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Maintenance Factor in Installation of Tunnel Lighting
Satoshi HIRAKAWA, Kunio TOEDA, Tsuyoshi SUGAWARA and Sho'etsu SAKAMOTO

Maintenance factors in installation of tunnel lighting have been considered in terms of traffic volume and tunnel length based on results from investigations into the use of tunnels. Ventilation conditions in tunnels are drastically improved by reinforcing exhaust gas regulations for cars, and dirt on luminaire is also remarkably reduced. Further, the life times of light sources are advancing. Therefore, we studied lumen maintenance factor, survival factor and partial maintenance factor by using dirty luminaire to take maintenance factor into consideration and these suggested a new method of establishing maintenance factor.

KEYWORDS: tunnel lighting, maintenance factor, survival factor, partial factor caused by dirt

Effect of the Density of Lattice and the Lighting Environment on the Evaluation of Comfortable Inside of Machiya-cafes
Aimi MOCHINAGA and Shino OKUDA

The purpose of this study is to show the effect of the density of lattice and the lighting environment on the evaluation of comfort at Machiya-cafes. We conducted a subjective evaluation by using a scale model of a Machiya-cafe with which the density of lattice and the lighting environment could be changed. In this experiment, subjects evaluated four evaluation factors: “Recognizable from the outside,” “Signline level from the outside,” “Suitability of the lighting environment,” and “Comfort at Machiya-cafes,” with six steps of the categorical scale. Subjects were 15 female university students. As a result of the evaluation, it was shown that the evaluation of “Recognizable from the outside” was higher, as the density of lattice was bigger. For the evaluation of “Signline level from the outside” was higher, as the density of the lattice was smaller. For the evaluation of “Suitability of the lighting environment,” subjects preferred a low color temperature to a high color temperature in the nighttime. For the evaluation of “Comfort at Machiya-cafes,” it was shown that a 20–40% density of lattice with a low color temperature was evaluated highest. Therefore, it was shown that a strong correlation was observed between the density of the lattice and the evaluation and that subjects preferred a low color temperature to a high color temperature in the nighttime.

KEYWORDS: Machiya-cafe, density of lattice, opening, comfortable

Study on Discomfort Glare Rating of the Luminaire with LED Array
Naoya HARA and Sanae HASEGAWA

The use of luminaires with LED array is increasing. The luminaire distribution varies by the number and interval of the LED devices, and the diffusers used in the luminaires. Discomfort glare is a problem for practical lighting design. When using the exiting method with discomfort glare ratings, the luminaire distribution is shown to be uniform. However, whether the typical luminaire distribution of LED luminaires can be considered uniform is a problem. In this paper, the result of an experiment under a certain condition of the background
luminance and the position and size of luminaire, is shown in which discomfort glare ratings of LED luminaires, such as offense to the eyes, glare, and the discomfort of the glare, were obtained for several luminance distributions of LED luminaires. The relationships between the transparency of the filter for visual field and the discomfort glare ratings are shown. An equivalent luminance coefficient is defined as the ratio of the uniform luminance to the average luminance of the luminaire, both which gives the same discomfort glare ratings. The equivalent luminance coefficients are shown for each luminance distribution. The UGR value, corrected by the equivalent luminance coefficient, is useful for estimating the discomfort glare rating.

KEYWORDS: LED luminaire, discomfort glare rating, luminance distribution, equivalent luminance, UGR

Color Discrimination Under White Organic Electroluminescence Illumination
Yasuki YAMAUCHI, Katsuaki SAKATA, and Masakatsu HIRASAWA

Organic EL (OLED) has been attracting attention as a next-generation lighting fixture that can achieve high energy efficiency. One of the advantages of OLED is that there is a lot of flexibility in terms of choosing which organic materials to use, which in turn creates various spectral distributions of light. For this purpose, it is important to evaluate the performances of color perception under OLEDs. In this research, we measured the color discrimination performance under a prototype OLED light and compared the results with those derived under fluorescent light and under a commercially available LED lamp. Some observers had more difficulty discriminating color under OLED compared with under D65 fluorescent light. Although the spectral distributions of the light sources were different, the performances did not indicate any statistically significant hue dependences.

KEYWORDS: OLED illumination, Organic Electroluminescence illumination, color discrimination, color perception

Examining the Effect of Illumination Color on Cognitive Performance
Haruyuki KOJIMA and Hiroyo MIURA

This study investigated the effect of color illumination on human behavior, especially cognitive performance. A series of experiments examined the hypothesis proposed by Mehta and Zhu (2009). The hypothesis was that red induced “avoidance motivation” enhancing the performance of tasks which needed attention to details, while blue induced “approach motivation” improving the performance in creative tasks. We employed some of the experimental tasks used in their study as well as our original ones. The task performances under red and blue illumination were compared. The results showed that memory performance increased in red condition compared to blue condition. However, the performance in the other cognitive tasks did not show any difference between the two illumination conditions, although subjective evaluation of the illumination colors showed different profiles between them. These results indicate that red illumination possibly enhances attention and/ or focusing properties than blue, but that blue does not necessarily enhance performance in creative tasks than red.

KEYWORDS: illumination, color, red, blue, cognitive performance

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The Effect of Spectral Power Distribution on the Perception of Scene Brightness in Nighttime Lit Streets
Kimitaka SHIRAKURA, Yukio AKASHI and Takashi SAITO

A laboratory experiment and two field experiments were conducted to investigate the effects of lamp spectral power distribution on perceived scene brightness in nighttime lit streets and reveal the mechanisms of the perception of scene brightness. The experimental results confirmed the Purkinje effect in which a scene appears brighter when it is illuminated by lamps with enriched short-wavelength radiation. The results also suggest that perceived scene brightness corresponds to mesopic luminances within the range of the experimental conditions and short-wavelength cones contribute to the perception of scene brightness to a limited degree at mesopic light levels.

KEYWORDS: street lighting, mesopic vision, scene brightness, spectral power distribution

Measuring Pesticide Residue Based on Infrared Absorption Features
Shota TOKUTAKE, Hiroaki ISHIZAWA, Takuro HORIGUCHI, Hiroki YOSHINARI and Hisaya YAMADA

This paper describes an original method for measuring pesticide residue. Recently, the demand for measurement of pesticide residue has increased because the concern of safety of the consumer’s food has risen. Furthermore, the dispersion of the pesticide (drift) has become an urgent problem. However, existing methods involve destructive inspection, and a lot of time and proficiency is necessary for the analysis. In this study, to solve those problems, we propose the application of infrared spectroscopy, which is a nondestructive measurement technique. This is a measuring method that assumes the adhesion density of agricultural chemicals using the IR spectrum and SIMCA.

KEYWORDS: pesticide residue, drift, infrared spectroscopy, SIMCA, nondestructive

Acceptable Region on Chromaticity Diagram for Office Lighting
Mitsunori MIKI, Mariko SUZUKI and Masato YOSHIMI

We focus improvement of office lighting and created a color lighting system that can adjust chroma of a given hue, using full-color LEDs. Here, we developed an algorithm that calculates the optimal ratio by adjusting the intensity of the target color while retaining the target illuminance. For many colors, we investigated whether the intensity of color is acceptable for office workers by experiments using the proposed system, and we applied the color intensity obtained to uv chromaticity diagram. As a result of the experiments, the acceptable region on the chromaticity diagram showed significantly individual different and is classified into three patterns. These results indicate the acceptable region on a chromaticity diagram for office lighting.

KEYWORDS: light, chroma, chromaticity diagram, acceptable region, lighting system, full-color LED

Effects of Central Luminance on Perceived Brightness of Surrounding Area
Qianying DAI and Yoshiki NAKAMURA

In this experiment, observers estimated the perceived brightness of a central and surrounding area under varying luminances, luminance ratios, and central area sizes by using a 13-step scale in a lighting condition with two different luminance areas. 1. Perceived brightness in the surrounding area was darker than usual in the high central luminance condition. 2. Perceived brightness in the surrounding area was different from that in the central area and changed independently. 3. Perceived brightness had a linear relation to the luminance logarithm in two areas, consistent with Weber & Fechner’s logarithmic law. In addition, the linear regressions’ coefficients changed depending on the contrasts (luminance ratio) and central area sizes.

KEYWORDS: perceived brightness, luminance ratio, contrast, peripheral vision, fovea, area size

Structure and Secondary Electron Emission Coefficient of Diamond Films Deposited by Hot-filament CVD
Masahiko MURAKAMI, Satoshi YAMAGUCHI, Nobuya TAKABATAKE, Takayuki MISU, Miki GOTO and Toshihiko ARAI

Hot-filament chemical vapor deposition (CVD) of diamond was used to obtain polycrystalline diamond thin film electrodes on silicon substrates. Deposition was carried out by using a mixture of CH₄/H₂ gases through a heated reactor in which a hot tungsten filament was held near the substrates. The films were evaluated by using a scanning electron microscope (SEM), Raman spectroscopy, and a photoacoustic method. The breakdown voltages for the electrodes of the CVD diamond thin films were measured under various Ne pressures by using a V-Q Lissajous method. The secondary electron emission coefficient of the diamond thin film elec-
trodones increased as Raman spectra intensity at 1333 cm\(^{-1}\) and optical penetration depth increased.

KEYWORDS: hot-filament CVD, diamond thin film, breakdown voltage, secondary electron, photoacoustic method

The Effect of Yellowing Human Crystalline Lens on Mesopic Visual Performance
Yukio AKASHI and Keiko NAKAGAWA

KEYWORDS: Mesopic vision, target detection, reaction time, lens yellowing, aging

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Effect of Preferred Illuminance and Color Temperature on Creative Works/Intellectual Productivity
Mitsunori MIKI, Yuka TANIGUCHI and Masato YOSHIM

Improving the lighting environment in offices leads higher levels of intellectual productivity. We constructed a system that provides the individual illuminance and color temperature preferred by workers, and we carried an experiment to clarify which illuminance and color temperature in the office were preferred. The result of this experiment show that each person’s favorite lighting environment was different and it changed with their state of health and time of day. We consider that creative works improved when workers were provided with a lighting environment they preferred.

KEYWORDS: intelligent lighting system, preferred illuminance, preferred color temperature

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The Effect of LED Illumination at Night on Expression of Floral Activator \(Hd3a\) in Rice with Different Wave-lengths and Luminescence
Yoko HARADA, Haruhiko YAMAMOTO, Kiyoshi IWAYA, Nanee KANEKO and Yoshimitsu SONOYAMA

In agriculture, particularly wet rice cultivation, light pollution caused by exterior illumination at night interferes with dark periods and results in delayed flowering (heading). In this study, using light emitting diodes (LEDs), which make it relatively easy to irradiate selective wavelengths and control luminescence, the effects on the heading of rice of the wavelength of the light source it was exposed to at night and the control of luminescence (pulse emission frequency and duty ratio) were investigated through the expression of floral activator \(Hd3a\). The results indicated that, under illumination with blue or green LEDs, the effect on the delay of flowering was small, but under illumination with near ultraviolet, yellow or red LEDs, it was large. Under illumination with yellow-green LEDs, it was predicted that heading would be delayed when the duty ratio was 100%; however, when the duty ratio was 70% and the pulse emission frequency was 700 Hz, the effect on the delay of heading was small. Therefore, it was suggested that by selecting the wavelength of light sources that rice is exposed to and controlling luminescence, it is possible to bring the time of heading closer to that of total darkness (control plot).

KEYWORDS: light pollution, delayed heading, illumination at night, luminescence control, floral activator \(Hd3a\)
A Study on Perceived Brightness in Different Parts of Fovea and Peripheral Visual Field—Effects of Retinal Locus and Contrast—
Qianying DAI and Yoshiki NAKAMURA

The purpose of this study was to consider the perceived brightness change in peripheral vision affected by retinal locus and contrast (peripheral field luminance/background luminance). Using the matching method and Nakamura's fovea brightness simulation system comprehensively, we complexly calculated the contrast change from the background, which cannot reflect in matching luminance, and significant perceived brightness changes among retinal loci were obtained. The result shows that the calculated peripheral brightness value in each contrast series is proportional to the luminance logarithm. Peripheral brightness is brighter than in the fovea when the contrast is larger than one and darker than in the fovea when the contrast is smaller than one. As a result, the calculated peripheral brightness value is greatly changed by the contrast effect further away from the fovea. Peripheral brightness is more sensitive to change by the contrast effect in smaller target stimuli. However, under low luminance conditions, peripheral brightness is brighter than in the fovea independent of contrast. These results show that the calculated peripheral brightness value's change in each retinal locus is based on equal contrast.

KEYWORDS: perceived brightness, luminance, contrast, central and peripheral vision, fovea, retinal locus

Potential of Non-destructively Determining the Purple Color of Flesh in Blood Oranges using Visible/near-Infrared Spectroscopy
Fumiaki ITOU, Susumu MORIMOTO, Gen HATTORI and Hidekazu ITO

The blood orange (Citrus sinensis) is one of the sweet orange cultivars, and its flesh color changes orange to purple. Anthocyanins impart the characteristic purple color of the flesh, and one of the primary anthocyanins is cyanidin-3-glucoside. The purple color is attractive and valuable to consumers, and the anthocyanins have antioxidants. However, it is difficult to judge this purple-colored flesh from the external appearance of the blood orange. Therefore, the objective of this study is to assess the potential of non-destructively determining the purple-colored flesh in blood oranges using visible (Vis)/near-infrared (NIR) spectroscopy. Multiple linear regression (MLR) analyses of the spectra (500 nm –1000 nm) of intact blood oranges (n=48) gave a calibration equation that uses absorbance at 508 nm, 580 nm, 606 nm, and 834 nm with a multiple correlation coefficient of 0.87. The MLR calibration was validated by using other blood orange sample lots, and the intact blood oranges were predicted well. Therefore, VIS/NIR technology is a potentially effective way to non-destructively determine the purple color of the flesh in blood oranges.

KEYWORDS: 'Tarocco', interactance mode, non-contact spectral measurement

Effects of Target Positions on Purkinje Effect
Keiko NAKAGAWA, Yukio AKASHI, Takayuki ARIMATSU and Nobuhiro KYOTO

The International Commission on Illumination (CIE) approved a compensated mesopic photometry system (MES2) to bridge between V (lambda) and V’ (lambda). However, before the system is applied to real road lighting applications, several problems need to be solved. Among them, we investigated the effects of target positions on the Purkinje phenomenon and therefore on the current mesopic photometry system. We conducted two experiments by using a high-pressure sodium (HPS) lamp and three ceramic metal halide (CMH) lamps. The experimental results showed that there were small variations in the Purkinje effect depending on target positions. Such experimental results seemed to reflect retinal density distributions of cones and rods. Practically, however, mesopic luminances obtained from the CIE mesopic photometry system (MES2) were correlated to reaction times to targets presented at eccentricity angles between 5- and 15-degrees. The experimental results also suggested that a glare source appeared to exaggerate differences in reaction time for peripheral target detections between HPS and CMH illuminations, and therefore that the use of lamps with higher S/P ratios improved drivers’ visual performance more than the mesopic photometry predicts.

KEYWORDS: Mesopic vision, cone, rod, photometry systems, reaction time, target position, glare

Approximate Cosine Response Detector Head for Integrating Sphere Photometers
Kazuaki OHKUBO and Shyunsuke MISHIMA

Integrating spheres are widely used to measure total luminous flux of LED light sources. Their detector heads are required to have a directional response matched to Lambert’s cosine law on the principle of the integrating sphere. It is approved on IES-LM79. the measurement method provisions, that the directional response, fθ, has a value less than 15%. In practice, for cosine response a small integrating sphere (satellite integrating sphere) is used as a light receiving system of
many sphere photometers. However, this also creates several problems such as attenuation of the photometer signals passing through the satellite sphere and anisotropic response caused by the baffle inside the satellite sphere. An optical system with directional response matched to the cosine law is considered a detector head of a sphere photometer. As a result, we found that by equipping a photometer head consisting of a transparent PTFE diffuse plate, a probe $f_2$ value of less than 10% can be provided. This indicates the possibilities of optical systems that have a smaller anisotropic response caused by a baffle and brighter throughput than a traditional satellite integrating sphere.

KEYWORDS: integrating sphere, total luminous flux, reflectance, baffle, radiance, detector