自動二輪車運転手に対する HUD による情報提示

Information Presentation Using Head-Up Display for Motorcycle Rider

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Abstract: This paper proposes a new type of navigation system using head-up display technology. The navigation system uses laser projector technology to construct the head-up display system to represent information with high contrast and high brightness image. We assume this makes the navigation system suitable for the motorcycles using the head-up display compatible with the windshield. It also means that it builds up the navigation system for motorcycles so that the rider can obtain information even while running on public road during day or night. To confirm the usage of this system, we conducted an experiment using the motorcycle simulator in the immersive CAVE environment. By measuring the rider's viewpoint in the motorcycle simulator, we concluded that the navigation system using the head-up display can potentially provide navigation information while keeping the rider's viewpoint on the road surface. From the results of the experiment, we found out that the method of displaying information at the lower right or lower left position is effective, because the rider can see it without moving his viewpoint largely.

Keywords: Navigation System, Motorcycle simulator, Head-Up Display, CAVE.

1. Introduction

There have been many studies and products of navigating system for 4-wheel vehicles, but almost none for 2-wheel vehicles. Currently, we can see people riding motorcycles with after-added road navigation system. Since these products are basically made for 4-wheel vehicle, it is obvious that it is not suitable for 2-wheel vehicles. Research in Japan Safe Driving Center reported that the navigation system added to the motorcycles did not give positive effect to the riders, although more than 90% people of the motorcycle riders want to obtain information from the navigation system [JSDC06].

This paper proposes a navigation system for motorcycle using the technology of head-up display (HUD). To evaluate the effect of the navigation system using the head-up display, we conducted an experiment using a scooter type motorcycle simulator in CAVE environment [Tateyama09].

2. Head-Up Display

In this study, head-up display for the motorcycle was designed using the laser projector (MicroVision, Laser Pico Projector SHOWWX+). This high contrast and high brightness projector makes it possible for the user to see the information displayed on the head-up display under the condition of sunlight. The projected image was magnified by convex lens (Eschenbach Magnifier 3.8x), and the user sees the virtual image reflected by the half mirror superimposed on the real scene. The focal distance for the displayed image was designed 3 meters from the rider's eye. Figure 1 shows the prototype of the head-up display that was developed in this study.

In the real motorcycle, the head-up display can be implemented in the windshield. In this study, the scooter type motorcycle simulator was constructed using the CAVE environment, and the prototype of head-up display was installed in it as shown in Figure 2. In the CAVE environment, since the user's head position is tracked using the electromagnetic sensor (Flock of Birds), the 3D image seen from the user's view position is rendered in real-time. Then, the user can see the three-dimensional stereo image seen from his own viewpoint by wearing the 3D glasses.

Figure 1: Prototype of head-up display for navigation system.

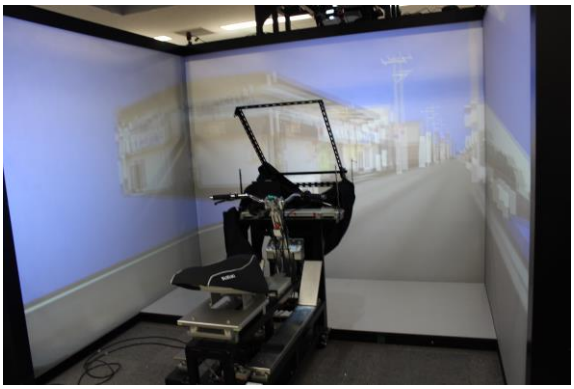

Figure 2: Motorcycle simulator using head-up display.

3. Experiment

In order to display information on the head-up display effectively, it is important to investigate where the information should be displayed in the visual field. First, we measured the movement of the rider's view direction using the eye-mark recorder (nac EMR-9) as shown in Figure 3. From the result, we can see that the rider keeps his viewpoint on the road surface while running the motorcycle.

Next, the evaluation experiment was conducted using the motorcycle simulator to investigate the effective position of the displayed information. In the experiment, we asked subject to ride the motorcycle simulator in the virtual world by using the accelerator lever, brake lever, and steering. The subject ran the motorcycle simulator and operated it according to the directions displayed on the head-up display. In this case, the movement of view direction and the behaviour of the subject were recorded using the eye-mark recorder and the video camera.

In the experiment, when the motorcycle approached the intersection, 4 kinds of signs that are "turn right", "go straight", "turn left", and "temporary stop" were displayed randomly at 9 kinds of positions that are "upper left", "upper", "upper right", "left", "center", "right", "lower left", "lower", and "lower right" in the field of the head-up display. The experiment was repeated 12 times for each sign and for each display position, and in total the experiment was conducted 108 times. Figure 4 shows that the subject is running the motorcycle simulator in the CAVE environment, and Figure 5 shows the example of the displayed sign and the recorded images by the video camera and eye-mark recorder.

From the data recorded by the eye-mark recorder, the cognition time between the time when the direction sign was displayed on the head-up display and the time when the subject looked at it and the confirmation time when the subject was looking at the displayed sign were calculated.

Analysis of variance for the cognition time and confirmation time with the display position of the information was conducted. As a result of the experiment, the cognition time has significance at 5% level, and the confirmation time has significance at 1% level. In particular, we can see that when the information was displayed at the lower right or lower left positions, both the cognition time and confirmation time were shorter and the information was transmitted to the subject effectively.

Figure 3: Experiment on measuring the rider's view direction

Figure 4: Experiment using the motorcycle simulator in the CAVE environment.

Figure 5: Example of displayed sign and viewpoint measured by eye-mark recorder.

4. Conclusion

In this study, head-up display was proposed as navigation system to the rider of the motorcycle. The superimposed representation of the information in the head-up display is considered to be effective, since the rider of the motorcycle must keep his eye on the road surface. The motorcycle simulator using the immersive environment of CAVE was constructed, and the evaluation experiment on the information presentation by the head-up display was conducted. From the result, we can see that the method of displaying information at the position of lower right or lower left is effective, because the rider can see it without moving his viewpoint largely.

References

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