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Examining Dominant Factors in Determining Interpretation of Indicator Lamp Using VR Simulator

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With the development of automotive lighting, there is an increasing need to verify not only the lighting equipment but also the traffic scene. Recent automotive lighting systems, such as Adaptive Driving Beam, dynamically control light distribution in response to the movement of oncoming and preceding vehicles. Dynamic light distribution control that is not completed by the lighting equipment alone, but is based on the traffic scene, including surrounding traffic participants and terrain, is becoming more widespread.

However, depending on the content of the verification, it may be difficult to actually perform the verification in real space. While it is difficult to set up hazardous situations and collect reproducible data in a real space or in a real vehicle, a simulator can set up and control such situations.

Therefore, we aim to develop the virtual reality (VR) simulator that can conduct various verifications in combination with traffic scenes in a simple and easy manner that is close to the experience in a real space, while also allowing experiments on test subjects. In this paper, we conducted an experiment using the VR simulator to clarify the dominant factors in a driver's decision to interpret the indicator lights of other vehicles (Fig. 1).

Fig.1 One of Lighting Patterns

Table 1 shows the interpretation results determined for each lighting pattern. Table 2 shows the relationship between the type of lighting pattern and the dominant factors. In the Fisher's exact test, there was no significant difference in the relationship between the type of lighting pattern and the dominant factor. Even if the dominant factors tended to converge to one factor, the interpretation of the results was not unambiguous.

Bonferroni's multiple comparison test were conducted on the tendency of the dominant factor in all 90 responses of the 10 subjects to the 9 lighting patterns (Fig. 2). The results showed that the lighting factor was significantly different from both the vehicle factor and the field factor. On the other hand, the number of respondents who made comprehensive judgments and decisions including the dominant factor and different types of factors was 55 out of the total of 90 responses.

Only one respondent mentioned light when asked whether there was a difference in sensation between the real and VR spaces, and his response was "I do not feel any glare." Although 60% of the respondents chose "not at all different" or "somewhat different," it is considered that this experiment can be verified with the VR simulator, since glare has little relevance to the content or purpose of this experiment.

These considerations suggest that there is room for further study of lamps with communication functions, aiming not to complete the interpretation by the lamps alone, but to provide a starting point for making comprehensive judgments and for noticing vehicle movements that might otherwise be overlooked.

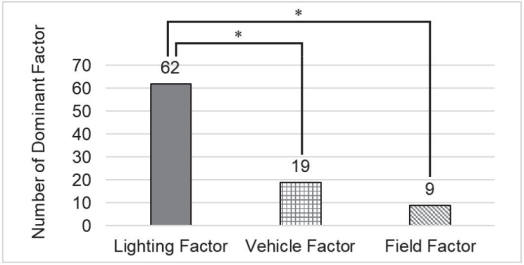

Fig.5 Result of three types of dominant factors (n = 90, * p<0.05)

Table.1 Result of Interpretation of Lighting Patterns

Lighting Patterns	Lighting Factor	Vehicle Factor	Field Factor
No.1	6	3	1
No.2	6	3	1
No.3	7	2	1
No.4	7	2	1
No.5	7	2	1
No.6	9	0	1
No.7	5	4	1
No.8	8	1	1
No.9	7	2	1

Table. 2 Result of dominant factors (n = 10, * p<0.05)

Lighting Patterns	Interpretation			
	Yield the Way	Warning	Don't Understand	Others
No.1	0	2	4	4
No.2	3	4	1	2
No.3	0	3	4	3
No.4	0	4	3	3
No.5	2	1	2	5
No.6	2	6	1	1
No.7	2	2	5	1
No.8	3	2	2	3
No.9	3	1	1	5