AUTOMOTIVE INDUSTRY LIGHTING CONTROL

PHOTOMETRIC & COLORIMETRIC MEASUREMENT OF CAR COCKPIT

Automotive manufacturers use distinctive styling as a means to differentiate their vehicle from the competition. Exterior styling is heavily constrained by energy-efficiency considerations and regulations. As a result, automakers are placing more emphasis on interior lighting for a simple reason: they offer designers more freedom and opportunity to differentiate and establish a competitive advantage. Not surprisingly, the more upscale the car, the greater the variety and scope of available lighting scheme. In fact, interior lighting has emerged as a marketing tool, besides satisfying its safety, convenience, and appearance requirements.

It is imperative for automaker to match night-time color of display panel, mainly located in cockpit module, to the overall interior lighting scheme. Such automotive display panel includes:

- Instrument cluster/panel
- Information display
- Centralize backlit switches (including the climate control unit)
- Audio or infotainment system

Optical measurements, involving photometry and colorimetry are necessary due to introduction of interior lighting scheme and adoption of new lighting technologies, e.g. LED and OLED, as well as, integration of digital display (e.g., LCD) into automotive display panels.

Subsystems of Automobile Cockpit Module

A cockpit module typically includes an instrument panel, and one or more of the following: wire harness, infotainment system, instrument cluster, climate control head, finish panels, steering column and steering wheel. The type of display panels that require photometric measurement are:

1. Car instrument cluster
2. Centralized backlit switches
3. Information display
4. Car audio

Application of Light Measuring Device in Automotive Display Panel

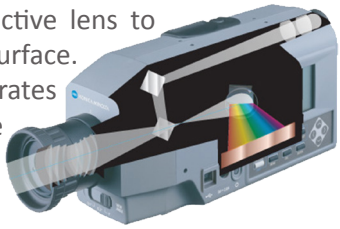
What lighting parameters are measured for specification conformance?

- Luminance and chromaticity of night-time colors
- Luminance and chromaticity uniformity of night-time colors
- Chromaticity of day-time colors

Spot Measurement Method

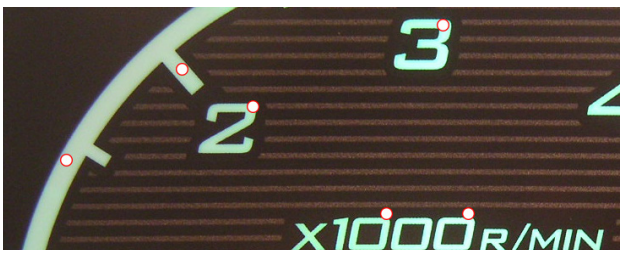
Traditionally, parameters like car instrument cluster and centralized backlit switches are measured using spot measurement method at several discrete points to check on color and luminance consistency and uniformity.

Spot measurement devices – light measuring device utilizes an aperture and objective lens to image a spot on the detector surface. This type of instrument integrates the light from the entire measurement spot defined by the projected aperture.



Example:

Spot measurement of luminance and chromaticity of speedometer panel at several points as shown below.



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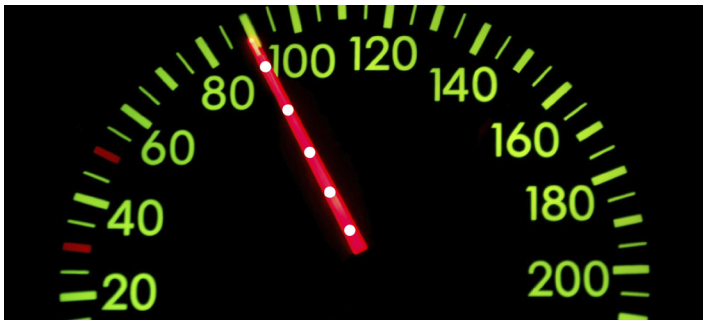
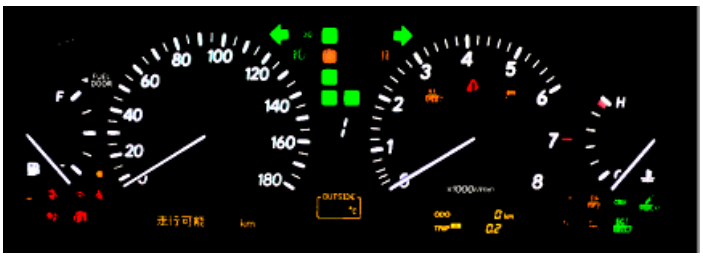
Example:
Measurement of luminance and chromaticity of red pointer at several points as shown below.

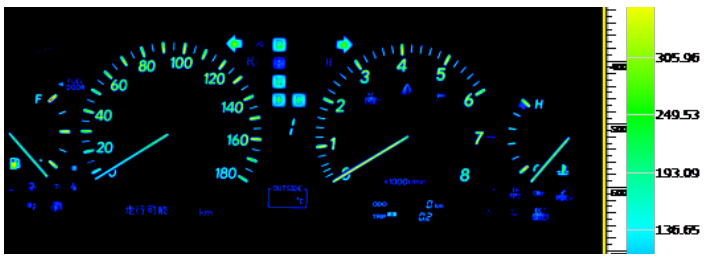


2-D Measurement Method

The introduction of high precision 2D Color Analyzer or Imaging Colorimeter incorporating XYZ filters and a high resolution CCD allows accurate 2 dimensional measurement of luminance and chromaticity distribution of illuminated characters of car instrument panel, as shown below:

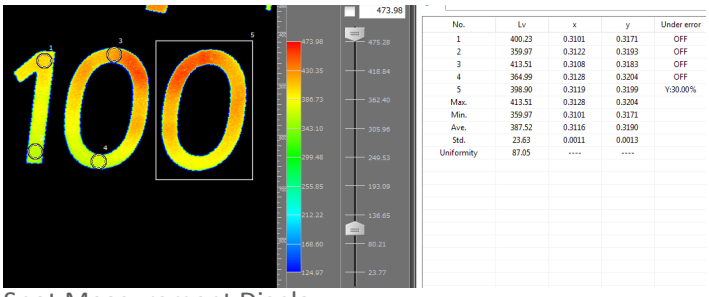


RGB Image



Pseudocolor Luminance Measurement Display

As shown in above display, the luminance distribution of the entire instrument panel was captured by the 2D Color Anlayzer and illustrated by the pseudocolor display. Darker blue patches represent the areas with lower luminance as compared to those areas with lighter blue patches. The highest luminance areas within automotive display panel are represented by the yellow patches.



Spot Measurement Display

Statistical result for spot luminance and chromaticity measurement are displayed in a list, and spots can be given numbers and labels as shown in the above diagram.

The average luminance of a freeform shape (e.g., the entire number 0 as shown above) can also be measured. Such 2D measurement system enables quick, comprehensive and efficient measurement, data analysis and evaluation.

Digital Instrument Panel and Infotainment Display

Automakers have begun offering vehicles with digital instrument panel, replacing the traditional analog gauges. Such digital instrument panels use LCD or OLED as their display devices. At the same time, integrated infotainment systems (also known as in-vehicle infotainment systems) in automobiles that deliver entertainment and information content have also gain popularity.

The display performance and visual characteristics of such display systems need to be evaluated. Current international standards for automotive displays, such as ISO 15008, 2009, indicate the specifications and test procedures for in-vehicle visual presentation. Some of the common display performance measurement parameters are:

- Luminance and luminance uniformity
- Color and color uniformity
- High ambient contrast ratio
- Gamma
- Color gamut
- Viewing angle

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Konica Minolta offers a wide range of colorimeters, spectroradiometers, and 2D Color Analyzer for the measurement of automobile display. For more information on display measuring instruments, please visit Konica Minolta website at http://sensing.konicaminolta.asia/applications/display-light-measurement/

You can visit this website at https://wwws.konicaminolta.net/instruments/registration_index/ to download our education handbook, The Language of Light explains basic concepts of photometry and colorimetry in an easy approach. This handbook also gives an overview on photometric and colorimetric instrumentations and addresses important considerations on instrument's selection.

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