

# Screen Design of Onboard Displays for Reducing Car Sickness

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## INTRODUCTION

Onboard displays for rear-seat entertainment are recently getting popular. However, car sickness would be frequently used by watching movies via an onboard display in the same manner as reading books in a moving vehicle. We propose two approaches to screen design of onboard displays for reducing car sickness.

## APPROACHES

The approaches are based on the sensory conflict theory [1]; they aim to inhibit inducement of car sickness by reducing a conflict of sensory information between the visual and vestibular systems. Optokinetic stimulus is presented along with an original image to provide sensation of yaw rotation when a vehicle goes around a bend.

In Approach 1, vertical stripes are presented around a movie so as to be perceived as a background of the movie, as shown in Fig. 1. An angular velocity  $\omega(t)$  of yaw rotation is measured in a car, and the background image is shifted to the right or left at a speed  $v(t)$  in proportion to  $\omega(t)$ .

In Approach 2, the movie program is transformed and displayed as if the plane of the movie revolves on a vertical axis, as shown in Fig. 2. A rotation angle  $\theta(t)$  is in proportion to  $\omega(t)$ .

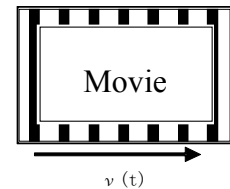


Fig.1 Approach

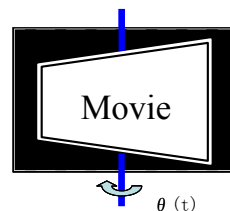


Fig.2 Approach 2

## EXPERIMENT

Fifty-six healthy subjects (41 males and 15 females), around 20 years of age, participated in the experiments (a total of 210 trials). Every subject was briefed on the purpose, procedures, risks and benefits of the study, and gave written informed consent before participating in the experiments.

The experiment was performed using a minivan-type car with four seat rows and a capacity of 10 passengers. Five onboard displays with a 11 inch-type wide LCD panel were installed behind headrests of one front row of seats, and DVD movies were played. Car sickness was induced by driving the subjects in the car along a winding path for 21 minutes. Each subject was assigned to one of the following four conditions during the car ride: 1) no-task (no movie-watching), 2) movie-watching, 3) movie-watching with Approach 1, and 4) movie-watching with Approach 2.

The subjective severity was measured by the rating-scale method using 11 numerical categories from 0 (no sickness) to 10 (limit of subjects endurance of severe nausea). In the analysis of motion sickness severity, the rating scale was converted to a distance scale.

## RESULTS

Figure 3 shows the progression of car sickness severity (distance scale) under the four conditions at intervals of one minute. Each point in the figure indicates the average of severity for all subjects at the elapsed time of riding.

The severity increased almost in proportion to the time over the 21 minutes of vehicle riding for all conditions. Carsickness was the severest under the movie-watching condition, and the least severe under the no-task condition at the end of the 21-minute ride. The car sickness severity was significantly reduced by either approaches, and the effectiveness of the two approaches was almost the same.

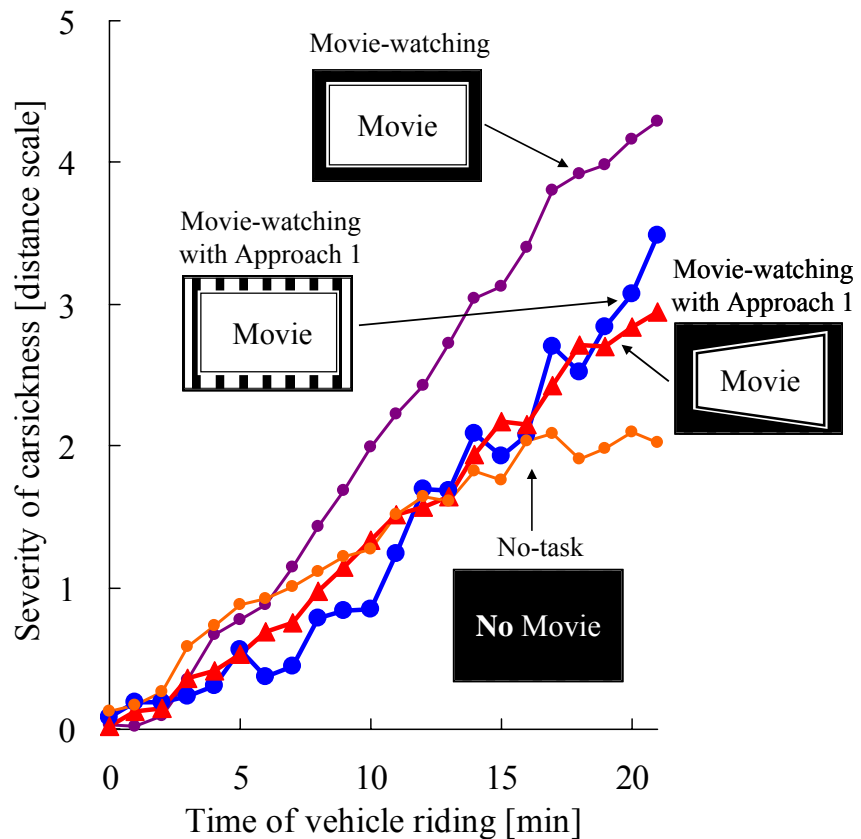


Fig.3 Progress of carsickness severity

## CONCLUSION

Experimental study showed that the car sickness was remarkably reduced by the proposed approaches. It can be interpreted that the circularvection caused by the approaches reduces the visual-vestibular conflict, and consequently, car sickness severity is effectively alleviated.

## REFERENCES

[1] Reason, J.T. and Brand, J.J.: Motion Sickness, Academic Press, London, 1975