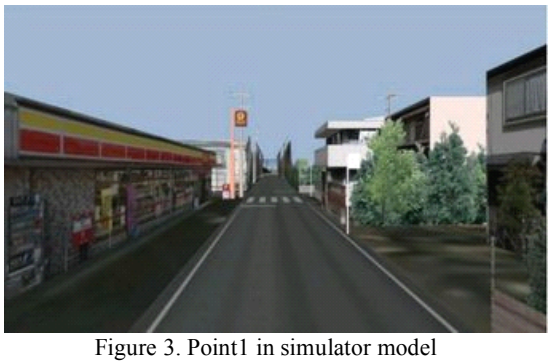

Figure 3. Point1 in simulator model

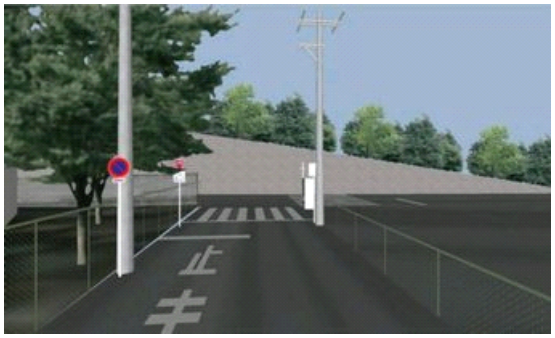

Figure 4. Point2 in simulator model

4. Result

First, although there were differences in times when turning right at the point 1 or at the point 2, a number of times that the driver checked right and left during turning right were same in both real and virtual environment (Table 1, Table 2).

Point1	Right	Left	Turning right time (s)
Real	2	2	8.87
Simulator	2	2	6.50

Table 1. A number of times of the driver's checking right or left and times to operate when the car turned right at the point 1.

Point2	Right	Left	Turning right time (s)
Real	2	1	4.50
Simulator	2	1	8.30

Table 2. A number of times of the driver's checking right or left and times to operate when the car turned right at the point 2.

Second, Table 3 and Table 4 showed first looking left timing after the driver started turning the steering wheel to the right. Since turning times were different between real and virtual environment, when normalized by overall turning right time they were close.

Real	Left1	Turning right time
Timing(s)	1.80	8.87
Normalized Timing	0.20	1.00

Simulator	Left1	Turning right time
Timing(s)	1.80	6.50
Normalized Timing	0.28	1.00

Table 3. Looking left-hand side timing at the point1.

Real	Left1	Turning right time
Timing(s)	0.63	4.50
Normalized Timing	0.14	1.00

Simulator	Left1	Turning right time
Timing(s)	1.83	8.30
Normalized Timing	0.22	1.00

Table 4. Looking left-hand side timing at the point2.

5. Conclusion

We developed an immersive driving simulator as a driving behavior observation system. We conducted an experiment: first one was a driver drove a real car and second one was he drove a virtual car in the driving simulator. We analyzed both results and compared them. We found that two features were same in both immersive environment and real environment. First one was a number of times that the driver checked right and left during turning right was same in both real and virtual environment. Second one was looking left timing after the driver started turning the steering wheel to the right.

Reference

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