



Programfüzet és előadáskivonatok

Lux et Color Vespremiensis

2016. október 14-15.
Veszprém

2016.10.14. Péntek

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ELŐADÁSKIVONATOK

Visual colour control in industry – the state of the art

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In our day to day activities we constantly perform visual evaluations, from selecting a matching tie and handkerchief to appreciating the beauty of a painting. In industry visual colour control still has its place in spite of all the advances in colour measurement instrumentation. There are samples which cannot be measured by conventional instruments (too small, patterned, highly structured or not flat), and for the establishment of instrumental tolerance limits visual experiments under controlled conditions are necessary (in order to scale the instrumental colour difference values).

Visual colour control includes

- the control of the illumination and the surround (spectral power distribution of the source, level of illumination, colour of the background and the surround);
- the control of the sample (conditioning of the temperature and the relative humidity, and the size of the sample itself); and
- the control of the observers' colour discrimination ability.

In industrial practice the first is taken care of by using a colour matching booth, the second by conditioning the laboratory and the third by testing and of necessary, training the observers. Although current standards cover most of these aspects unfortunately these standards are not strictly observed in industry, and in many cases not even in research laboratories.

Keywords: *visual colour control, daylight simulator, colour matching booth, sample size, testing observers, pass/fail*

Investigation of colour representation on mobile devices and visual display units

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Most of the mobile device users do not care about the display technology of their device until they can read and see all the needed information they need in all lighting situations. To be honest the majority of applications also do not need displays with advanced technologies but the manufacturers are pushing the newer and newer display developments to keep or enhance their market share.

The characterization of a visual display unit can be done on the one hand for ergonomic aspects based on the ISO standard No. 9620 [ISO]. On the other hand the physical parameters of the device can be investigated with objective measurements based on the standard IDMS (Information Display Measurements Standard) worked out by the SID (Society for Information Display) subcommittee ICDM (International Committee for Display Metrology) [IDMS].

The investigation covered the most of today's display technologies including TFT, IPS and AMOLED. The paper summarizes the applied measurement methods and introduces the measurement results of the devices. The aim of the investigation was to find out if today's mobile display technologies are advanced enough to display medical images or not. There are medical VDUs which have grayscale representations and those have often a more advanced dynamic range in grayscale than the most consumer devices.

Keywords: *mobile devices, colour representation, photometry, visual displays, LED, AMOLED, gamut*

Colorimetric evaluation of the effect of surface finishing techniques on offset prints

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Print finishing operations are very frequently used in industry for surface protection and aesthetic purposes. Although the primary property of print media products is usually the visual quality, other properties may also play an important role in designing the printed product by enhancing not only the appearance but other qualities as well (e.g. durability). The goal of our research was to determine how print finishing operations influence color appearance. We used typical print finishes techniques such as glossy and matte lamination, glossy and matte varnishing and glossy UV varnishing. Test prints of our study were produced on glossy and matte coated paper by a sheet-fed offset press. Colorimetric properties of the finished products were measured and evaluated. Color shifts and color gamut changes caused by the finishing processes were analysed. We found that all the investigated finishing operations affected color reproduction at a perceivable level. In general matte techniques affected chroma and gamut size, while glossy coatings improved these properties.

Keywords: *offset print finishing, lamination, varnishing*

Comparison of the photometric measurement of LED luminaires with three different goniophotometer types

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A goniophotometer is needed to measure the luminous intensity distribution of luminaires. Goniophotometer types differ basically how their

axes relate to the optical axes of the luminaire under test and in which order they apply the turnings. As the result one gets luminous intensity distributions in different coordinate systems, but those can be transferred into each other's system. Some light source types like gas discharge types based on their operation principle are not allowed to measure them other than in their operation position. There are some light source types which operate independent from their operating positions. Such light sources are for example the semiconductor based light sources, like the LEDs. Some specially designed high power luminaires (like luminaires for sport lighting) can have forbidden operating positions which also are not allowed to measure with luminaire turning goniophotometers. Also new technologies recently developed for the testing of LIDCs of luminaires as near-field goniophotometry is still not properly implemented into the international or european standards because it exist doubt about credibility of the results in LIDC measurements of these systems.

The opinions about the right method are different also inside professional lighting communities. It is often complaint when such measurements are done that the luminaire is operated other than its original burning position and therefore the thermal conditions change inside the luminaire which results false data according the luminous intensity distribution and also its total luminous flux. The comparison is based on measurements carried out both on luminaire turning goniophotometer, mirror goniophotometer and near-field goniophotometer. Based on our experience the rotation of an LED luminaire is not causing definitely a worse cooling. To proof this experience thermal sensors are placed and monitored on the luminaires during all types of measurement. The aim of the paper is to show the observed differences on the different luminaire types in their luminous intensity distributions and their total luminous flux values when measured on different goniophotometer types.

Keywords: *goniophotometry, luminous intensity distribution curves, luminous flux, LED*

Elaboration of environment - friendly reactive dyeing procedures by means of computer-aided simulation

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An “utility” computer program has been elaborated by us as extension to that computer program of CLARIANT which is simulating the exhaust and pad-batch dyeing procedures. The fixed proportion of selected reactive dyes could be predicted by the program of CLARIANT as the function of the applied dyeing technology. Our utility program has been appropriate for the rapid calculation and demonstration of the characteristics of the wastewater (Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD₅)) produced in the course of simulated dyeings.

Beside their impact on the environment our model dyeing experiments have been evaluated also economically.

Keywords: *computer-aided simulation, DRIMAREN dyes, environmental load*

Investigation of the influence of lighting parameters on people’s productivity in office environment

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A Living Laboratory has been created in an Office environment to investigate the effect of lighting and other environmental parameters on the productivity of the office workers. A specially developed office lighting fixture with variable illuminance and correlated color temperature set up the lighting parameters, built-in temperature, humidity, CO₂ and motion/presence sensors recorded the other environmental parameters. The

productivity was measured by means of Number Verification and other supplementary tests, meanwhile the stress level of the participants were recorded by means of portable ECG sensors.

Keywords: *office lighting, productivity, environmental sensors*

Anomaloscopes give false results usinganop diagnosis as prejudice

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The diagnosis of the colour deficiency is a simply task in some degree. Nowadays it is possible the correction of the colour deficiency, and become important to know the type and the measure of it.

We used Ishihara, D15 and anomaloscope tests and checked two new methods: Anomal Tester and the MMAM test. Although anomaloscopes are common used instruments to measure colour deficiency, we realized that the method of using thoseis not enough reliable.

Keywords: *colour blindness, colour deficiency, colour vision, colour filters, clinical trial*

Retina simulation software and its application to road marking visibility investigations

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A retina simulation software (RetModel) was developed by the authors during the last years. The present version is capable of simulating the direction dependent acuity, the mesopic vision and a simple model for photochemical reactions in the receptors. In this paper we investigate photos of road junctions with different complexity using this software. The aim is to characterize the visibility of road marking and traffic signs in peripheral vision. Output of RetModel is analysed by a digital image processing program

that follows the traffic lanes based on road marking. The conclusion is that visual tracking of the lanes is often extremely difficult in complex junctions, if the driver not gazes directly to the road markings. This retina-modelling based analysis can measure the difficulty of overview and understand complex junctions and can be a tool in the hands of traffic engineers.

Keywords: *retina, peripheral vision, road marks*

Comparison of chromatic contrast sensitivity of colour vision deficient people and normal colour observers

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In Europe 8% of the male population lives with colour vision deficiency (Gegenfurtner, Sharpe, 1999; Mollon, Pokorny, Knoblauch, 2003). However from ophthalmological point of view their vision is just like the vision of normal colour observers, they perceive colours in a different way, generally they can discriminate less colours. (Samu, Wenzel, K., Ladunga, 2001). This difference puts them at a disadvantage in many different situations.

The human body is excellent in adaptational mechanisms as it can be understood from blind people's example. The sensitivity of their unimpaired sensory organs increases in order to be able to collect more information and so to compensate the lack of their vision.

In virtue of this example a couple of questions might occur: do people with colour vision deficiency, who can discriminate specific colours harder than normal colour observers, have worse performance in visual acuity also? Are the functions of our image processing able to compensate the deficiency of colour vision?

In order to answer these questions we designed a complex series of measurements. We applied two series of examining images. One of them

contained achromatic (dark pattern on light background) while the other contained coloured (red pattern on green background) pseudoisochromatic images. The achromatic and the chromatic contrast between the pattern and the background was large in the first images and small in the last ones, hence the images were ordered from the easiest to the most difficult one. The variable that represented the result of the measurements was the number of the first image of which the participant could not tell the orientation of the Landolt-C (Samu, Wenzel, Ladunga 2001). This number gives representative information about the actual participant's contrast sensitivity (Barten. 1999).

The results of the survival analysis show that normal colour observers find the orientation of the coloured figures with higher rate however participants with colour vision deficiency were more successful in the achromatic series.

Keywords: *colour vision deficiency, contrast-sensitivity, chromatic contrast-sensitivity, pseudoisochromatic plates*

Traffic lights – from the point of view of colour vision deficiency

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The last years have brought revolutionary changes in the field of traffic lights. Tungsten lamps positioned under red, yellow and green glasses gradually give their place to LED lamps. In our paper we would like to answer the question: how do people with colour vision deficiency perceive the traffic lights applying the former tungsten lamps and the new LED lamps.

Keywords: *colour vision, defective colour vision, traffic light, LED lamp*

The effects of colour vision deficiency on life quality

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I have examined several colour vision deficient (otherwise colour blind) patients with the aid of Colorlite Atlas. I have defined the type of their colour anomalies, and with the help of a questionnaire, I elaborated their

experiences related to their career choice, employment opportunities and life standard. I have examined their psychological problems related to their colour vision deficiency too.

The seriousness of colour vision deficiency is not differentiated, and the requirements of work positions are not differentiated too. More important features are not taken into consideration because of the judgement of colour vision deficiency.

The opportunities for correction are not widespread. It would be beneficial for the professionals who are responsible for screening (district nurses, paediatricians, opticians, optometrists) to become familiar with the opportunities and efficiency of correction.

Image processing in ethorobotics behavioural engine development

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The main contribution of this paper is to enhance the different features of the robot in order to make its behaviour and reactions closer to that of an animal. In term, the robot should be able to associate colours with emotions through motion.

Keywords: *image processing, behaviour engine, ethorobotics*

Color inspection of tinted plastic lenses

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There is a simple way of tinting plastic spectacle lenses by immersing lenses into hot bath containing dye material.

There are many unknown factors in the process which have influence on the final result. The two most important unknown factors are:

The quality of the supplied dye stuff. There are minor deviations, sometimes difficult to adjust

The polymerization level of the plastic lenses, which results density and tone deviation

In spite of this unstable condition, the final product should have the same colour, in case of stock tint lenses even in 1-2 years.

Colour inspection is very subjective, therefore we try to support the tinting and inspection processes with colour measurement as much as possible. However the final decision is always by eyes. Our customers check our lenses also by eyes in most of the cases.

There are two main groups of the measurements:

Control of tinting bath with spectrophotometer. When creating new colours the spectral curve is a big help, because metamerism can only be prevented by well-matching curve.

The spectrophotometer is used in daily production as well for maintaining the condition of tinting baths and for adjusting the requested colour. It is not 100% check.

Measurement of density by density meters, it is 100% check. These units are more simple measuring devices, some opticians also have similar units.

Earlier HOYA used ASAHI density meters from Japan, however these units became old and worn and the replacement was too expensive. As a result of co-research with the University of Debrecen, based on HOYA license, the Metalektro Méréstechnikai Kft. built a suitable device, named Optical Lens Density meter (OLD). The original unit has been up-graded several times and all newly arisen requirements are fulfilled.

Keywords: *colour inspection, tinted lenses, density meter*

Lightspectrum, lightenergy, colour temperature

Lajos Erbeszkorn

Determination of colour temperature for a light source is on the grounds of uncertain notions. A new method is suggested directly based on energy distributions of blackbody radiator.

Keywords: *colour temperature, Planck's law, blackbody radiator*

A tangible light

Dr. habil Miklós Ernő Balázs DLA

mosaic artist, Budapest

The properties of the materials are determined by the quality of their lowest components and the proportions and the bonding force thereof. The artistic mosaic is also built from small elements. However, the mosaic pieces (tesserae) are held together not only by chemical and mechanical but also by aesthetic binding forces. The genre thus serves as an analogy for the fellow arts whose aesthetic values just originate from their specific technology making intensive use of the substances. Thus the tiny mosaic pebble is the tangible Earth, the shining glass mosaic is tangible light! Hence the two-ended openness of the genre towards the microscopic and the monumental. Below I would like to outline how in the wake of a pioneering role of mosaic art those genres of visual art were formulated and developed, which not only portrayed light but turned it into an art tool.

Even Goethe would like it: an interactive presentation of colors

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A 3m long water filled dispersion prism and a 1.8m tall egg-shaped body with a background surface illuminated by RGB LED-s were installed in the Central Market Hall in Budapest just during the International Year of Light in 2015. Based on Goethe's „Color Theory” this completed Color Space serves as an interactive presentation how colors are born by just simply watching through the prism or how different color hues appearing on the surface of the egg harmonize. Nature of additive color mixing caused by different methods can be observed as well.

In this article we hereby expound the structure of the installation as well as it's operation. We give a clear, visual and simple interpretation what happens along the black and white boundaries when watched it through the water prism; this explanation could be an easy-to-understand, however practical aid while teaching about primary or complementary colors or rules of additive color mixing. Based on a unique, novel revolvable 3-Layered (3LD) Color Wheel the installation is able to play pre-programmed time-varying

sequences of remarkable color contrasts (60, 120, 180 degrees etc.) directed by control buttons.

Keywords: *Goethe's color theory, additive color mixing, color contrasts, color harmonies*

Impact of led-based lighting on the selected historical pigments – preliminary results of ageing test

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At the University of Pannonia pigment ageing investigation is carried out in order to determine the effects of LED lighting on several artistic pigments from different art periods. The current ageing test is conducted with 16 historical pigment materials. Each pigment sample is prepared by adding different, widely used binding materials and various varnishes. These complex systems are aged artificially in two spectrally tunable LED lighting booths, which have 20 different colour channels. Surface spectral reflectance measurement technique is used to measure and compare the aged and non-aged pigment-binding material and varnish combinations. This paper summarizes the spectral reflection measurement results after 5-000 hours of ageing.

Keywords: *pigment ageing test, historical pigment, LED lighting, spectral reflectance, colour change*

Peak task efficiency of outdoor sports lightings for aired and non-aired events

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This paper presents a method of determining an appropriate luminous intensity distribution of specified luminaires maintaining defined lighting requirements over the task area. In particular, arbitrary light distributions are generated using the introduced reverse calculating, additive algorithm for a sport lighting scenario, where the ratio of illuminance superposition

from multiple light sources is weighted in order to be compliant with conditions targeted for obtrusive light. This diversification is based on an automatic and adaptive fractional factorial optimization process. The algorithm considers minimum specified illuminances both in horizontal and vertical planes for multiple sections and increases the luminous intensity towards the specific directions, while keeping the Glare Rating value specified in European Standard EN 12193 at a given level. Using this method results a theoretical lighting design that could achieve up to 45% decrease in energy consumption of a benchmarked sports lighting of a stadium; assuming the same technology and luminaire efficacy as by the existing installation, simply by eliminating wasted light. Another important achievement observable was a drastical decrease of Maximum to Average (M:A) illuminance ratio both for horizontal and vertical illuminance, lower Coefficient of Variation (CV) and better Uniformity. Besides optics design, this approach can provide useful input for lighting designers and optimization of existing lighting installations.

Keywords: *Lighting, Sports lighting, Light pollution, Illuminance, Glare*

Application of Colour Moiré Method

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Optical-based non-invasive, fast, accurate measuring techniques are currently used for many types of measurements including displacement or surface shape. Moiré fringe technique is an important metrological tool in area of topographical measurements. The novel moiré method based on application of special bicolour gratings was theoretically developed for solution of the “hill&valley” problem and practically applied to the real moiré topographical measuring methods. Development of the new moiré method that allows to get the extra information about the form of measuring surface from the one moiré image.

Keywords: *moiré method, bicolour gratings*

Teaching colour mixing – NEWTON's or GOETHE's way?

Klára Wenzel

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We are living in the age of colours. Bookstores are stuffed with books about colours that discuss all the possible applications, from fashion to colour therapy. The internet provides access to the curricula of painting schools and courses. Some of these go into scientific details about the theory and application of colours. However, we are often exposed to false information, with special regard to colour mixing, a specific field of colour science. In this paper we investigate where this false information may root, by discussing the laws of colour mixing.

Keywords: *color science, additive color mixing, subtractive color mixing*

Measuring treshold of sensitivity on coloured monitor

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Today, as LCD and TFT displays are more common than CRT monitors, we felt the need to study, how the visual perception laws, especially Weber's law work on LCD display. Treshold sensitivity measurements were carried out on a commercial laptop, whiches spectral power distribution and gamma were measured, with nine subjects. It is shown, there is a significant dark noise range, above which Weber's law can be observed. It is also presented, there is a significant difference between the color deficient subject and the others having intact color vision.

Keywords: *Treshold sensitivity, Weber's law, LCD-display*

Measuring colour histogram changes due to solar radiation

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Széchenyi István University, Győr

It is a well-known fact that the colour of surfaces exposed to solar radiation changes due to the ultraviolet radiation. According to the reciprocity law of photochemical reactions, the colour change depends on the radiation dose, which, in theory, makes it possible to estimate the solar radiation dose. This method can be useful in case of the examination of packaging whether the solar radiation has effected the quality of the goods (e.g.: food) negatively. For the sake of a wide range of application, this method does not suppose measuring in laboratory with high-precision colour measuring devices, but with low-cost imaging hardware. This method makes possible to estimate the solar radiation dose that has reached a given coloured surface with the use of a common scanner and a digital camera. In this way, those products can be selected easily that have suffered deterioration.

Keywords: *UV-radiation, digital camera, CIE u'v', histogram*

Colour education palette in the Hungarian universities

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Colour is a language and tool that has profound implications for affecting our world. Colour is a universal language understood by all people in all cultures. Colour education sometimes is walking in a harsh infancy. Everyone knows that is important to be taught, but it is taught only as an optional subject. A survey was made in order to collect the thematic of colour science subject in the Hungarian universities. The data were collected from 4 universities and an education department from the industry. This article shows the analysis of responses.

Keywords: *colour science, education, university*

