Topics

A Color Matching Method for Automobile Body and Bumper.

Kazuhiko Suzuki, Applied Optics Lab.

1. Introduction

Automobile bodies and bumpers are painted by different coating materials and then assembled in the factory. Therefore, the colors of the body and the bumper are difficult to match correctly, and the initial color matching requires considerable man-hours. For efficient color matching, a quantitative evaluation method is necessary; however, conventional methods are said to be insufficient as quantitative guidelines because they have low correlation with visual observation due to the dependence on an integrating sphere colorimeter. As for the light metallic paint colors with high lightness (tint colors), the correlation is particularly low and the color matching is very difficult.

In order to establish a quantitative evaluation having high correlation with visual observation, we have searched for the optimum angle for colorimetry and corrected the existing color difference formula to improve the accuracy.

2. Method

The correlation between the visual observation by an expert (**Fig. 1**) and the gonio-spectral photometry was analyzed using sample bumpers having tint metallic colors with various levels of lightness and chromaticity. To examine the accuracy improvement of the existing evaluation equations, the color difference formula was corrected based on the visual characteristics for the paint colors.

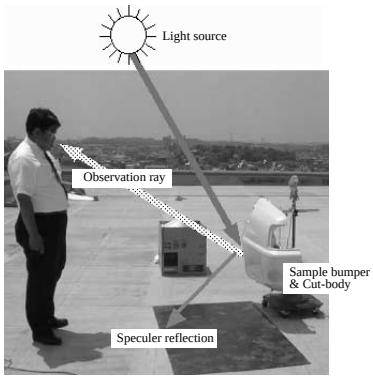

Fig. 1 Observation geometry.

3. Results

(1) The region of the diffuse reflection away from the regular reflection around the angle of the visual observation was the optimum angle condition for colorimetry, where a high correlation between the visual observation and color difference was indicated (**Fig. 2**).

(2) The color difference formula was formulated by correcting the existing CIELUV color difference equation based on the MacAdam ellipse in the color gamut of the paint colors with high lightness and low chromaticity.

$$\Delta E = \sqrt{1 \cdot \Delta L^{*2} + c(h_{uv}) \cdot (\Delta u^{*2} + \Delta v^{*2})} \quad \cdots\cdots(1)$$

l: Correlation coefficient for the lightness difference
$c(h_{uv})$: Correlation coefficient for the chromaticity difference
H_{uv} : Hue angle

By using the above equation, the correlation was improved compared to the existing color difference formula (**Fig. 3**).

In color matching using a commercial multiangle spectral diffraction colorimeter, a correlation as high as that shown in Fig. 3 has been obtained from the CIELUV color difference corrected using the spectral reflectance in the diffuse reflection region away from the regular reflection.

4. Summary

A quantitative color matching method having high correlation with visual observation has become possible using colorimetry corresponding with the angle conditions of the visual observation and the color difference formula reflecting the visual characteristics of the paint colors.

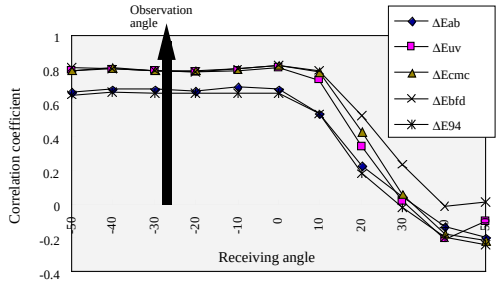

Fig. 2 Correlation coefficient between visual difference and ΔE on receiving angle. (incident angle : 60°)

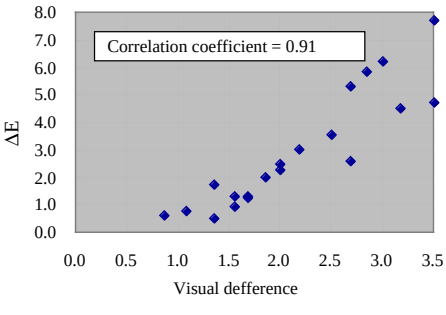

Fig. 3 Relationship between visual defference and ΔE.

R&D Review of Toyota CRDL Vol. 34 No. 4 (1999. 12)