Sequence Design 'Optical Dot' as Appropriate Speed Controlling
-- 4 Years Transition after the Field Experiment--

Ayumi Han[*1], Shintaro Ono, Masato Sasaki[*2], Yoshihiro Suda, Katsushi Ikeuchi, Masaaki Yamaguchi[*3]

In Tokyo Metropolitan Expressway (MEX), due to its complicated road alignment and traffic congestion, more than 10,000 traffic accidents such as the rear-end collision occur in a year. Although various measures; signage, warning light, markings with symbols or enhanced frictions have been implemented at the danger points, but these often become ineffective due to drivers' cumulative experience. Accordingly, we developed unique road-marking design 'Optical Dot' (OD) based on Ecological Psychology. It is focusing on the visual-perception to enhance the drivers' ability to perceive of speeding and to naturally adjust vehicle speeds accordingly. Our technological study is to realize 'Sequence Design' in which the optic flows are visualized to guide the appropriate driving, for improving safe and smooth traffic flow. Sequence Design is conceived to make drivers perceived the affordances of roadways at a glance; environmental functional information which is necessary for the locomotion.

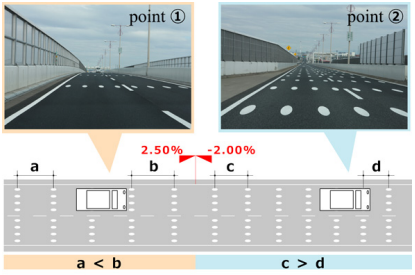
Full scale actual field operation tests of OD were conducted at the long vertical curve section before the tollgate at Bijogi Junction Saitama-Omiya Line of MEX in 2008. This segment of highway has been a very dangerous section where more than 60% of traffic travels at speeds over 100km/h. There we tried to make drivers be perceived the gradient easier by the oval dot-patterns' layout on the slope. Before-and-after data show that total number of speeding vehicles has decreased by 20-40%, to less than 40% of the traffic flow. After four years, by analyzing the transition of traffic counter data in the site, it is proved that OD was effective to slow down the traffic in the descent, especially for high-speed range at night and reducing variance of speed range. In parallel, by using ITS Driving Simulator, we performed experiments with 36 test subjects to verify the visual effect of the OD. One year later of the implementation, on the actual highway of OD segment, it was validated the flows of the individual driving using a probe-car by 10 test drivers. The each result tended to follow the hypothesis that driving speed is controlled by designed optic flows.

Comparing the transition of speed distribution for these 6 years: before (2yrs) and after (4yrs) in two speed range, the shift from high: 100-120km/h to mid: 80-100km/h range can be confirmed, and the control effect is significant. Since the before-after transition difference 20%-30% or more has been kept equally throughout these four years. Thus, it also shows clearly the stable sustainability of the speed controlling effect until now.

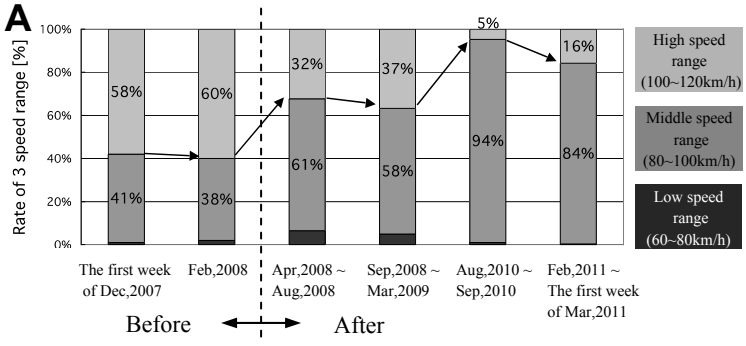
Publication

1. A. Han, M. Sasaki, K. Ikeuchi, "Optical Dots at Saitama Omiya Line on Metropolitan Expressway-Sequence Design based on Ecological Psychology-"(in Japanese), 7th Symposium on ITS: Intelligent Transport System, 2008 (Best Poster Award).
2. A. Han, S. Ono, M.Sasaki, Y. Suda, K.Ikeuchi, M.Tamaki, M. Onuki, T. Kojima, A. Nishikido, "The Evaluation of driving control result by Highway Sequence Design 'Optical Dots' based on Visual-perception information" (in Japanese), 9th Symposium on ITS, 2010 (Best Poster Award)
3. A. Han, M.Tamaki, S. Ono, M.Sasaki, Y. Suda, K.Ikeuchi, "The Transition of the Driving Control Result by Sequence Design 'Optical Dots" (in Japanese), 10th Symposium on ITS, 2011.

Field Operation Test

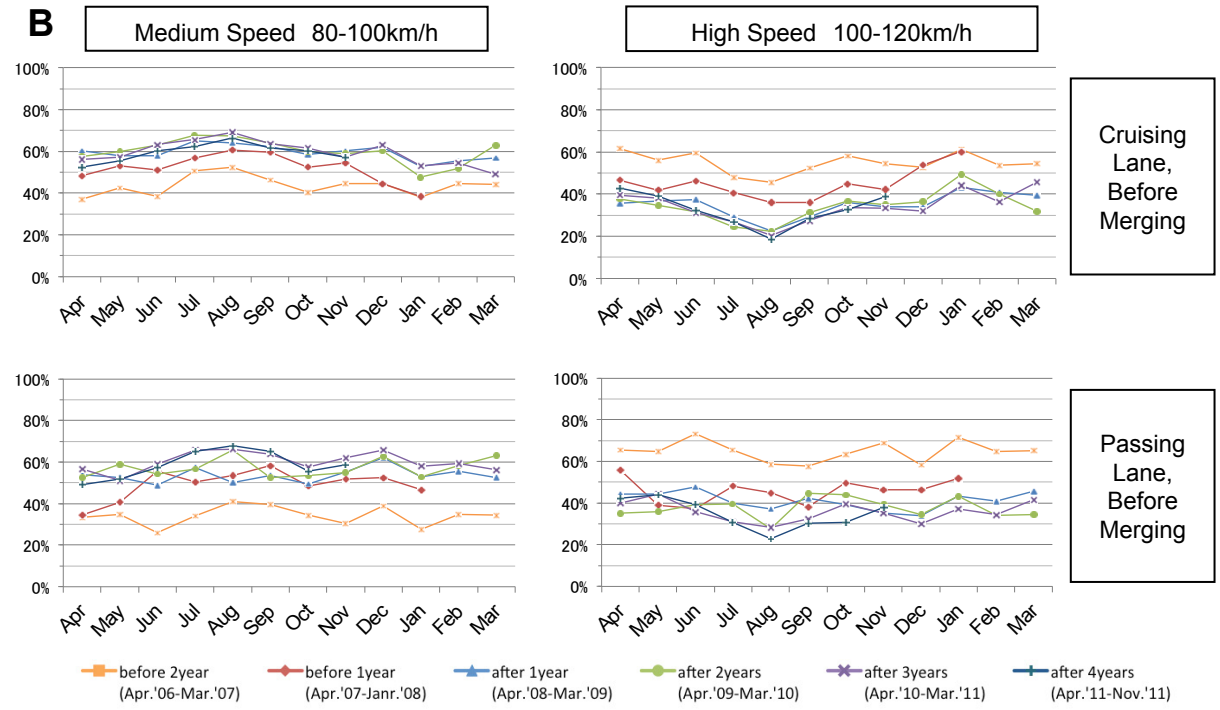


Point①: Expanding Intervals on Ascent
Point②: Shrinking Intervals on Descent



A: A graph 'Changes of the 3 Speed Range Before and After Setting Dots Patterns' of the Cruising Lane Traffic Counter Data at 10pm.

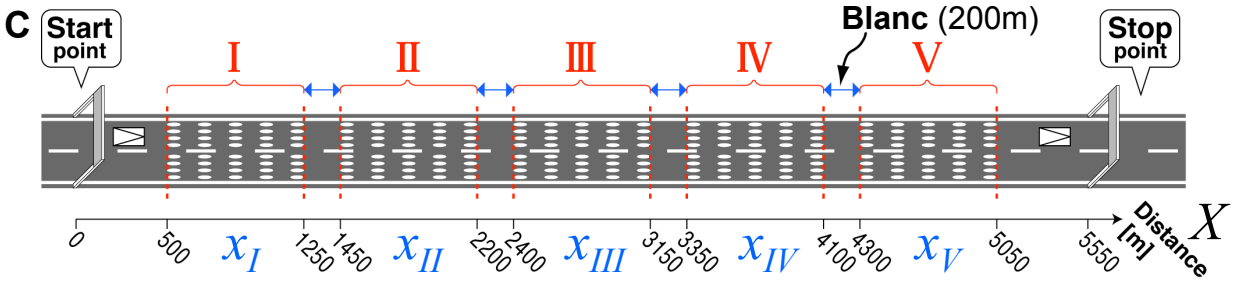
[*1]Ikeuchi Laboratory / Studio Han Design s.r.l. [*2]Graduate School of Education, The Univ. of Tokyo [*3]Metropolitan Expressway Co., Ltd.



The Average of 10:00PM-11:00PM on Weekday

Data Provided by Metropolitan Expressway Co.,Ltd., Japan

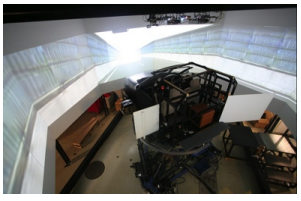
DS Experiment



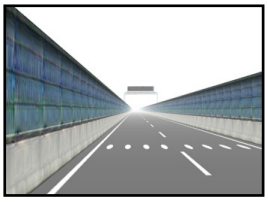
D

Driving turn	Position				
	I	II	III	IV	V
1st	N	E+	E	S	S+
2nd	N	S+	E	S	E+
3rd	N	E+	S	S+	E

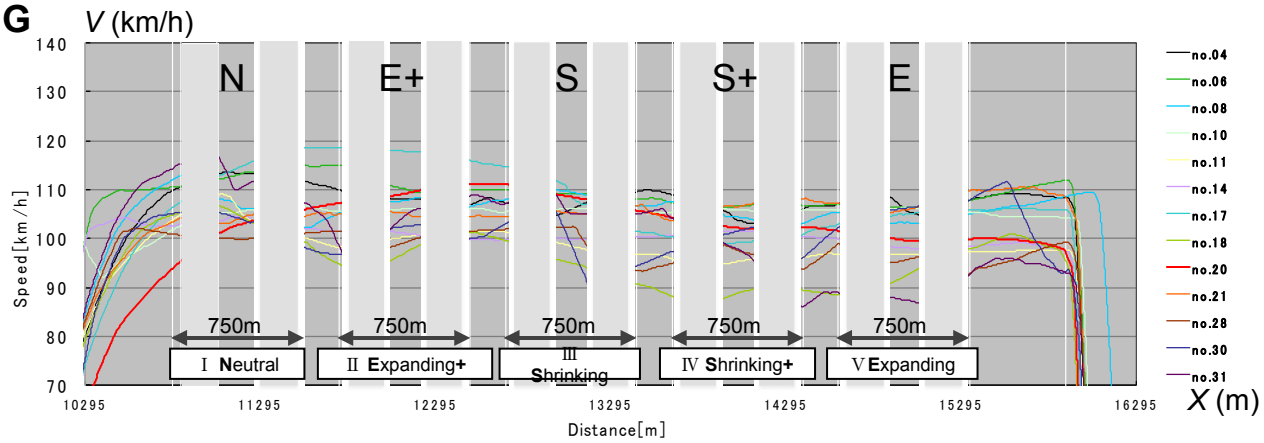
E



F



G



B: Transition for 6years by Speed Distribution (Per Month)
C: Long Scenario of 5,500m
D: The Order of Each Driving Scenario
E: ITS Universal Driving Simulator
F: A Basic Visual of the CG Animation Prepared for the Experiment.
G: A Graph 'the Velocity-Distance' of 12 Test Subjects Driving Data.