

## Novel Technique for Color and Appearance Measurement and Analysis

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### Abstract

The measurement and analysis of color and appearance is essential for design and approval of coatings in automotive industry. Novel method to measure the appearance using color measurement of coated surface is investigated. The reflection of objects from coated surface under similar lighting condition is analyzed using new image analysis technique to compare appearance of coatings. Result shows good correlation between visual perception and appearance measurement.

**Key-words:** Automotive, Clearcoat, Appearance, Color, Image analysis

### 1. Introduction

The coatings appearance is one of the key requirements in the automotive industry. There are several standards that are used to determine the quality of appearance. One of the methods is by using the wave-scan instrument that provides structure information in five distinct wavelengths based on the reflection of light source over a surface<sup>1)</sup>. It is widely mentioned that the measured surface waviness in terms of these values are difficult to correlate well with the visual perception<sup>2)</sup> specially for colored painted panels<sup>3)</sup>.

New technique is developed to analyze appearance from digital image of coatings. Instead of single laser source of fixed wavelength, color image obtained from digital camera could be used for analysis of surface appearance waviness. Image of surface obtained under reflection of a light source at a fixed angle and exposure can be used to quantitatively determine the appearance. The image is digitally analyzed for variations in pixels RGB value and calculation of roughness based on variation in the numerical value of the color coordinates. Human eyes visualizes color spectrum based on the three primary colors red, green, and blue receptors, and image analysis based on the RGB map of the surface is well suited for the appearance as well as color analysis.

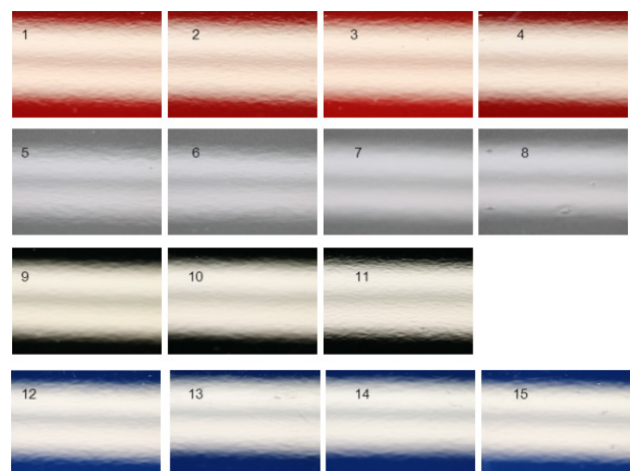
### 2. Experimental section

E-coat steel panels of size 20 cm × 10 cm are spray-coated using waterborne three-wet painting process with 20 μm primer layer. Commercial grade automotive basecoat paints of four colors namely red, blue, grey, and metallic silver with different variations from Nippon Paint Automotive Co. Ltd. is applied to a thickness of about 15 μm by spray coating on panels. 2K solventborne clearcoats is applied to a thickness

of 35 μm and cured in an oven at 140°C for 30 minutes to obtain finished panels for testing.

Digital images of the panels are obtained in controlled light intensity at fixed reflection angle using high resolution camera (**Fig. 1**). The image RGB values are obtained and low pass filter is applied to the data. The appearance arithmetic and root mean squared roughness parameters values  $R_a = \frac{1}{n} \sum_1^n |y_i|$  and  $R_q = \sqrt{\frac{1}{n} \sum_1^n y_i^2}$  are calculated based on the plot of RGB pixels values  $y_i$  across the image. Higher  $R_a$  would imply more structure present in the surface with higher waviness. The labelled panels are examined by four panelists independently providing rating from 1 to 5 with 5 being the best appearance. The surface roughness parameters are measured by contact roughness meter Mitutoyo SJ-210 and correlated with the appearance roughness parameters.

The method is further extended to analyze the metallic appearance and flip-flop measurement of effect coatings



**Fig. 1** Panel images sorted with color.