



MEETING

AIC COLOR 2002 SI COLOR & TEXTILES

Book of Abstracts



Maribor, Slovenia
August 29 - 31, 2002

MEETING SCHEDULE

DATE		28.08.2002		29.08.2002		30.08.2002		31.08.2002		
TIME		WEDNESDAY		THURSDAY		FRIDAY		SATURDAY		
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19 ⁰⁰ -		EXHIBITION OF THE DESIGNERS								
20 ⁰⁰ -				TRIP TO POHORJE HILL		SLOVENIAN EVENING				

LEGEND:

- + CRYSTAL HALL / KRISTALNA DVORANA
- + CONGRESS HALL / AVLA
- + CITY HALL / ROTOVŽ
- + DIPLOMATIC CLUB / DIPLOMATSKI KLUB
- + VOKAČ HALL / DVORANA - VOKAČ

- A - ENVIRONMENTAL COLOR DESIGN
- B - ADVANCED COLOR MEASUREMENT METHODS

**AIC COLOR 2002 SI
COLOR & TEXTILES**

Book of Abstracts

ISSUED BY

- DKS - DRUŠTVO KOLORISTOV SLOVENIJE, MARIBOR, SLOVENIJA / SCA - SLOVENIAN COLORISTS ASSOCIATION, MARIBOR, SLOVENIA
- ODDELEK ZA TEKSTILSTVO, FAKULTETA ZA STROJNIŠTVO, UNIVERZA V MARIBORU, SLOVENIJA / TEXTILE DEPARTMENT, FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY OF MARIBOR, SLOVENIA

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PROGRAMME

ORGANIZED BY

- DKS - DRUŠTVO KOLORISTOV SLOVENIJE, MARIBOR, SLOVENIJA / *SCA - SLOVENIAN COLORISTS ASSOCIATION, MARIBOR, SLOVENIA*
- ODDELEK ZA TEKSTILSTVO, FAKULTETA ZA STROJNIŠTVO, UNIVERZA V MARIBORU, SLOVENIJA / *TEXTILE DEPARTMENT, FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY OF MARIBOR, SLOVENIA*

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Thank the Patron and the Sponsors.

PREFACE

The inception of color science in Slovenia goes back to the 1980's, when the Laboratory of Colorimetry was founded and equipped at the Faculty of Technical Sciences in Maribor. Many organizational changes have taken place since then and in 2002 we will celebrate the tenth anniversary of the Slovenian Colorists Association. We are, therefore, particularly happy to host the AIC meeting, entitled "AIC Color 2002 SI – Color & Textiles", on the occasion of our Jubilee. The Textile Section of our Association is amongst the most numerous and active ones and so it is not a coincidence that "Color & Textiles" is the topic selected for the AIC meeting in 2002. It is only natural that color science, color design and many other color-related topics of great interest to the Textile Industry will be discussed at this meeting.

Textiles remain among the most important material goods needed in every day life. They are used for a variety of purposes, so they must have certain specific properties in order, to be both comfortable and fashionable, and color is a phenomenon that greatly influences textile aestheticity. The aim of this meeting is to present the most up-to-date theoretical and research achievements in color science and their implementation in textile practice. The AIC Color 2002 – Color & Textiles aims to provide an international forum for the presentation and discussion of novelties and the state-of-art of this scientific field. In the frame of introductory lectures, the importance of color for designing, projection, production, as well as for quality of textiles will be presented. Furthermore, the relationship between the dyestuff and color of a textile product will be discussed. The following topics are included into the main theme of the meeting:

- Interdisciplinarity of Color Science,
- Color and Design,
- Color Education and Color Imaging,
- Color Evaluation, and
- Colorimetry in Textile Applications.

Two roundtable discussion panels are organized that will follow the respective oral presentations on the last day of the meeting:

- Environmental Color Design, and
- Advanced Color Measurement Methods.

We would like to express our thanks to our sponsors and to all that contributed to AIC Color 2002 SI. On behalf of the International Scientific Committee and Organizing Committee we wish all the participants an intensive exchange of knowledge and experience and a pleasant stay in Maribor and in our beautiful and colorful Slovenia, where visitors are received as guests, and leave as friends.

President of Slovenian Colorists Association

Prof. Dr. Slava JELER



Chair of AIC Color 2002 SI

Prof. Dr. Vera GOLOB



REGISTRATION

8.00 - 18.00

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EXHIBITION

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COLOR AND TEXTILES

Vera Golob, Slava Jeler

The textile industry represents an internationally-significant production outlet for various products used in every-day life such as garments, textiles in living environments and technical textiles. They consist of natural and man-made polymers, which can be colored in different stages of the production chain in the forms of fibers, yarns, threads, woven and knitted fabrics and apparel. The color of textiles depends on the concentration of whitening agents, dyestuffs or pigments used in the bleaching, dyeing and printing processes, which selectively absorb light within the visible range.

Eco-production of colored textiles requires highly professional knowledge, therefore many specialists from various scientific fields collaborate as designers, color chemists, textile engineers, computer specialists, etc. The development of new textile products follows fashion trends, and color is the most important aesthetic component of their design and appearance. Textile styling and design is an innovative art usually based on a subjective relationship with fashion. Computer-aided color design and computer-based color systems enable the designer to create unlimited variations of color patterns and combinations.

The design and production of bleached, dyed, printed and colored-woven textiles is one of the technologically and ecologically most demanding and quickly developing industrial branches. This paper emphasizes the importance of color science education and its application in the reproduction of colored textiles from idea to end product, which enables the necessary flexibility for a rapid response to the fashion demands of the market. Today, color design, accurate recipe composition and color evaluation are supported by CAD-CAM, color imaging, color match prediction, color appearance, color management and advanced measurement methods and equipment.

Keywords: textiles, color design, coloration processes, color science, color education, colorimetry

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DYESTUFFS AND COLOR OF TEXTILES

Marija Gorenšek

The dyestuffs for the application in the dyeing processes of textiles are represented. Correlation between the chemical structure of the dyestuff and its color is described in the example of a simple azo direct dye. In this context indigo is mentioned for its extraordinary cross-conjugated system, which is responsible for its long-wavelength absorption. The indigo dyeing process of cotton fibers is explained.

Although the main purpose for dyeing of textiles is the production of beautiful and usable textiles, the process may also have another benefit. Nowadays people are afraid of the carcinogenic influence of UV A and B waves, due to the damage of the ozone layer. Today is probably the moment to point out the protective effect of some dyes on textiles. The transmittance of UV A and UV B waves and Ultraviolet Protection Factor (UPF) for pale and dark tones of the dyeing of cotton and polyester fabric are represented.

Keywords: azo direct dye, indigo, chemical structure, protective effect

COLOR APPEARANCE OF COMBINATIONS OF TEXTILES

Lucia R. Ronchi

A survey of the literature shows that since long time samples of textiles have been used as test-objects in visual laboratories to quantify a variegated set of effects. This is the case, for instance, of the brightness-luminance discrepancy, of the dependence of color appearance on illumination (quality and quantity), including the Purkinie effect, by the use of color naming and color categorization; the influence of texture on the appearance, under various angles of illumination and of observations, (for instance in the case of ancient-like tapestries and damasks), and in various conditions of gloss. Various patterned textiles may act as highly effective visual inputs, ranging from highly contrasted gratings, checkerboards, to ambiguous optical illusions inspired to the Op-art. In some paintings, where textiles are represented as curtains, garments and similar, color constancy may be favored by the knowledge of the effects of illumination, the local distribution of patterning of lightness being properly manipulated by the artist.

In this framework, we performed some experiments concerning the appearance of various color combinations. Without calling into play either preferences or harmony, we determine the visual balance (at the match of the “visual weights”), having in mind Munsell inverse area-brightness relation and its modified versions.

We call into play the “shape” of the two samples combined in a pair. Starting from the simplest case a), where a single sample is viewed on a uniform (amodally perceived) background, we pass to consider (case b), a pair of samples so combined as to form a well defined shape, by varying, in particular, the curvature of its border, and the aperture of corners.

The balance condition is found to be related to the luminance contrast between the two samples through a power law, with exponent from 0.5 to 0.6.

It seen of interest that those colors which are known to “go with” every other color (and which probably belong to the missing 12th category), reach the mutual balance after proper manipulation of the relative areas, once fixed their luminance contrast.

In general, Munsell’s law is confirmed once more to fit well the data at the balance. However, for a better understandings of some form-related complicates, we performed an experiment *ad hoc*, based on the assessment of the color appearance of test-objects of increasing spatial complexity, both in steady state situations, and by placing them on a spinning disk. This leads us con consider pattern-related concepts like camouflage, pop-out, Ikeda’s RVSI, and to note once more how “robust” the spatial symmetry is.

Keywords: paired colors, visual balance

PREDICTION OF PERCEIVED COLOR OF LIGHTING IN A COLORED ROOM

Taiichiro Ishida, Naohiro Toda

Colors of the inner surfaces of a room must have significant effects on our perception of color of lighting in the room. For instance, if a room is colored green and illuminated by a white illuminant, we may perceive the color of lighting as somewhat greenish. The aim of this study is to examine how we perceive the color of lighting in a colored room and develop a method to predict the perceived color of lighting quantitatively. The light filled in a room physically consists of the direct and indirect components. The direct component is the light that is emitted directly from the illuminants, and therefore its color is equivalent to the color of the illuminant. On the other hand, the indirect light components are produced by mutual reflections of the light between the inner surfaces, and therefore their color shifts toward the color of the surfaces. The actual light illuminating the room is the sum of these two components. The focus of this study is to test which physical components of the light determine our perception of the color of the lighting.

Two small model rooms were used for the experiments: one is referred as the test-box and the other as the matching-box. The two boxes are illuminated separately by three types of fluorescent lamps (R, G, and B) to produce various colors of lighting. The colors of the inner surfaces (walls and floor) of the test-box were set to various combinations of nine colors. The color of the inner surfaces of the matching-box was gray (N7.4). The task of the subjects was to adjust the color of the illuminant of the matching-box so that the matching-box appeared to be illuminated by the same illuminant of the test-box. In addition, the indirect components of the light were estimated using a conventional computation method for the mutual light reflections.

It was shown that the subject's judgment of the color of lighting was closely correlated to the sum of direct and indirect components of lighting. The similar results were obtained in our previous study in which the illuminant colors were limited only along yellow-blue direction. Our results suggest that the perceived color of lighting in a colored room can be predicted as the sum of direct and reflected component of the lighting.

Keywords: color of lighting, interior color, mutual reflection, illuminant perception

UNIFORM SCALE OF CHROMATICITY AND HIDDEN GEOMETRICAL STRUCTURE OF THE COLOR OPPONENCIES IN FOVEAL VISION

Claudio Oleari

Recently, two different transformations between the (X_{10}, Y_{10}, Z_{10}) coordinates and the $(L_{OSA}; j, g)$ ones of the Uniform Color System of the Optical Society of America (OSA-UCS) have been proposed related to two different geometrical structures, one *evident* and the other *hidden*. Both transformations are logarithmic. The second transformation has a simpler and highly symmetrical structure, and the regularity of the OSA-UCS lattice in the new coordinates is very high. This structure reveals the role of a particular reference frame in the tristimulus space, named *main* reference frame. These results were presented at the 2001 Rochester AIC meeting. With regard to foveal vision, a chromaticity diagram with uniform scales has been proposed obtained from the tristimulus space by logarithmic transformations. The geometrical structure of this transformation is *evident*, in analogy with the *evident* one given for the 10 degree observer. All that induced us to search for a transformation related to a *hidden* geometrical structure for foveal vision. In the large field vision, the new uniform coordinates are a mixing of the logarithms of the ratios of two pairs of components of the tristimulus vector in the main reference frame (A, B, C) . The present work shows that analogous properties hold for the 2 degree observer, too. This result is based on the MacAdam ellipses and therefore holds for illuminant C adaptation.

It is shown that color discrimination is represented on the chromaticity diagram by a couple of independent angular variables centered on two vertices of the triangle ABC of the main reference frame or, equivalently, by a couple of ratios of reference color stimuli A, B and C . Complete symmetry exists among the three main reference stimuli A, B and C .

Any pair of the following quantities

$$q_{AB} = \ln\left(\frac{A}{B}\right), \quad q_{BC} = \ln\left(\frac{B}{C}\right), \quad q_{CA} = \ln\left(\frac{C}{A}\right),$$

which are logarithms of ratios of proper linear combinations of the cone activations, can be considered as orthogonal coordinates, in which, with good approximation, the MacAdam ellipses appear equal. By a proper *scale dilation* in the direction defined by the semi-axes of the ellipses, the ellipses are transformed into equal radius circles. The dilation mixes the q quantities and reveals that, if the q 's represent color opponencies, the opponent mechanisms are working in a mutual dependent way, as was shown for the large field view.

Now the analogy between the 2 and 10 degree observers is almost complete.

Keywords: uniform color scales, color opponent mechanisms

WHAT INFORMATION IS CODED IN HUMAN V4?-NOT ONLY COLOR, BUT ALSO FIGURE-GROUND SEGREGATION -

Yasuyo G. Ichihara, S. Nakadomari, H. Takeuchi, K. Kitahara, S. Miyauchi

Whether human V4 is a color center or not is still controversial, because a colored stimulus is usually presented with a figure and a ground, and it is difficult to completely separate the color processing from the processing for figure-ground segregation. Here we report that V4 can be activated not only by color, but also by figure-ground segregation.

Three subjects without color vision deficiency observed the following five pictures composed of 1400 small dots: "rand", "kumo", "uzuu", "rect", and "mono". The first four were composed of dots with four different but iso-luminant colors: "rand" is a random pattern; a vague cloud-like pattern was depicted in "kumo"; a whirl in "uzuu"; rectangles in "rect". "mono" were achromatic versions of these four pictures. Data were collected with a clinical MRI system (Siemens Vision, T2* weighted EPI; TR: 5000 msec; TE: 66 msec; FA: 90 degrees; voxel size: 3x3x3 mm). Preprocessing (realign and smooth [6x6x6 mm]) were done using SPM99. Then, we calculated the mean time course of the MR signals in the areas around the collateral (V4) and the calcarine sulcus (V1/V2).

In Exp., all the colored pictures ("rand", "kumo", "uzuu", and "rect") activated V4 in comparison with the achromatic pictures ("mono"). In addition, there was a tendency that both "uzuu" and "rect", which had clear figure-ground segregation, showed higher V4 activity than "rand" and "kumo", which had no or vague figure-ground segregation. These results suggest that human V4 is not a simple color center. Rather, V4 activity is more associated with figure-ground segregation as a pre-processing for shape cognition in the higher ventral/what system.

Keywords: color vision, fMRI, human visusl cortex V4, color center, Retinex

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PRACTICAL EXPERIENCES WITH THE COLOR CONTOUR TEST

Klara Wenzel, Ilona Kovacs, Veronika Böhm

The Contour Test was constructed by Bela Julesz and Ilona Kovacs in 1993 to conduct psychological tests. The test consists of small black and white Gabor forms on an A4 gray paper or on a monitor. The Gabors are placed on the paper with random orientation and distances, but some of them are arranged at the same distance from each other in continuously changing orientation and form a closed loop. The test has 15 plates numbered from 1 to 15 with more and more randomly placed Gabors on them. Recognition of the different test plates is not equally difficult; the most difficult test plate is which contains the most randomly placed Gabors. The goal of the test is to find the closed loop among the other random Gabors. The result of the test is the number of the last plate, which was yet recognized.

In year 2000 Ilona Kovacs developed a new Contour test (Color Contour Test) to examine the color vision of people with normal or anomalous color vision. The test is principally the same as the contour test; however, there are not Gabors but small red and green flats placed on the test plates randomly. The size of the flats is different and the colorfulness and darkness of the red and green flats are different too. The small flats are placed on a white paper or on the color monitor randomly but some red flats of different size and shade of color are arranged in a closed loop and are placed in equal distance from each other. The test has 15 plates with more and more randomly placed red and green flats on them. The plates are numbered. The goal of the test is to find the closed loop among the other red and green flats.

We conducted examinations on 24 people with normal and on 12 with anomalous color vision. The color vision of the participants was checked with Ishihara plates and a Heidelberg anomaloscope. To differentiate between the psychological effects and differences in the color vision we have conducted measurements with both the Contour Test with Gabors and the Color Contour test.

The results of the experiments with the Color Contour Test were in good correlation with the anomaloscope measurements.

The advances of the Color Contour Test are: (1) We can make it fast, (2) We can make it easy, (3) The test plates are cheap, (4) The result is reliable.

The disadvantage of the Color Contour Test is: The Color Contour Test cannot differentiate between deuteranomalous and protanomalous people.

The most important advantage of the test against the Ishihara plates and the anomaloscope measurements is that the result shows the degree of the color anomaly so we can show and measure some effects about color vision E.g.: (1) Increasing of color vision in consequence of learning effects, (2) Decreasing of color vision in consequence of fatigue, (3) Increasing of color vision in consequence of applying color vision enhancing eyeglasses.

Keywords: defective color vision, contour integration test, color contour integration test, anomaloscope, pseudoisochromatic plates

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RATING OF COLORS USED FOR LIVING ENVIRONMENT BY YOUNG AND ELDERLY PEOPLE

Haruyo Ohno, Masami Kono

Visual perception of colors used for living environments is affected by various factors, whose psychological effects have conventionally been studied. However, it is difficult to predict actual color visions and the psychological and physiological effects of color targets applied to living environments based on the results of such studies.

The author conducted experiments using subjects on the color perception of chromatic color targets and concluded that the concept of the perception of gray scale obtained from previous studies can be partially applied to the evaluation of colors for living environments. However, the ratings of hues widely scattered when compared with other attributes, suggesting the necessity for more data to conclude the qualitative tendencies. For this reason, the author conducted experiments on the perception of chromatic colors commonly used for living environments by a larger number of subjects.

This paper reports on the perception of chromatic colors used for living environments using samples against achromatic color background. The subjects consisted of 369 college students with an average age of 19 and 228 people studying at a college for the elderly with the age ranging between 58 and 80. The number of colors used for the experiment was 50. The colors consisted of colors with high and medium Munsell Chromas, safety colors, and commonly used interior finishes. The subjects were requested to answer the difference between the visual perception of the color target and reference by numerical values. The finish of the test room was all in achromatic colors. The illuminance was approximately 500 lx.

The colors with a high Munsell Chroma were rated high by both age groups, with the ratings by the young being higher. Some of the safety colors were perceived as not having the intended effect of distinctiveness by both young and elderly people, posing a problem of safety color planning. The colors commonly used for interior finish were similarly rated by both age groups.

Keywords: visual perception, achromatic color, living environments, safety colors, rating

COLOR AND LIGHT, ORIENTATION AND WELLBEING

Leonhard Oberascher

Besides the measures essential for care and therapy, architectural design is of considerable significance for the purposes and demands of health care facilities. For patients/inmates, staff and visitors, the considerations – variously evaluated – are: well-being, minimizing of stress factors, gaining control, and participation in the life of the institution, and (inner and outer) orientation by means of clear and readily comprehensible orientation systems.

Thus color design should not only fulfil architectural or aesthetic criteria, but above all regard specific user requirements. A balance between stimulation and sedation, order and variability, affinity and contrast, can reinforce the function of a room, enhance it optically, structure and animate the ambience. Group-specific color preferences and trends should also be considered. Moreover, a color concept can form the basis of direction signs and orientation systems, thus contributing to well-being and identification with the place of residence.

The influence of color on well-being cannot, however, be reduced to simple formulae (as for instance, "blue soothes, red stimulates"), but depends to a considerable extent on its cultural, milieu-specific and individual significance, as well as on the context in which it is experienced. Moreover, color combines in effect with other elements of the design of a room, such as form, materials and, above all, lighting. Intensive care units in particular demand sensitive use of color and lighting, in order to convey to the patient a sense of comfort, relaxation, recuperation and security. Decisive factors here are non-reflecting surfaces, the link with the outside world and with daylight, directing daylight or, if absolutely necessary, supplementary artificial light. Special attention must be paid to light-sources for examination, night-lights and orientation lighting (avoiding dazzle or disturbance of other patients during night rounds...) (v. Bartenbach). Various studies on the biological and therapeutic effects of light show that light can have a strong influence on our biology/physiology both externally (skin) and internally (circadian/neuroendocrine system). In addition, light and color are regarded as having a therapeutic effect, for instance in the treatment of Seasonal Affective Disorder.

As far as color is always a (perceptual) function of light, material properties and structural context, a design concept will be all the more purposive, the more completely it succeeds in integrating the various dimensions of color, thus anticipating as realistically as possible – and ultimately rendering – the total color appearance. Several contributions to the development of this kind of integrative color theory take into account visual sensations such as transparency, specular reflection, translucence, diffuse reflection and absorption (black); the concept of "tincture" (a general concept for all aspects of what we see beyond but including color); the dimension "micro-polychromy" (consisting of several scales, e. g. from dichromatic to polychromatic); the emotional, cognitive and behavioral aspects of a scene, thus the properties of the scene as well as the characteristics of the perceiver – to mention only a few. Such initiatives offer the designer "a methodology for thinking about the disciplined control of the images we create and those to which we are subjected" (J. Hutchings).

Of course, such a complex combined effect of color, light, material, structure, specific user requirements and activities in a therapeutic context renders it difficult to establish generally prescribed criteria for design, and necessitates a differentiated and comprehensive view of each individual object/room in order to arrive at the best possible design solution – which will probably not be the all too prevalent sterile, empty, deserted, chill effect of white!

Keywords: well-being, orientation (way finding), total color appearance

COLORS OF TEXTILE AS CHROMATIC ALPHABET OF SOCIETY

Lia Luzzatto, Renata Pompas

The history of dyestuffs, used for dyeing and decorating fabrics, is closely related with evolution of social organization.

Value of color is as sign and symbol: sign in regard to indicate the membership of group or tribe and, where it is index of rank or function; symbol regarding to assume meaning of communication with souls' and forces of nature world.

It is possible operate a survey about use of colored textiles as chromatic alphabet of society, in horizontal manner (spatial – geographical) and in vertical manner (temporary – historical).

In horizontal manner coloring materials, which are typical in each geographical area, were object of trades, business and also political strife; and the overall of tints characterizing specific matching of colors, distinguishing culture of territory.

In vertical manner these specific matching of colors changed inside the same society the passing of time, in relation with mutations generated by culture, becoming witness of social, political, religious and aesthetic orientations.

Fabric's color organized itself as a non-verbal language, with immediate visibility and comprehension, capable to express beauty and to dialogue with emotions. Colors went signs of status to play ourselves on "stage of society".

A dress color is expression of the individual who is wearing it and the society he belong to. From the Romans to the XXI century different ranges of colors have distinguished communities develop and also people expectations. The reasons of the variations of the chromatic tendencies pass trough a lot of difficult event, often interwoven: in these changes it's possible to underline commercial flows history, the power hegemony, the philosophic artistic and social conceptions. Our speech describe the change of polychromy in different periods: contrasted in Medieval, mellow in Renaissance, castigated in Protestantism, frivolous in Rococo, bourgeois in Victorian age, decadent at the end of century, feverish various in twentieth- century from catwalks to street.

With invention and production of synthesized coloring, value of symbol and sign of each tint knows a strong inversion of meaning and the criterions of uniqueness and vitality, qualifying natural colors, are substituted by those of multiplicity, permanence and equality, qualifying industrial dyeing.

Today dyeing of fabrics represent aesthetic characteristics "body advertising": a variable packaging, actualizing in accordance to fashion trends imposed by market.

So fabrics' colors answer project of communication both to individual and collective, interacting on the one hand with sensations, emotions, to be and to appear, on the other with social aspirations and orientations.

What is the chromatic scenery prospecting us? (Following hypothesis)

Keywords: color as interface and document, historical changing colors taste, alive colors and permanent colors, collective and individual consumptions, chromatic futures sceneries

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EXAMINING COLOR - PREFERENCES OF DESIGN STUDENTS WITH RESPECT TO HARMONIOUS COLOR COMBINATIONS SUGGESTED BY EXPERTS

Nilgün Camgöz

Research on color combinations has been two fold. On the one hand there has been scientific research from the fields of physics, psychophysics, and psychology (Helson and Lansford; etc). On the other hand, there have been theories developed by experiences of experts (Chevreul; Munsell; etc). Scientific research on color combinations provides the designer with perceptually based knowledge obtained from color preferences of people in general. Expert views, alternatively, provide conceptual knowledge gained from people with professional experience. Expert views are widely known as color harmony studies within color theory. Color harmony is traditionally referenced in design education, initiating from the very first year of a design student. It should be noted that expert views and color harmony studies do not have to depend on any empirical data.

Within a controlled experimental setup, 123 undergraduate students studying in design related departments in Ankara, Turkey were presented image sets through a computer monitor. The image sets consisted of 8 background colors. Each image had a specified background color on which 63 color squares of differing hues, saturation's, and brightness were presented. Every student viewed and singled out the color square that they preferred on the presented background color for each one of the eight background colors. The research hypothesized that there would be a consensual idea on preferred background-foreground color combinations and that this consensus would reflect students' prior knowledge on color harmony.

These design students were equipped with two types of knowledge on color: firstly, through their own visual and perceptual experiences, and secondly, through expert views and color harmony studies instructed in their courses. The findings of this experimental research favored only a few harmonious color combinations recommended by experts (Chevreul; Munsell; Itten, The Elements of Color; Itten, Design and Form). On the other hand, they confirmed most of the results from previous experimental color-preference research. Thus, despite the conceptual knowledge that is instructed within the design tradition, there seems to be an inclination towards perceptually based responses for one of the basic themes of design, color harmony.

Keywords: color combinations, color in design education, color harmony, color preference

TEXTILE DESIGN BASED ON BUILT ENVIRONMENT AND END-USERS SPECIFICITIES – Re-scaling a classroom with colored patterns on textile curtains

Jean-Luc Capron, Marie-Hélène Huysmans

In 1999-2000, Hic et nunC designed and printed about 70 m² of curtains for a classroom with large windows on north and south façades, generating the discomfort of pupils, due to overheats and glare. This design task was part of a larger process, including a previous consultancy for the choice of appropriate colors for the new individual benches and chairs, and post-occupancy evaluation of the impact of the printed curtains on pupils' behavior and well-being in this classroom of the Athénée Royal de Rixensart, an elementary school in Belgium.

Aim of the design is to provide a solution combining the necessity of a solar protection and a visual screen with the need for a spatial balance between the scale of the group of pupils and a personal anchoring for each individual. The entire composition is made of colorful silkscreen prints of a unique pattern on the curtains. The curtains, made of three-meter high hangings pieces of serge cotton, natural-colored, were chosen for both the low cost of their production and maintenance, but also for their easy manipulation by children.

By taking in account space and user specificities, the nature, graphic delineation, size and color of an abstracted floral pattern are defined to reach the objective of virtually rescaling the classroom: (1) The perceptive dynamic generated by the composition of the colored patterns has to provide the balance between the scale of the group and the one of the child. (2) Territorial anchorage and appropriation of the space are achieved by the association of a textile support and the colorful patterns organized according to a horizontal segmentation and vertical rhythmic. Colors, pattern, composition, and the interaction between those perceptual factors, have to rescale the classroom dimensional characteristics to its perceived size, in accordance to pupils' scale sitting on individual schoolchild's benches. (3) Pattern, colors and the textile support have also to act on a semantic dimension, as a mean of personalization.

The paper discuss in detail: (1) The entire process, which is of a type evaluation-design-evaluation, with on site and full-scale test of the pattern, scale and colors, as well as the global composition. (2) The results of a three years assessment program, based on a post-occupancy evaluation approach and a questionnaire focusing on three topics: general preferences (colors, shapes and patterns), perception of space (depth and anchoring) and users' feeling (comfort and quality). (3) The proposed guidelines for similar designs.

Keywords: built environment, colored patterns, children, perception, behavior

INFLUENCE OF THREAD FINENESS AND WARP AND WEFT DENSITY ON COLOR VALUES OF WOVEN SURFACES

Helena Gabrijelčič, Krste Dimitrovski

Multicolor jacquard fabrics are mostly structurally multi-layer fabrics with patterns of various shapes and sizes, which are made of differently colored areas. The color in particular parts of pattern depends upon the number of differently colored threads that interlace in the top layer of the fabric and their color characteristics as well as upon the fabric constructional parameters – thread fineness, warp and weft threads density and weave. In practice it happens very frequently that a yarn of defined fineness is replaced by a yarn of slightly lower or higher fineness with identical color values and with an unchanged or adequately corrected thread density. Of course this reflects in color values of those parts of the fabric where these threads appear on surface. The color effect of surface changes particularly in relation with other effects in the patterns.

Prior to introduction of numerical evaluation of colors and equipment for optical measuring of their values it was impossible to objectively estimate color deviations resulting from the changed yarn fineness or changed warp and weft threads density. Even today it is practically impossible to carry out a systematic research of this influence on real fabrics because it is impossible to weave such a big number of referential patterns (different types of yarn, different ranges of fineness and densities). CAD systems enable relatively quick and cost-effective preparation of simulations of color surfaces of multicolor patterns. They even enable changing of certain parameters within the ranges, which can be hardly or cannot be achieved at all in practice. By the measurements carried out on these simulations color deviations due to the changed yarn fineness or warp and weft density can be estimated in a wider interval. It has to be emphasized that there is a difference between the measurements carried out on color simulations and on real fabrics. However, the aim of the research is to determine the principles and above all to estimate quantitatively the influence of the changed yarn fineness and warp and weft density on color values of a fabric simulation. In further researches it would be possible to prepare only a defined number of real fabrics and to compare the results on simulations.

The paper presents the simulations of a defined number of fabrics of different fineness, the results of their color values measurements and the analysis of their differences.

Keywords: fabric simulation, thread fineness, thread density, color values measurements

OPTICAL COLOR MIXING OF TWO OR MORE COLORS ON THE WOVEN FABRIC'S SURFACE

Tanja Nuša Kočevar

A woven fabric's surface can be either in one color or in two or more colors. On the surface of a two- or more- colored woven fabric, individual color surfaces respectively surfaces of yarn floats, can be very small and in addition, distances between them can be very short too. In a case when the color surfaces are so small and close together that they cannot be distinguished with the naked eye, they mix together into a new, uniform color sensation. Alternation of parameters of a woven fabric's composition and construction influences the size of individual color surfaces and distances between them, and other fabrics' surface characteristics, which influences a perceived optical color mixing respectively a color of a fabric's surface.

The paper presents the results of optical color mixing of two and three colors on the fabric's surface. Besides, the influence of some parameters of a woven fabric's composition and construction on the color – interacting activity and on the optical color – mixing is presented too. Two methods were used, investigating the color on fabrics' surface: visual estimation and the measurement of colors.

Optical color mixing is creatively used by woven fabrics designers to reproduce various shades of color on the surface of colorful woven fabrics and to express their ideas in textile medium. Thus the statements made during the research process should be of assistance to woven fabrics designers when predicting the outcoming color on a fabric's surface.

Keywords: optical color mixing, woven fabric, design

TEACHING COLORIMETRY

János Schanda

Colorimetry becomes an important subject in many areas of life. Traditionally a subject for specialized arts and crafts students, now a day it is penetrating areas of science, techniques and arts.

The basics of color are usually taught by the art teacher, who has a very special relation to color: for him it is a vehicle to express his/her mood. The child will learn about color harmony, the meaning of different colors in its cultural environment, will perhaps experiment with subtractive color mixing using paints, but will not hear anything about how to use color when he is confronted with a computer and experiences the possibilities of producing colored text and graphics on the monitor.

Probably it would be the task of the physics and biology teacher to explain the laws of color stimuli and the functioning of the human color perception mechanism, but time is usually too short in the curriculum to deal with these subjects. The interdisciplinary character of color makes it even more difficult to include it into a regular set of school courses. Thus by the time the students get their introduction to the use of computers, now a days equipped with color monitors and printers, they have only very faint thoughts how color can be specified and communicated, not speaking of its best use in desk-top work.

It seems that colorimetry has to be dealt with in computer studies, at the time the students get introduction to make their layouts on the computer. This is a good timing, as hands-on exercises can be made explaining both the fundamentals of colorimetry and showing good and bad examples of using color in their design work.

The paper will show an outline of such a color course that can be implemented into the normal school system, where the students can experiment with color matching on the computer, learn the differences between additive and subtractive color mixing, where color harmony, assimilation and contrast can be shown by examples and where the students are lead to understand the proper use of colors in their everyday life.

Keywords: colorimetry, education, teaching color

COLOR EDUCATION AND TRAINING FOR TEXTILE ENGINEERING AND DESIGN

Robert Hirschler, Jennifer Gay

Teaching color is a fascinating battle: you have to fight with yourself all the time, trying to contain the flood of ideas, reducing the material to a fraction of what you originally intended to tell your students - only to discover halfway through the course that you barely covered a quarter of the topics you were supposed to. Looking back to the first colorimetry/color science course one of us (RH) gave nearly 30 years ago to a group of interested (and, in retrospect, we must add very patient) engineers and physicists it looks simply horrible. Over the years the course material has lost about 80% of its “scientific” content and became – we sincerely hope – so much the better for it.

Color education and training has a special importance at SENAI/CETIQT, a textile educational and technology center in Rio de Janeiro, having a full 5-years textile engineering, a one and a half (soon to be 3) years textile design and a 3 years higher education level fashion course. All of these include at one point or another “color studies” and we are trying to give each side a reasonable insight into the other world: engineers learn about color order and color harmony, and designers have some simple color physics and psychophysics.

We are convinced that the key to successful color education and training is trying not to overwhelm the students (be they technically or artistically inclined) by the complexity of the subject, and cram all the information - that may or may not be important - into the available number of hours, but to show them the beauty and the intellectual challenge of the subject. To capture the students’ interest our courses are highly visual, with lots of demonstrations showing additive, subtractive and “partitive” mixing, the spectrum and how it is modified through selective absorption, the effect of illumination, adaptation, contrast and those visual illusions which every designer (and engineer) should be fully aware of.

For the more technical courses we use a fully interactive classroom equipped with 16 industrial color measuring and formulation systems, while the designers can play around with complete sets of NCS and Munsell student kits, and get familiar with all the well-known color order systems and color collections. Those wishing to learn more than material given in the courses a library is available with over 300 books and all the major journals on the technical and artistic aspects of color.

Integrating the services of the only accredited colorimetry laboratory in the country with the facilities of the SENAI/CETIQT Design Institute a new Color Institute is foreseen to be established in 2003, offering the full spectrum of color education and training for engineering and design students as well as for technical, design and other professionals throughout Brazil.

Keywords: color education

THE NCS COLOUR SYSTEM AND IT USING FOR TEACHING AND APPLICATION IN ENVIRONMENT AND INDUSTRY

Todor Ivanov Kehlibarov, Yanko Milev

In the last years it is to observe a more use of the NCS Color System for teaching and applications in the practice of developing of color projects. From 1998 the NCS become ISO certification. We wish to give some information about our using of NCS from experience in the field in color teaching from more of 15 years and our evaluation in industrial design and industry connected with the problems of visual evaluation of different kind of samples. Will be presented also as examples some developed from as color projects using the NCS Color System in different areas in color applications.

Keywords: NCS color system, color teaching, industrial design

GAMUT EFFECT IN THE PROJECTED IMAGE BY LIQUID CRYSTAL PROJECTOR

Hirohisa Yaguchi, Masaaki Toraiwa, Satoshi Shioiri

The perceived color at each point in an image is not merely determined by the colorimetric value of the point. It depends on various factors such as the chromatic adaptation of the visual system and the simultaneous color contrast effect. Brown and MacLeod found that objects appear much more vivid and richly colored against low-contrast, gray surrounds than against high-contrast, multicolored surrounds. It tends to normalize the gamut of perceived colors in each visual scene. This phenomenon is called gamut effect. In the present study, we examine if the gamut effect is observed when we see images projected by a liquid crystal projector in a dark room and in an illuminating room.

Two degree square test color patch surrounded by uniform gray background or a multicolored pattern with the same space-averaged luminance and the same chromaticity as the gray. These test images were projected by a liquid crystal projector in two type of room lighting conditions, a dark room and in an illuminating room where the illuminance on the projected screen was 280 lx. We used 156 colors distributing at about $15 \Delta E^*_{ab}$ step in the CIELAB space as test stimuli. The gamut area in the (x, y) diagram of these 156 colors in the illuminating room condition was reduced to about 50 % of that in the dark room condition. In order to evaluate color appearance of test stimuli, we employed the method of categorical color naming, where subjects were asked to see each test stimulus and give a color name of it. Color names were restricted to eleven basic color names determined by Berlin and Kay.

We found that color appearance of test color patches did not change much in spite of changing the colorimetric purity according to the room lighting condition. This type of color constancy was observed in both surround conditions, the gray uniform background and the multicolored background. Comparing the experimental results of two different surrounds in the dark room condition, we found that the area of neutral color such as white and gray increased at the multicolored surround. This result is consistent with the gamut effect.

Keywords: gamut effect, color appearance, categorical color naming, liquid crystal projector

TECHNICAL COLOR REPRODUCTION CHARACTERISTICS ON A LCD

Sara Leckner

Cathode Ray Tube (CRT) monitors have been used for a number of years in the graphic industry for visual matching, image processing and soft proofing, where correct color reproduction is essential. The factors that have an impact on the color reproduction on a CRT are well known, but the CRT technology is not optimal. Quite recently the Thin Film Transistor (TFT) - Liquid Crystal Display (LCD) technology has become so sophisticated that the desktop LCD is getting an interesting alternative for professional color work. With its wider contrast ratio, sharper reproduction, smaller volume etc. LCD has many advantages, but the question is; is the LCD technology good enough yet for professional color reproduction, and is it an alternative for the graphic industry to replace the CRT for a LCD?

This paper evaluates the technical aspects of three different manufactured desktop TFT-LCDs that have the technical potential for color reproduction.

Aspects investigated are factors essential for correct color reproduction that can be an issue on an LCD, like: calibration, characterization, uniformity, viewing angle, color stability etc.

The main purpose of this project is to assess the impact different technical parameters having on the reproduction of color images reproduced on a LCD and if these parameters allow the LCD to be used with the same certainty as a CRT monitor in a Color Management System.

Keywords: LCD, color reproduction, colorimetric characterization, soft proofing, CMS

INVESTIGATING IMAGE DISCRIMINATION

Sze Man Michelle Lee, John H. Xin, Stephen Westland

There are strong demands for quick response communication in textile and clothing industries such as product design, production, product quality assessment, sales and marketing, etc. We have witnessed the dynamic changes that have taken place in the world through out the years. With dramatic growth of digital communication, the discrimination of images from thousands to millions of database is becoming a difficulty. There is an urgent need of an effective image discrimination system which can discriminate relevant images quickly on demand. Image discrimination can contribute to many aspects — searching specific sample from a large database and Internet for e-commerce, searching defects from fabric and garments for quality control. It has applications for manufacturing industry, e.g. quality control of textured materials, marble, wood, and many foodstuffs which are difficult to be evaluated using standard color-measurement systems. Machine vision on searching images has been developed for decades. The foundation of such machine vision is based on the response of the human visual system, which depends on a multitude of image features, such as color, shape and texture. This article discusses an image discrimination method based on content of textile images with different textures. The strategy of image discrimination was based on evaluating image content — spatial and spectral properties. A psychophysical experiment was conducted to evaluate the performance of this strategy.

Keywords: spectral information, spatial information and color similarity

PROPAGATION OF DETECTOR-BASED PHOTOMETRIC AND COLOR SCALES USING A SPECTRALLY TUNABLE LED-SOURCE

George P. Eppeldauer, Steven W. Brown

Improved accuracy photometric and tristimulus color scales are being developed at NIST utilizing the very low uncertainty of novel spectral responsivity determinations. The scales are realized on a filtered tunnel-trap detector. During scale realizations, monochromatic point sources are used to calibrate the four channels (Y, X₁, X₂, and Z) of the filtered tunnel-trap detector against Si tunnel-trap transfer standard detectors. The channels are calibrated in irradiance measurement mode. The Si transfer standard detectors were calibrated against a cryogenic radiometer. From the measured spectral irradiance responsivities, the (broadband) illuminance or luminance responsivities can be determined for the four channels. The broadband calibration factors of the channels can be calculated for the spectral distributions of standard sources such as incandescent lamps and special test sources such as display monitors using phosphors or liquid crystals, light emitting diodes (LEDs), and gas discharge lamps.

In order to transfer the scales with minimal uncertainty increase from the NIST standard (the filtered tunnel-trap detector) to field-level photo/colorimeters, a transfer source is needed with a spectral distribution equal to the distribution of the test source to be measured.

The design and characterization of a tunable output LED transfer-source is described here that can satisfy the increased accuracy requirements of photometric and colorimetric scale transfers. In this prototype source, 40 LEDs with 10 different spectral distributions are mounted onto an integrating sphere source. A voltage-to-current control circuit was designed and implemented, enabling independent control of the current feeding each set of 4 LED's. The effect of LED seasoning for luminance and chromaticity was studied. Also, the luminance, chromaticity, and spectral distribution changes versus LED drive current were analyzed for representative red, green, and blue LEDs. The prototype source demonstrates the feasibility of development of a spectrally tunable LED source with up to 40 different LED's. Simulations demonstrate that such a source would be able to approximate standard light-source distributions over the visible spectral range – from 380 nm to 780 nm – with deviations smaller than 2 %. The tunable LED source can also simulate the spectral distributions of special test sources. With this tunable transfer source, a test instrument can be rapidly calibrated for a variety of different source distributions tailored to the anticipated uses of the artifact. The first tests on increased luminous intensity LEDs show that extension of the maximum LED drive current from 50 mA to 1 A will be necessary. Also, pulsed mode light source operation is planned for the tunable LED source. Target uncertainties for the calibration of test artifacts are less than 1 % ($k=2$) in luminance and 0.002 in chromaticity for any source distribution.

Keywords: color scale transfer, light emitting diodes (LED), photometry, spectrally tunable source, tristimulus color measurement

STUDY OF THE COLOR FIDELITY OF TEXTILE MATERIALS CAPTURED BY DIGITAL INPUT DEVICES

John H. Xin

Globalization of textile and clothing industry demands high speed and precise communication of product information. Digital colors have been gradually adopted by Textiles and Clothing companies as the use of digital colors for communication has significant advantages over the conventional physical colors. This is particularly true for textile and clothing industry in which the supply chain is relatively long. The main advantages of using digital colors are cost and time saving. For the digitizing of the colored textile materials, input devices such as digital camera and digital scanners are widely used. These devices can be characterized first so that the device independent colors defined by CIE colorimetry can be used. However, for different textile materials, the accuracy of the digitization depends very much on the materials used in the characterization processes. If different materials are used, the accuracy of converting the digital counts to the CIE color attributes will be affected. In this paper, the accuracy of the digitizing of different textile fiber materials, such as synthetic and natural fibers by a digital camera and a digital scanner were studied and the results in terms of color different were analyzed in relation to the fiber materials used.

Keyword: digital color communication, device characterization, digitizing textile materials

INTEGRATION OF UNIFORM COLOR SPACE AND COLOR APPEARANCE MODEL

Yasuhisa Nakano, Naoki Obayashi, Ken-ichiro Suehara, Jiro Kohda, Takuo Yano

Purpose of colorimetry is to quantify color, but there are several ways to do it. In such case as one wants to evaluate how two colors are different, one might use uniform color space such as CIELUV or CIELAB, or might use color difference formula such as CIE2000. In another case as one wants to evaluate how the target color looks like under different lighting conditions, one might use color appearance model such as CIECAM97s. It is very valuable if these color spaces are integrated into one model. Purpose of this study is to propose such color space model.

We proposed a new uniform color space based on color vision mechanisms in 2001. This uniform color space improved uniformity of small color differences such as MacAdam ellipses and that of large color differences such as Munsell grids simultaneously. This model utilizes non-linear input-output function for cone photoreceptors and for successive post-receptor mechanisms. We introduced adaptation into this input-output function as follows.

$$f(x, \sigma, a, \beta) = \frac{\sigma}{114} \left[\left\{ 342 \left(\frac{x}{a\sigma} \right) + 1 \right\}^{\frac{1}{3}} - 1 \right] a^{\beta} \quad (1)$$

where x , σ , a and β represent input value such as one of cone tristimulus values, saturation constant, adaptation coefficient and incomplete adaptation index, respectively. Adaptation coefficient a was determined by

$$a = \frac{x_{N5\text{test}}}{x_{N5\text{ref}}} \quad (2)$$

where $x_{N5\text{test}}$ and $x_{N5\text{ref}}$ represent input values for neutral grey (N5) when it is illuminated by test illuminant and by reference illuminant, respectively. Incomplete adaptation index β was a function of $x_{N5\text{test}}$ for cone photoreceptors and a constant for post-receptor mechanisms. Other processes to calculate lightness and chromaticity coordinates were the same as previous model without adaptation.

Experimental data of corresponding colors under different illuminants were explained using the present color space model with adaptation. This model can explain other phenomena such as Hunt effect and Helson-Judd effect, too.

In conclusion, we integrated uniform color space and color appearance model by introducing adaptation coefficients and incomplete adaptation indices into our uniform color space model.

Keywords: uniform color space, color appearance model, chromatic adaptation

A COMPUTATIONAL ANALYSIS OF COLOR COMBINATIONS IN "KASANE-IROME," JAPANESE ANCIENT COURT COSTUME

Mituo Kobayasi, Minori Takahashi, Takuzi Suzuki

"Kasane" attire is the dress style of the women of the Heian-period (794-1185) aristocracy in Japan, who wore unlined kimono one over the other, taking great care to match and contrast the colors of each layer, which were visible at the neck, sleeves ends and lower skirt. The essential element of this style was the layering of garments to display set combinations of colors collectively known as "kasane-irome" (set of layered colors).

The aim of this study is to analyze features of color combinations in "kasane-irome" computationally.

Color samples of "kasane-irome" made of dyed silk cloths have been published by researchers of Japanese traditional textiles. We performed colorimetric measurements of such color samples belonging to National Museum of Japanese History. The colorimetric data obtained were stored in our computer system and transformed into Munsell and NCS color values for computational analysis.

Utilizing our software system, especially designed for multilateral color analysis, the colors used in "kasane-irome" are displayed and visualized in Munsell and NCS color spaces. Analysis of color distribution in color spaces tell that colors mainly used in "kasane-irome" in terms of hue are yellow, orange, red and green. Most colors have large chromaticness and small whiteness. The analysis of variation of order of the layered garments, or order of colors, through color sequences in NCS chromaticity diagram and nuance triangle show that combination of hue contrast (especially "red-green" or "white-chromatic color" contrast) with gradation in nuance (especially tone gradation of red, purple and green) are frequently used.

In this study the essential features and aesthetic aspect of Japanese traditional color combinations in "kasane-irome" are revealed by calorimetric and computational analysis. A new scientific approach to the study of color in culture is proposed.

Keywords: "kasane", traditional Japanese colors, color combination, computational analysis

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APPLYING DIGITAL CAMERAS FOR GRADING TEXTILE FASTNESS

Ming Ronnier Luo, Gui Hua Cui, J. Dakin and J. Morris

Fastness is an important property for textile materials. It is evaluated via visual assessments against a grey scale by experience operators. The assessments are divided into two: one considering how much change of a color before and after a process, degree of stain by adjacent fabric. Two grey scales recommended by ISO 105: Textiles – Tests for Color Fastness are used: Part A02 and Part A03, respectively. The assessment process is considered to be highly subjective. Although ISO 105 also recommended instrumental methods for assessing fastness of staining (Part A04) and color change (Part A05), they have not been widely used because of the difficulties for measuring very small-sized test and multi-strip for assessing staining specimens. These specimens sometimes are also non-uniform.

A system called DigiEye was developed at the University of Derby for measuring color and appearance of objects. Based upon the DigiEye technology, research was carried out to quantify the grades of fastness for color change and staining. The two ISO instrumental methods were implemented. Many testing specimens were collected together with their visual estimations assessed by a panel of experienced operators. The images of these specimens were captured and the grades were evaluated by instrumental methods. It was found that there is an excellent agreement between the instrumental and visual results. The camera based system is proven to be repeatable, accurate and to save tremendous amount of time comparing with visual assessment.

Keywords: fastness test, grey scales, color change, staining

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A NEW APPROACH TO DEPTH ASSESSMENT

Christopher J. Hawkyard, A. Haque, M. Kelly

Depth of color is of great relevance to colorists and dye manufacturers, but its definition has proved difficult and somewhat arbitrary. Much of the work in this field has been carried out on a series of dyed woolen samples (the Hilfstypen standards) produced in Germany in the 1920s, before the advent of color measurement and the CIE System. More recently the 18 depth series have also been printed on card (BS 1006, AO1) and these are used during the determination of light fastness, since this varies with depth. Some of the formulae for depth use measurements of the woolen standards as a starting point, while others, such as Integ, are based on the Kubelka-Munk relationship.

The work carried out at UMIST was based on the premise that when a dye is applied to a white substrate the lightness falls as more colorant is applied, but the chroma reaches a maximum value and then decreases. This was found to be true in most cases, though some yellows reach a point of maximum chroma but never pass it. Analysis of a large number of databases from the four major European dye manufacturers showed that, provided allowance was made for the color of the substrate, the lightness, L^* , at the point of maximum chroma, was remarkably constant over a range of dye classes and substrates, for a particular hue angle, h° . It is suggested that the value of L^* at C^*_{max} for the relevant position in the hue circle could define 1/1 standard depth. An equation relating L^* at C^*_{max} to h° has been determined with this in mind.

Unfortunately there was a noticeable gap in the data in the green region of the hue circle due to there being very few dyes of that color in use. It was therefore decided to use combinations of blue and yellow dyes to obtain data in this region. Two reactive dyes, a bright lemon yellow and a turquoise were selected, and recipes for the combination to achieve hue angles in the desired sector were determined using match prediction software (virtual dyeings). Some physical dyeings were also carried out. The position of the point of maximum chroma, and the lightness at that point were then determined and found to fit the line predicted by the equation generated with data for single dyes very well. It would therefore appear that the concept of using L^* at C^*_{max} as a measure of standard depth for a particular hue angle applies well to single dyes and also to combinations of dyes. Further work is required to confirm these findings and to determine other depths.

Keywords: depth, lightness, maximum chroma, hue

THE DETERMINATION OF A SURFACE OF EQUAL VISUAL DEPTH IN $L^*A^*B^*$ COLOR SPACE

Chao-Chi Chen, Roger H. Wardman, Ken J. Smith

Standard depths were originally developed and agreed by the German and Swiss dye manufacturers in the 1920's. A series of 18 standard shades, representing the various hues of the hue circle and possessing equal visual depth, were produced on woolen fabric at what was termed 1/1 standard depth. Additionally, sets were produced at the ratios 2/1 (stronger) and 1/3, 1/6, 1/12 and 1/25 (weaker). In visually assessing the depth of shade of a sample, it is necessary to compare the sample against the standard that is closest in shade to it. However this method is not accurate because visual assessments are subjective and significant differences between different observers can result. Further, the standard depth sets vary widely in strength. An instrumental method is required and Christ developed a formula by which the L^* value a color should have if it is of 1/1 standard depth, could be determined. The formula defines eight planar subsurfaces, each occupying a unique sector in the a^*b^* diagram and all meeting at $a^* = b^* = 0$. This formula was developed to give broad agreement with the 1/1 standard depth samples and has been incorporated into ISO 105 A06, a method "for the instrumental determination of 1/1 standard depth".

The object of the work reported in this paper was to map a surface of constant visual depth throughout the $L^*a^*b^*$ color space. Samples were prepared for visual assessment at intervals of approximately 5 CIELAB units of chroma, along eight equally spaced radii from the neutral point. The equi-depth samples were determined sequentially, so that a sample at a given value of chroma served as the "standard" for the selection of the next equi-depth sample at a chroma 5 CIELAB units higher, and so on. On reaching the maximum chroma possible with the dyes available, samples were then produced between the ends of the hue directions (thereby linking them together) so that samples of constant visual depth could be determined round the hue circle also. The visual assessments were conducted by a panel of four professional colourists all of whom worked for dye manufacturing companies. The trends in lightness as a function of chroma were determined for the dyeings judged to be of equal visual depth along the eight hue directions. An algorithm based on a conic function was developed to define the surface of constant visual depth that determines the value of L^* that a color of given C^* , h values should possess if it lies on the surface.

The surface of constant visual depth determined in this work was at a slightly higher value of L^* overall than that defined for 1/1 standard depth by the Christ formula. However by appropriate modification of certain constants of the conic formula, the surface determined in this work can be lowered so that it originates from the same L^* value on the neutral axis. It was found then that there was a good level of agreement between the shape of the surface defined by the Christ formula and that mapped in this work. However the values of depth yielded by other instrumental methods for the measurement of depth were found to correlate poorly with the surface mapped in this work. The algorithm developed in this work is suggested as a replacement for the Christ formula for the specification of 1/1 standard depth.

Keywords: dyeing, depth, visual assessment

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THE USE OF THE ARTIFICIAL NEURAL NETWORK IN TEXTILE PRINTING

Darko Golob, Jure Zupan

The Kubelka – Munk theory is unsuitable for the computer match prediction of dye concentration for printing paste thus research is oriented in other directions. One of them is the use of artificial neural network. It provides the capability for learning on the basis of numerous samples and predicting unlearned targets.

This present paper shows a sample of using artificial neural network for the calculation of dye concentration in textile printing paste preparation. An existing collection of printed samples with a different combination of 19 dyes was used for neural network training. Samples were printed with one or two dyes in various concentrations and ratios. The reflectance value (16) served as input data and the known concentrations of each sample were the targets. The learning data was divided into smaller datasets, which included only a few different dyes in a combination (up to 10) in order to keep the learning time reasonable.

Some variations of neural network were tested as well as various dimensions of neuron in each layer. Neural network was trained using different amounts of learning data and the optimum number of training data was investigated. In addition the influence of the training set organization was examined together with the number of learning epochs on the success of learning.

Keywords: neural network, colorimetry, computer match prediction, textile printing

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DYEING IN SUPERCRITICAL CO₂

Eckhard Schollmeyer, Elke Bach, Erst Cleve

At DTNW a process for dyeing of hydrophobic textiles has been developed and patented by replacing water by supercritical CO₂. The process is carried out at temperatures between 90 and 130 °C and pressures between 200 and 300 bar. The advantages of supercritical CO₂ in comparison to water are, more than 90 % of the CO₂ can be recycled, and no waste water treatment and drying of the fibers after the dyeing process are needed.

In 1995 UHDE Hochdrucktechnik (Germany) has designed and built a supercritical CO₂-dyeing pilot-plant on a technical scale with a 30 l autoclave based on the lab experiences of DTNW. Meanwhile the machine has been optimized in close cooperation with UHDE to get deep and uniform dyeings of PETP yarn and fabrics. The optimization steps of the machine include the pumps, the dye vessel, and the extraction- and impregnation cycle. Some other important factors which affect the dyeings, concerning the plant, the fibers, the dyes, and the optimum dyeing conditions are reported.

SEM photographs show that during the equilibration of the dyeing system without circulation of the CO₂ through the dye storage vessel crystallization and agglomeration of the dyes take place to a great extent. If the dye storage vessel is filled with CO₂ after the dyeing conditions have been obtained and instantly opened, crystallization as well as agglomeration can be mainly avoided.

For the characterization of the certain optimization steps of the CO₂ -plant and the dyeing parameters on the dyeing results, the dye uptake of the PETP fibers has been determined spectroscopically by reflectance measurements and by the quantitative dye uptake. Furthermore, a comparison between water- and CO₂-dyeing results of PETP in relation to the dye uptake and the light-, washing and rubbing fastness properties will be presented.

Key words: supercritical carbon dioxide, dyeing, process optimization

TESTING THE COLOR MATCH PREDICTION NOVELTIES

Boris Sluban, Olivera Šauperl

The article presents some results of laboratory tests of the least metameric recipe prediction method and uses them as the starting point for the discussion on accuracy of dyeing. The main question of the research was: Can the predicted sensitivity of the recipe color to the colorant concentration errors assist in the selection of the most repeatable recipe(s)? The dyeing of polyacrylic with basic dyes under laboratory conditions was examined. Both the biggest scattering of color in groups of repeated dyeings and the biggest predicted recipe sensitivity to the colorant concentration errors were observed in the cases of light, less saturated target colors. Some such light, less saturated target colors were selected and per each target 8 recipes with different sensitivities were tested. The less sensitive recipes generally produced lower scattering of color in groups of 20 repeated dyeings than the more sensitive recipes did, although also some exceptions were noticed. In majority of cases a weak but still statistically significant correlation between the predicted sensitivity of recipe color and the observed repeatability of the recipe color was found.

Keywords: recipe prediction, colorant concentration errors, repeatability of the recipe color

SETTING STANDARDS FOR PRECISION, ACCURACY AND FUNCTIONALITY

Stanislav Šulla

The Premier 8000 Series is the new benchmark in benchtop color measurement. It sets new industry standards for functionality, while meeting user demands for precision and accuracy. Featuring digital image capture technology, a dual-position body for front and top loading, unparalleled ease of use and seamless correlation with X-Rite portable sphere spectrophotometers, the Premier 8000 Series is a superior color measurement solution for the industrial lab. The Premier 8000 Series includes the high-performance 8400 unit and the mid-range 8200 unit (with optional add-ons). Both feature sphere interiors made of machined Spectralon[®], X-Rite's proprietary reflectance material that ensures accurate spectral data and is durable enough to last the life of the instrument.

The Premier 8000 Series includes the following key features and benefits:

Built-in Image Capture: The 8000 Series is the first benchtop instrument to capture a digital image of a sample and let users view and verify it on a computer monitor before measuring.

Horizontal and Vertical Positioning: In its standard, front-loading position, samples can be measured and sampled vertically. In its top-loading position, users can present samples horizontally on the aperture.

Easy-Access Transmission Measurement Chamber: The 8000 Series has an extra-wide transmission chamber to accommodate larger samples, including various-sized sample holders and cuvettes.

Inter-Instrument Agreement: The Premier 8400 model complements all X-Rite industrial color-measurement solutions, allowing data to be shared across the supply chain.

Durable, Maintenance-Free Spectralon[®] Sphere: To avoid common, expensive recoating, the 8000 Series sphere is built of Spectralon[®], a durable material that will not corrode, flake, peel, or yellow with age. Spectralon[®] offers the highest level of reflectance available in today's market.

Internal and External Protection: An optically pure glass plate shields the lamp, detector and electronics from damage.

USB Interface: The 8000 Series is the first benchtop instrument with a USB interface to the software. In addition to plug-and-play convenience, this means increased speed.

User-Defined Instrument Configuration: The 8000 Series uses X-RiteColor[®] Master software, which manages both quality assurance and color formulation. The software allows users to save and store frequently used instrument configurations for quick selection.

Keywords: Benchtop spectrophotometer, reflection, transmission

A HISTORY OF THE INTERNATIONAL COLOR ASSOCIATION STUDY GROUP ON ENVIRONMENTAL COLOR DESIGN, FROM 1982 TO 2002

José Luis Caivano

The AIC Study Group on Environmental Color Design was created and started during the Interim Meeting on Color and Dynamics, held in Hungary, in 1982, and since that, it has been continuously active holding meetings at the AIC congresses, proposing aims for research and work to be done, and achieving results in some of these aspects.

Among the specific aims that have been proposed along these twenty years there are: to present papers and have a forum for discussion in AIC meetings, to collect a specialized bibliography, to arrange an annotated glossary on light, color and environmental design, to carry out surveys on preferences for color combinations, to make specific publications, to set up a web page and an e-mail list for discussion.

The membership of the ECD Study Group ranged approximately from 20 to 40 members, since its creation until today, with variations along the years. Among some of the most known members, including also some chair-persons and secretaries of the study group, I can mention Berit Bergström, Monica Billger, Giovanni Brino, Michel Cler, Osvaldo Da Pos, Karin Fridell-Anter, Paul Green-Armytage, Anders Hård, John Hutchings, Shigenobu Kobayashi, Nancy Kwallek, Harold Linton, Antal Nemcsics, Leo Oberascher, Lucia Ronchi, Lars Sivik, Grete Smedal, Miho Saito, Werner Spillmann, Theano F. Tosca, and myself.

As a way of celebrating the twenty years from its creation, the aim of this paper is to make a history of the activities of the study group and the persons involved in it, by collecting and arranging in a comprehensive and organic way information that appears fragmentarily spread out in diverse media: AIC Newsletters, Proceedings of Congresses, tapes and videotapes of meetings, documents produced by the collective work of the members, written reports by chair-persons and secretaries of the study group along the years, and personal recalls from the initial and most outstanding members, some of which are still active and involved in the matters of the study group. In addition, considering that in recent times there was an increasing number of new members that do not necessarily know the origins and history of the study group, this will be a means of providing background and contextual information to these new members and other prospective ones.

Keywords: environmental color design, AIC study group, history, 20 years

LIGHTING FOR THE ART: WHITE LIGHT OR COLOR LIGHT?

Mauricio Rinaldi

Light is necessary for the visual perception of the objects. However, in the case of art, the use of the light is not a problem that can be considered as *neutral*, since the way in which the light is treated will produce a determined kind of perception of the object of art. On this way, in lighting objects of art it is necessary to consider the visual result that will be obtained.

These considerations let to spot the attention on two possibilities referred to the art lighting: 1. To use *homogeneous* lighting, without modulation, in order to maintain the “objectivity” in the way of presentation of the objects of art; 2. To use *heterogeneous* lighting, with modulation, in order to present the object of art in a determined way. These two kinds of lighting have direct relation with the *formal factors* of light: position, intensity, color, diffusion, size, form. As it can be observed, the color is one of the morphological factor of light, and, on this way, it is possible to analyze other two possibilities: a. to use white light; b. to use color light.

In this paper, the way in which the objects of art are perceived depending on the treatment of lighting morphological factors is analyzed in painting and sculpture.

Keywords: lighting, white light, color light, visual perception

URBAN FABRIC: A COMPARATIVE STUDY OF COLOR AND PATTERN IN AERIAL VIEWS OF CITIES AND ORIENTAL CARPETS

Galen F. Minah

The structure and design of oriental carpets is similar to that of a city. There is in both a conceptual design which considers the total form as a synthesis of parts. These are organized by shapes and typologies derived from meaningful patterns based upon tradition and everyday life. These parts are organized as a system of hierarchies within a whole and constructed upon an infrastructure of the grid, as warps and wefts or as streets and blocks. A city like Rome has uniform building heights, and this uniformity, defined by shadow, reveals a repetitive pattern defined by the urban block and its variations. These patterns, as in a carpet, become the principal ordering element. Many goals in Turkoman carpets have pattern types similar to urban blocks. There are color similarities between the roofscapes of Rome and Naples and those of many oriental carpets. Colors in the Tabriz carpets, and the natural dye palettes illustrated by the Kerman color samples are very similar to colors in these roofscapes. Spatial illusions created by color juxtapositions in carpet design is often visually similar to real space defined by shadows in aerial views of cities. These color juxtapositions are, in many cases, the principal means for perceiving these hierarchies in both carpet design and in urban design. By viewing the city from an aerial plan view in true color, an order is revealed which is unseen in other visual representations of the city in plan. The comparison of this view of the city to scale variation, edge condition, and hierarchy in many oriental carpets suggests a means for visualizing and understanding order. This comparison suggests also a point of departure for textile design which uses a color palette, patterns, scale variations, and hierarchies derived from the city.

Keywords: aerial, city, urban, oriental, carpet

APPLYING DIGITAL CAMERAS FOR MEASURING COLORS

Ming Ronnier Luo, Gui Hua Cui, Changjun Li, Wei Ji, J. Dakin

Digital cameras are becoming commonplace not only for consumable electronics but also for digital photography, industrial inspection. The performance of cameras such as resolution, color fidelity, image quality has been rapidly progressed over the years. It is expected that they will be applied to much wider application areas. This paper describes color measurement using a digital camera.

Different technologies will be introduced for the characterization of digital cameras, i.e. to convert digital counts to CIE tristimulus values and spectral reflectance functions. A system called DigiEye developed at the University of Derby for measuring color and appearance of objects will also be described. It overcomes the problems for the use of conventional instruments such as not capable of measuring ultra-small and curved surfaces, and multi-colored object at one time. The hardware and software of the system will be introduced together with its performance in terms of repeatability and accuracy. Some application examples will also be given.

Keywords: characterization of digital camera, CIE colorimetry

COLOR MEASUREMENT EMULATOR WITH A SCANNER AND ITS APPLICATION TO CMS

Aran Hansuebsai, Krisada Kitisarakulchai, Pontawee Pungrassamee

A desktop flatbed scanner is used to capture the image of a known color test chart; the color transformation algorithms can be created as emulators of a color measurement tool. Thus, input and output device profiles are obtained that can be applied to a Color Management System to convert original RGB data to appropriate output CMYK data for printing. Color reproduction is improved and controlled by various types of algorithms. Based on quick processing time and print quality, it is found that matrix functions of 3×4 and 3×11 are enough for this application. The total color difference values fall in an acceptable range, less than 6.0.

Keywords: color measurement, color management

ACCURATE RECORDING OF COLOR INFORMATION OF MUSEUM MATERIALS BY DIGITAL STILL CAMERAS - IN CASE OF “UKIYO-E” AND “KIMONO”

Takuzi Suzuki, Mituo Kobayasi

Colors of museum materials have been faded. To record and distribute their accurate color information is quite useful for research and appreciation, and is also desirable for preservation. Nowadays, digital still cameras (DSCs) on the market have a potential of accurate color image recording. We devised color transfer functions of two DSCs (Olympus C3040ZOOM and Minolta Dimage7). These functions are estimated by the relation between machine-dependent RGB values and CIEXYZ values of 240 color chips of Macbeth ColorCheckerDC. The average error of estimation was 2.5dEab for each DSC, which shows that they have high potential of accurate color recording.

As an application to real museum materials, we took images of ten UKIYO-E pictures (woodblock prints of 17c-19c in Japan) in National Museum of Japanese History by a DSC (Minolta Dimage7). We compared the estimated color values with the measured values by a colorimeter (Minolta CM-2600d) for several sampling points of each image. The average error was 4.8dEab. The result shows that DSCs are useful for accurate color recording of color information of museum materials.

Now we are trying to record colors of KIMONOs (Japanese traditional-style clothes) and will report in the proceedings.

Keywords: digital still camera, accurate recording of color information of museum materials, estimation of color transfer function

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INTERPOLATION REFLECTANCE VALUES AND EFFECT IN CALCULUS CIELAB COORDINATES

Natividad Alcón, Marcela Picó, Francisco Redondo, Ángel Tolosa, Elena Sanjuán

The CIE Standard on Colorimetric Observers (CIE 1986b) recommends that the CIE Tristimulus values of a color stimulus be obtained by multiplying at each wavelength the value of the color stimulus function $\Phi_\lambda(\lambda)$ by that of each of the CIE color-matching functions and integrating each set of product over the wavelength range corresponding to the entire visible spectrum, 360 to 830 nm. The integration may be carried out by numerical summation at wavelength intervals, $\Delta\lambda$, equal to 1 nm.

Nowadays, the industrial requirement has been that the manufactures offer measurement equipment's smaller, portables and cheaper. This evolution requires more simplicity of its components, what implicates bigger wide of split in the diffraction nets.

In relation with this subject a problem is detected in some industrial environments. They attempt to improve results making measurements with bigger wide of split and offering CIELAB results after interpolation reflectance values to 1 nm intervals.

The objective of this study is to value the error introduced by this practice in the calculus of chromatics coordinates values L^* , a^* , b^* . It means, the error that is introduced to carry out 5 nm bandpass scan for reflectance measurement and its later interpolation to values of 1nm bandpass in order to CIE LAB calculus.

Keywords: wide of slit, reflectance, color difference

COLORIMETRICAL EVALUATION OF DYEBATH ACIDITY'S EFFECT ON WOOL COLOR

Sonja Čelan Benkovič, Darinka Fakin, Vera Golob

Wool is natural protein fibre, composed of polymer chains containing different amino acids as monomer units. The amphoteric character of wool, caused by acidic carboxyl and basic amino side-groups of amino acids, has an important role in the dyeing process. In acidic solutions the basic amino groups are protonated and able to bind dye anions by electrostatic forces. pH variation of dyebath markedly influences the net positive charge of wool which affects the exhaustion of the dyebaths and consequently the colour of the wool.

The effect of dyebath acidity on the exhaustion of three dyestuffs was investigated, differing in chemical constitution and color (yellow acid dye, blue and bordeaux 1:2 metal-complex dyes). Dyeing of wool tops was performed by the prescribed procedure in liquor ratio 1:20 using laboratory dyeing apparatus Turby (producer W. Mathis). pH values 4, 5 and 6 of dyebath were regulated with acetic acid (CH_3COOH) and maintained at an appropriate value during the entire process using MA235 pH/Ion Analyzer (Mettler-Toledo) with a special electrode for high temperature measuring. The sorption of each dyestuff and their mixtures from the dyebath into the fibres was followed on-line during the dyeing process using a CARY 50 spectrophotometer (Varian) with special measuring sound (optical length $l=0,2$ cm). Dyed wool samples were colourimetrically evaluated using a SF 600+ spectrophotometer (Datacolor).

The obtained results indicate great differences in the sorption of the used dyes at various pH values, which lead to color differences in wool production. The most sensitive to the pH changes is acid yellow dye, whilst blue and bordeaux have similar dyeing properties under various acidic conditions. The study of individual dye sorption from dyebaths containing mixtures of dyes in a real dyeing process is an important parameter, which makes possible quality preparation and realization of dyeing processes and assures the color reproduction in industrial practice.

Keywords: wool dyeing, acid dye, metal-complex dye, dyebath pH value, dye sorption, colorimetry

THE MAGIC FUNCTIONS OF COLOR IN THE TRADITIONAL BULGARIAN COSTUME

Roumyana Danova, Sasha Lozanova

The color characteristics of the Bulgarian traditional costume have an important place and role. Color, like the remaining costume components (elements of the garment, material, cut, workmanship technology, decoration elements including ornaments, amulets etc.), has a variety of functions: sign – ethnic appurtenance, gender, age, marital status, occupation, social status etc.; utilitarian –congruence with climatic, economic etc. conditions and typical activities of the people of Bulgaria; decorative - metrical organization and composition of colors in the costume, ornamentation etc. The latter is especially apparent with some collective labor or festive activities (e.g. harvest, folk dances). But color has also sacred and magic functions. They have been “encoded” in it since the remote past and have kept their meaning till the end of 20th century. These functions were inherited through the mechanism of their handing down from generation to generation as it has happened in the millennial history of Bulgaria. Here, the role of a mediator was played by the Christian religion practice, which developed and at the same time preserved the magic functions of the colors in the traditional Bulgarian clothing.

The paper will focus on the origin, character and functioning of the magic elements of colors in the folk costume. These functions are quite distinctly manifested in it with the rites and rituals in man’s life cycle and the annual calendar cycle.

Keywords: traditional Bulgarian costume, colors, clothing

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COLOR MEASUREMENT OF FLUORESCENT TEXTILES

Helen H. Epps

Because they are highly conspicuous, fluorescent colored textiles are often used in safety applications and in recreational apparel. Many fluorescent-dyed fabrics have poor colorfastness to light, while most of the safety applications for which they are used require that they be subjected to sunlight continuously. Typically, as fluorescent colored fabrics fade, they lose their fluorescent quality, and therefore, are no longer conspicuous in safety warning applications. For these reasons, an accurate measure of the color of fluorescent materials is crucial in determining the usefulness of such products.

The amount of visible light that leaves the surface of a non-fluorescent material at a particular wavelength depends solely on the amount of light incident on the material at that particular wavelength. However, the visible light that leaves the surface of a fluorescent material is dependent on both the incident light at that particular wavelength, and the incident light at other wavelengths. This characteristic of absorbing light at one wavelength and emitting it at a different wavelength complicates the color measurement of fluorescent materials.

Standard visible-range spectrophotometers are designed primarily to measure color of non-fluorescent materials, although some such instruments provide a partial characterization of fluorescent materials. For example, reflectance spectra measured using a 31-point color spectrophotometer will indicate a reflectance of greater than 100 percent in the region of fluorescence. This may indicate that incident ultraviolet light is emitted or “reflected” in the visible region of the electromagnetic spectrum. Not only is this indication of greater than 100 percent reflectance misleading to some users, measured tristimulus values using such an instrument may be inconsistent and inaccurate.

Color of fluorescent materials can be more accurately measured with an instrument that utilizes two monochromators, namely an excitation monochromator which separates light before it reaches the specimen, and an emission monochromator which enables measurement of the light at different wavelengths as it is emitted from the specimen.

In this research, samples of highly fluorescent and moderately fluorescent textile samples of different hues were measured using two instruments: a Macbeth Color Eye, 31-point visible range spectrophotometer, and a Labsphere BFC-450 bispectral fluorescence colorimeter. Using the BFC 450 instrument, spectral radiance factors were analyzed every 10 nm of the visible region from 380 to 780 nm, based on incident light that spanned the range of 300 to 780 nm. Measurements were compared with reflectance spectra and CIELAB measurements taken using the traditional visible range spectrophotometer. Color measurements were found to be more reproducible using the BFC-450, and were more accurate measures of the true color of the materials. Darker colored textile specimens, which showed less fluorescent color as measured by the bispectral colorimeter, were more consistent with traditional spectrophotometric readings.

Although measurements require more time, and the instrument is more expensive, for applications in which accurate color measurement of fluorescent materials is necessary, a bispectral instrument is recommended because of its accuracy and reproducibility.

Keywords: fluorescent, bispectral colorimeter, excitation, emission

COLORIMETRICAL DETERMINATION OF DISPERSE DYES' COLOR GAMUT

Darinka Fakin, Darko Golob, Veronika Vrhunc

Contemporary manufacturing trends demand a prompt response for the market, which primarily means reliable scheduling of textile production starting from the development and design of the product, continuing with optimization of the technological processes and finally quality control. The assurance of these elements demands a lot of knowledge and collaboration work for designers and technologists supported by advanced information technology and equipment. In the production of colored textiles a computer-aided system for color evaluation and match predictions is particularly important.

When creating a new pattern collection designers have to consider the color gamut that depends on selection of the substrat, available dyes and the dyeing process. For color gamut determination of the PES yarns with selected disperse dyes the samples were prepared with various concentration of a single dye and mixtures of two adjacent dyes after (hight – temperature exhaustion) dyeing procedure. The dyed samples were colorimetrically evaluated using CIELAB color values L^* , a^* , b^* , C^* and h , and graphically presented in CIELAB color space. Most of the colors required can be obtained using a ternary combination by mixing the dyes in different proportions.

Definition of color space enables quick determination of the possibility to achieve a desired color with selected dyestuffs and a foreseen technological process. It is also a useful aid in communication among designers, technologists and sellers. It also enables optimal recipe preparation, reduces the number of needed dyes, shortens production time and reducies recipe preparation costs, as well as dyeing costs.

Keywords: PES, dyeing, disperse dye, colorimetical determination, color gamut

BIOPREPARATION OF COTTON - INFLUENCE ON DYEING PROPERTIES

Ana Marija Grancarić, Đurđica Parac-Osterman, Ana Sutlović, Ivo Soljačić

Scouring of cotton removes impurities from the primary wall of cotton fibres in order to reach much more water absorptivity of cotton, which is main condition for dyeing, printing and finishing. These impurities contain waxes, pectins, proteins, noncellulosic polysaccharides, inorganic compounds, lignin, coloring materials etc. that makes cotton hydrophobic.

Traditional scouring with sodium hydroxide solution effectively removes impurities but has several disadvantages. Such scouring process leads to high weight loss of cotton fibers, having high-energy requirement and yield waste products.

Recently biopreparation (or "bioscouring") of cotton was developed as an alternative scouring process using newly isolated powerful pectinase that removes impurities under slightly alkaline conditions. These pectinase are able to hydrolyze the glucosidic linkages of polygalacturonic acid into galacturonic acid monomers. With removal of polygalacturonic acid the rest of pectic material and other substances from primary wall are mainly removed. Such scouring can be targeted to only the impurities with intact cellulose structure.

The objective of our paper is to investigate the influence of bioprepared and conventionally scoured cotton knit fabric on differences of reactive dyestuff yield. For such purpose dyeing processes were performed using bifunctional reactive dyestuff Bezaktiv Red S-3B by an exhaustion method.

The percentages of dyebath exhaustion and fixation values were determined spectrophotometrically. Color yields of cotton knit samples, in the form of K/S and CIELAB values were measured using Datacolor system.

Keywords: bioscouring of cotton, dyeing properties, reactive dye, CIELAB values

ARTISTRY POTENTIALITIES OF THE NATURE STAINS (ON MATERIALS OF BULGARIAN TRADITIONAL TEXTILES)

Ralitza Gueleva-Tzvetkova, Krassimir Krastev

Present exposé describes formation of regional color peculiarities thanks to the usage of natural coloring agents, based on traditional textile examples. The research goal is to show the mechanism of regional color peculiarities formation like a part of creation of the textiles. Color harmony transfers itself directly on the interweaving of the cultural and the natural is reached, and in the center is the human - creator and consumer. And it is him who is the factor making a cultural reality out of the natural color.

The main conclusion made out of the received results is the confirmation of natural colors important role for Bulgarian folk art decoration and artistic system build-up. The observations on local coloring agents extraction, their usage, as well as ready products aesthetic influence for traditional home environment building up permit to make several conclusions regarding natural colors role in Bulgarian folk art decoration and artistic system.

Keywords: natural colors, textile technology, folk art, home environment

THE CHARACTERISTICS AND CHANGE OF COLORS ON FASHION COLLECTIONS IN 1990s

Young In Kim, Honey Kim, Sooyoun Kim

The purpose of this study is to examine color characteristics and color changes on the fashion collections through 1990s, and to provide efficient color information for color planning appropriate to fashion themes. For this research, a total of 30084 colors were collected from Paris, Milan, London, New York Collections during 1990s. Those colors were first measured using the Pantone Textile Color System and COS Color System and then spectrophotometer (color eye 1500). These measured color values $L^*a^*b^*$ of CIE colorimetric system were converted into H V/C of Munsell System, and 12 tones of PCCS as well as 5 achromatic colors. The general characteristics of collected colors were analyzed and more specifically by seasons, cities, and years.

The results of the study are as follows: First, the hues of neutral, purple blue, yellow red, red, yellow and the tones of grayish, pale, white, dark grayish, black, dull, light grayish are most widely distributed. Second, neutral, yellow, and green yellow showed more frequently in S/S while purple, purple blue, red, and yellow red in A/W. White, pale, light, light grayish and light gray showed more frequently in S/S while black, dark grayish, grayish, dark gray, and dark in A/W. Third, color characteristics by 4 cities were similar to the general color characteristics in the 1990's. Fourth, red, yellow red, yellow were widely distributed in the early 1990s and blue, green yellow, green, blue green in '95-'97, purple blue, purple, neutral in '97-'99. High range of chroma was widely distributed in '90-'92 and '95-'96 to some extent. Grayish, gray, and black were widely distributed in '97-'99. Finally, fashion themes such as 'seductive', 'shiny', 'high-quality', 'little' and 'active' were mainly used in fashion collections during 1990s.

Keywords: fashion collection, fashion color, fashion theme

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THE DETERMINATION OF COLOUR PREFERENCES FOR CLASSROOMS OF EDUCATIONAL BUILDINGS-AN EXAMPLE IN ARCHITECTURAL DESIGN STUDIOS

Aziz Kiran, Cigdem Baytin, Mehmet Tunbis

The aim of this research is to determine the effect of color, as a design element of architectural composition, used for wall surface of a studio that the students are in constant interaction with. The determination of color preferences of male and female university students for the wall surfaces of the studios they use will help to make suitable arrangements for a better education medium. The first part of this study was completed as a pre-experiment using yellow, red, green, blue as 4 main colors and yellow-red (orange), red-blue (purple), green-blue, green-yellow as 4 intermediate colors from NCS, and the results were sent to the conference in Göteborg in 1996. The second part experiment took four terms to complete. In this part of the experiment 22 colors have been used together with the colors that have 50% white, black and gray in them. Thus, evaluations have been made for the 32 colors. 30 male and 30 female students of architecture from the 1st year, ages ranging from 17 to 21 have been chosen as subjects. In this research evaluation has been made by using the Semantic Differential Method. In the Semantic Differential Scale of 7 digits 24 objective couples have been used and the results of the evaluation has been tested by the Arithmetic Mean and the scores of every color determined. The results of this experiment will be presented in the conference for discussion.

Keywords: color preference, education buildings, semantic differential scale

THE CONTEMPORARY BULGARIAN TEXTILE ART AND THE COLOUR

Dotchka Kisijova – Gogova

The color in the art of textile has a special place in the contemporary Bulgarian textile art. The coloring is almost as much important as in the traditional one.

The art textile and the work with it – that is a way of thinking. This was the way the great artist, the deceased professor Marin Varbanov, who would be 70 years old in 2002, taught his students.

The course of the art textile in Bulgaria is steep and difficult. It was prepared by the generation of artists begun their creative development in the 30-ies and 40-ies of XX century. These artists specialized in “textile” abroad. Following them another creative generation continued developing the inherited from their colleagues and educating independently. Thus, the ripe necessity of creating a Bulgarian academic art school lead to its creation on the very limit between the 50-ies and 60-ies of XX century. Its leader became the artist Marin Varbanov.

A retrospect to these times and the parallel with later periods and especially with the last decade of XX century reveals interesting moments in the use of color by the artists working in the textile art.

In this field are now creating different generations in a wide spectrum of styles, technological and expressive trends.

The art textile in Bulgaria starts from the industry, through the tapestry, to the textile plastics and its separation from the wall to the three-dimensional plastic work, fully separated in space and broken with the tapestry textile, up to the textile and video-installations nowadays. At each stage of this development the coloring has its own role, but the tapestry has a special place. In the 70-ies and 80-ies of XX century it proves to be in the centre of the creative groping and interests of the Bulgarian artists as superiority over the other genres. The tendency, which abruptly moderated the limits between the decorative and fine art did not passed over the textile works. The authors emphasized on the easel kind of the works, which found expression to a certain degree through the color too.

It has its importance and role later, when the authors carry out their ideas with untraditional techniques and materials and provoke themselves as well as the audience by using not textile materials of different kinds.

Keywords: tradition, tapestry, unconventional

COLOR APPEARANCE OF FLASH IMAGE DISPLAYED ON COMPUTER MONITOR

Saori Kitaguchi, Kazuomi Gokuta, Tetsuya Sato, Yoshio Ohtani, Yukitoshi Takahashi

The development of the multimedia such as TV and computer has caused some problems that people fall during watching a TV program or playing a computer game. Most of the fallen people were children. In December 1997, around five hundred children had been fallen by red and blue flash image used in a TV animation in Japan. The cause of the problems is a photosensitive seizure. And it is thought the triggers induced the seizure are wavelengths and light-quantity, color, visual pattern of the images.

Therefore, we thought that the factors induced the seizure would be in the relations between the optical characteristics and human sensation. In this study, with the viewpoints of color physics and sensory engineering, we investigated about relations between the optical characteristics and human sensation, to find a way for protecting people from the problems. We paid attention to visibility such as difficulty to see and speed of flash image displayed on a computer monitor. We also tried to investigate the influence of colors.

Consequently, human impressions of difficulty to see and speed for flash images were changeable, even though the frequencies of flash images were the same. And, we found that the relations between human senses and the luminance difference of flash colors are proportional.

Keywords: flash image, photosensitive seizure, epilepsy, color, multimedia

MEASUREMENT OF THE EFFECT OF CAMOUFLAGE ON THE VISIBILITY OF THE CLOTHING

Masashi Kobayashi, Wonjong Lee, Ikuko Okamoto

Camouflage pattern on clothing will disguise and conceal itself by lowering its visibility. The effect may be changed by color, the form of the pattern, the background and so on.

For evaluate the effect of camouflage patterns, a computer program was developed and the experiment was performed by using a personal computer system. In the experiment, the stimulus portrait, consisted of the circle models and the natural scene background, was displayed on the CRT screen successively. The stimulus consisted of nine small squares arrayed in a large square. The central small square was used for indicate a number character selected at random from one to eight. The circles are the simplified clothing models and they colored by a plain color (grey; Gy, green; G) or patterned by a camouflage pattern (the U. S. marine Corps pattern; CF1, the U. S. Army pattern; CF2, the Japanese Self-Defence Force pattern, CF3).

As quickly as possible, the experimental subject selects the small square that contains circles of the same number as the central number by the mouse operation. The times from the indication of central numbers to the correct selections by the subject ware measured and used for the evaluation. The times obtained ware t-tested.

In the comparison between Gr, G and CF3, the most effective pattern was CF3. In addition, between CF1, CF2 and CF3, the most effective pattern was CF3. However, the differences between Gr and G or CF1 and CF2 did not clarified by this method.

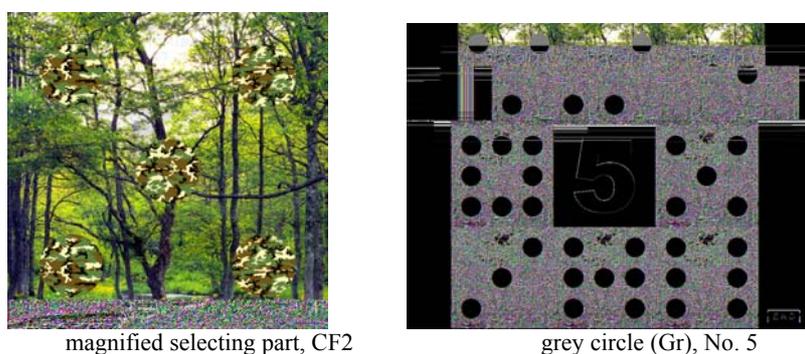


Fig. 1: Example of the stimulus



Fig. 2: The circle model of clothing used

Keywords: camouflage, visibility, measurement, personal computer, searching time

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INTERACTIONS BETWEEN PRINTING PASTE COMPONENTS STUDIED BY COLORIMETRY

Vanja Kokol, Reinhold Schneider, Sonja Šostar-Turk

Sodium alginate is still placed among the most widely used natural thickeners in the reactive printing of cellulose fibers, due to its resistance to chemical reactions with reactive dyes as well as its good washing properties. The application of less expensive and qualitatively more stable alternative polysaccharide guar gum thickeners in cellulose/bireactive dye printing is still impossible because the chemical covalent binding of guar gum macromolecules via bireactive dye, as well as directly into the cellulose substrate, results in an extreme increase of fabric stiffness and color changes. The occurred chemical cross-linking of the thickener on the fiber surface is most strongly expressed for nonsubstituted polysaccharide thickeners with a high solid content. Although, the undesired polysaccharide thickener/reactive dye interactions decrease when the modification of guar gum thickener increases, the results are in spite of this unsatisfactory. An alternative way to reduce or prevent these interactions during the fixation of printed cellulose fabric can be performed by adding an appropriate additive into the printing paste; namely, it is proven that some anionic and nonionic surfactants reduce the stiffness of such printed substrate to a certain degree.

In this contribution the interactions occurring among the individual printing paste components (i.e. guar gum thickener, bifunctional bireactive dye and nonionic surfactants) is studied by color evaluation (K/S and CIE-L*a*b*C*h color values) and the dye penetration of differently printed viscose fabric. Additionally, the efficiency of the surfactants with respect to (a) the chemical structure (the hydrophilic and the hydrophobic chain length) and concentration of the surfactant, and (b) the type (regarding to the degree of carboxymethylation and the amount of the solid content) of guar gum thickener used is presented.

It shows that some surfactants diminish the stiffness of printed substrate to an acceptable degree causing practically no changes in depth of color and color values, while the dye penetration is exclusively surfactant dependent and diminishes owing to the occurrence of surfactant/guar gum interactions. These investigations confirmed that the surfactant reduces the reactive dye/guar gum interactions because of surfactant/guar gum occurrence as well as the surfactant/reactive dye interactions. The best prints are obtained using a printing paste containing C18EO10 nonionic surfactant and a highly carboxymethylated (DS=1.1) guar gum thickener.

Keywords: viscose printing, guar gum, bireactive dye, nonionic surfactants, chemical reactions, fabric stiffness, colorimetry

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THE INFLUENCE OF ENZYMES ON VISCOSE DYEABILITY

Vanja Kokol, Nataša Štandeker, Vera Golob

Growing consciousness regarding environmental issues continues to promote the development of alternative processes in many industrial areas. In some parts of the textile processing industry, residual material is emitted into wastewater. The use of biotechnology offers innovative solutions and interesting perspectives for optimizing these processes and reducing waste emission, especially in textile finishing.

The enzymatic process is one of the most interesting alternatives. The intention of enzymatic treatment is the achievement of physical, instead of chemical, finishing of fabrics, and consolidating the efficacy of the treatment (improvement of the product in its usage and efficacy) with economical (optimizing the procedures and processes) and ecological (reducing waste substances and/or prevention of their formation) demands. Thus, ecological - friendly and cost - effective processing, biological degradation, and the saving of fossil resources, water and energy, are the main advantages of such processes.

The enzymatic treatment of cellulose textile materials has gained increasing practical importance for various kinds of textile goods to enhance handle-softness and surface appearance. Often these goods are further subjected to dyeing or finishing prior or subsequent to enzyme treatment.

Since enzymatic treatment influences the decreasing weight losses and, consequently, the reducing strength of the substrate, it could also have an influence on the increasing amount of amorphous areas and, therefore, on the absorption of dye molecules and depth of color. Namely, the worse dyeability of fibers results mainly from their relatively lower dye absorption. Basic operations leading to fiber purification and preparation for further processing stages include boiling-off and pretreatment. The effect of these treatments depends closely on the types of chemicals used, as well as technical and technological developments. Usually, considerable amounts of chemicals are used in these processes.

In this paper the influence of different chemical structure, reactive systems and reactive groups, of bireactive dyes on the dyeability and mechanical properties of differently enzymatically (cellulase) pretreated viscose are investigated. The criterion is the lowest modification of color (K/S and CIELAB color values), and the lowest weight and strength losses of the substrate.

Keywords: viscose, dyeing, cellulase enzyme, bireactive dyes, dyeability

DYE SORPTION OF DIFFERENT REGENERATED CELLULOSE FIBRES DETERMINED USING COLORIMETRIC EVALUATION OF COLOR

Tatjana Kreže, Slava Jeler, Karin Stana-Kleinschek

This work correlates fine structure with the adsorption behavior of the new (lyocell) and conventional (viscose, modal) regenerated cellulose fibers. In the research an overall analysis of the structural characteristic of lyocell fibers was performed and a comparison with the conventional viscose and modal fibers was made. We studied the molecular structure, the fine structure and, most important of all, the amorphous regions and void system. Their effect on the adsorption properties of the fibers was investigated. The differences in adsorption properties of all three fibers types were obtained on the basis of various methods for determining the water, dye and the iodine adsorption. The structural analysis shows that higher molecular weight, a higher degree of crystallinity and a higher molecular orientation are observed with lyocell fibers [1]. Our results, obtained by different independent methods, demonstrate clearly, that the adsorption properties of cellulose fibers depend, with the exception of the portion and orientation of amorphous regions, predominantly on the void system (diameter, volume and inner surface of voids) [2].

Keywords: regenerated cellulose fibers, structure, water adsorption, dye adsorption

COLORIMETRICAL EVALUATION OF COLORS IN FOUR-SEASON TYPOLOGY

Majda Kuzmič, Vojko Pogačar, Vera Golob

This advanced approach to textile color consultation for selecting appropriate wardrobes and home-furnishing colors is based on four-seasonal personal color palettes. The seasonal color theory has already been proposed by artist and colorist Johannes Itten who after years of working with his art students discovered that they consistently chose personal colors, which were complimentary to the natural coloring of their skin, hair and eyes. The four-seasonal color palettes were developed as guides for personal colors by adapting Itten's theory on fashion.

In nature, each season offers various palettes of harmonious color combinations and personal coloring should be in harmony with one of these palettes. For color-design support four RAL design color palettes are available, consisting of 32 colored paper samples or 28 colored textile samples for each season. The whole color gamut varying in shades and intensity is contained in each palette. Spring and autumn colors have yellow undertones, whilst summer and winter colors have blue undertones.

Determining personal colors is still subjective, depending on the adviser's intuition or experience, therefore a more objective method using colorimetry needs to be developed. In this research the natural skin and hair coloring of selected individuals was colorimetrically evaluated and classified according to seasonal types. Systematization of color tones surely makes personal color consulting more logical and predictable. Such an objective color evaluation will result in more a logical method of projecting personal fashion colors.

Keywords: color consulting, color design, seasonal color theory, four-season color palettes

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THE SIGNS AND SYMBOLS OF RED COLOR IN EAST ASIAN COUNTRIES

Young Gull Kwon

East Asian countries including Korea, China, Japan were under the same dominant influences of Confucianism, Buddhism and Taoism. These philosophies established the fundamental of their spiritual culture and social infrastructure, which had a great influence on application of colors. For instance, '*Yin-Yang and Five-element School*' built the harmony of '*Yin-Yang (negative-positive)*' and the concept of circulation on the thinking system. On the basis of these thoughts, people in East Asian countries made religious and ideological system needed for daily life. Through these thought system, the distinctive color system, '*Obang-Saek(Five-element color)*' was created and has been applied to every field of society.

In Korea, there was the color application principle, which came from the transformation of color concept. Chromatic colors were used for expressing the strict regulation and hierarchy of ruling classes and achromatic colors were used for ordinary people. Chinese people believe that red color brings them wealth and happiness, thus at China towns placed all over the world, red color is dominant on urban environment, architectures, clothes and products. At the era of Shogun in Japan, red color was regarded sanctified because red stood for blood of sacrifice. So red was used only for the Imperial Family. It was very similar to the case of Korea and China. In Korean folklore, red points out the direction of south, which means that the place is warm, full of energy and covered with all things.

Since red color has a character to be aggressive and masculine, it frequently represents battle and reminds fighting and burning world. In East Asian countries, red symbolizes the bellicosity, thus was used for encouraging soldiers. According to *Yieji*, a Chinese old text, the flag that has an image of red bird should be at the head of military procession. When soldiers occupy the enemy's position, the red flag has a meaning of victory and indicates the marshalling area.

Chinese people believe that the amulet has a power to confront against the evil spirit. The amulet is produced with drawings by red cinnabar on yellow paper. According to Korean custom and folk belief, red has enchanted meaning to drive away evil spirits.

Abstracted concepts are always expressed with color as symbols in history, social structure formulated with colors gets more practical power. As color is examined as universal function given by ideals and as a kind of sign system to represent meanings, the color of red has been used for meaning of authority, power, wealth, good luck, ideology and purging away evil as described above. At the bottom of these meanings, there exist religious and philosophic background and interpretation shared within East Asian countries. It has been the sense code of East Asian people and still has a dominant effect on their lives.

Keywords: Eastern Asia, *Yin-Yang*, red, signs, symbols

MODEL FOR QUANTIFYING THE QUALITY OF ARTIFICIAL LIGHT SOURCES

Yuk-Ming Lam, John H. Xin, Kwan-Moon Sin

The variability of spectral power distribution in illuminating light source has a very significant effect on color appearance of objects. International Commission on Illumination (CIE) recommended two principle methods to quantify the ability of a light source to produce the same perception as a reference standard illuminant. The first one is the test color method, which is used to estimate the degree to which a test light source renders a set of object colors compared to their appearance under a reference CIE standard illuminant A or D65. The second one is the virtual metamer method, which is used to estimate visual difference of metameric pairs under a test daylight simulator that match under a reference CIE standard daylight illuminant, D50, D55, D65 or D75. However, the chosen CIE standard illuminant is in forms of data and can not be simulated exactly by physical light source especially CIE standard daylight illuminants. Consequently, the effects of illuminant metamerism may arise when a CIE standard illuminant is chosen as reference illuminant for colorimetric computations, but alternative artificial light sources are used for visual evaluation of object color. For this issue, a mathematical model is developed to quantify the quality between a specific pair of reference and test artificial light source using colorimetric method with respect to their differences in relative spectral power distribution between 400nm and 700nm. The modeling algorithm will be illustrated. This model is divided into three parts including generating synthetic metameric pairs for a reference artificial light source, calculating the instrumental color difference of synthetic metameric pairs using test light source, and averaging the instrumental color difference of each synthetic metameric pairs. Examples will be given to demonstrate the validity of this model.

Keywords: CIE standard illuminant, spectral power distribution, synthetic metameric pair

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COLOR MEASUREMENT AND APPEARANCE EVALUATION IN THE TEXTILE PRODUCTION INDUSTRY

Antonio Mauro

Clothing production involves various stages: designing the garment, choosing the fabric, dyeing, making up and finally, presentation in sales outlets.

Color appearance changes during the various processes depending on the work conditions of the different observers. Invariance of color appearance therefore becomes indispensable to ensure uniformity of judgment throughout the successive stages.

The correlation of color measurement with the assessment of color appearance can contribute in this sense.

This poster presents a few appearance evaluations made during the various production stages of knitwear, from yarn design to final fabrics. These are linked to the color measurements.

The cases under examination stress once more the need to carry out in-depth studies into appearance linked with color measurements in order to rationalize both the productive and commercial processes.

The experimental study is carried-out with collaboration of local knitwear factories and technical support of Prof. Lucia Ronchi (Associazione Ottica Italiana - Florence) and Prof. Claudio Oleari (Dip. Fisica –Università Parma).

Keywords: knitwear, color measurement, color appearance

BLOCKING PROPERTY AGAINST UV-RAYS: EFFECT OF FABRIC AND DYE MATERIALS

Tomoko Mima, Masako Sato

In the future blocking against harmful UV-rays would be more important problem for human health. The purpose of this research is to investigate the mechanism of blocking property against UV-rays by fabric substrate and dye or dyed fabric. The authors have studied on the coloring effect of dyed fabric in expectation to UV-rays blocking.

The results were: 1) Even the light colored fabrics showed higher UV-rays blocking property than non-dyed fabrics showed. UV-blocking property of fabric increased with decreasing of the lightness of fabric by dye up-taken on the fabric. 2) Yellow colored fabrics were examined high luminance even at the high up-taken of dye and showed effective UV-rays blocking even at the light color level.

This study was undertaken to investigate the relation between absorption and blocking of electric magnetic wave from 280 to 700nm of wavelength region using two kinds of fabric materials and two kinds of dyes. Cotton shirting fabrics dyed with fourteen kinds of direct dyes and polyester taffeta fabrics dyed with eight kinds of disperse dyes were used. Those dyed fabrics were classified into three colors of red, yellow and blue.

Molar absorption coefficients of dye were respectively examined at the regions of 700-400nm in wavelength (visible light region: VIS), 400-320nm (UVA) and 320-280nm (UVB). Dye exhaustion (%) on the fabrics and blocking property (%) against UV-rays by dyed fabrics were investigated.

Compared with non-dyed fabrics, UV-blocking property of polyester fabric were examined more than 90%, and higher than cotton fabrics especially in the region of UVB. Blocking property of polyester fabrics dyed with disperse dyes were resulted in improving in the region of UVA in spite of high luminance reflectance.

Disperse red and blue dyes were inferior to direct dyes of each color. Yellow colored fabrics dyed with disperse or direct dyes were examined higher than red and blue colored fabrics.

Keywords: UV-rays blocking, polyester taffeta, disperse dye, cotton shirting, direct dye

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COLORS PRODUCED FROM NATURAL DYES SUITABLE FOR LIVING ENVIRONMENT

J. Jeyakodi Moses, A. Venkatachalam

Colors in the day to day life of human are very prominent and unavoidable. It is associated in the form of colored (dyed) dress materials, hairs, furnishings, upholstery etc. The coloring of textiles using natural dyes dates back to antiquity. The oriental rugs in the museums of all over the world happen to be one of the living evidences of the ancient art of natural dye's mystery by employing vegetable, animal and mineral sources. However, the use of natural dyes was almost completely alternated from the 19th century by the new invention of synthetic dyes which because of its good sharp color, brilliancy, resistance towards chemicals etc received good appreciation from the global textile consumers without knowing the consequences of them towards environment and human being. The use of hazardous synthetic dyes and chemicals leading to the cause of carcinogenic effect on human and disastrous effluent problem to the surrounding environment has culminated into a alarming situation made the way to the process of complete checking followed by banning them, thanks to the global awareness and warning about the environment. Therefore, the eco-friendly chemicals and dyes particularly natural dyes revive its lost natural glory once again.

In this view, the development of natural dyes is necessitated to produce colors on textiles particularly natural fibbers such as cotton, jute, silk, wool and their blends, thereby reducing the hazards created by harmful chemicals and dyes towards mankind and environment. Among the natural fibbers jute is nowadays considered an important one because of its biodegradable, renewable aspects. Based on this, jute is popularized by its diversified products suitable for environments. Therefore, based on the eco-friendly aspects consideration, the authors have decided to work on the coloration of natural fibbers such as jute, cotton, wool and silk using natural dyes with their usual textile properties.

Keywords: environment, eco friendly, natural dyes

COLOR EVALUATION OF TEXTILES USING A FLATBED SCANNER

Igor Nahtigal, Vera Golob, Bojan Dolšak

Conventional industrial color evaluation of textile samples is based on reflectance measurement using spectrophotometers connected to a computer with the powerful software programs. Sufficient sample size is required for spectrophotometrical measurement, therefore, this method is inappropriate for many multicolor fabrics with small color patterns, such as colored wovens, melanges, jacquard and printed fabrics.

A flatbed scanner, also called a desktop scanner, is a computer input device, much like a keyboard or mouse, except that it takes its input in graphical form. Most scanners today use the single pass method. The lens splits the image into three smaller versions of the original. Each smaller version passes through a color filter (either red, green or blue) onto a discrete section of the CCD (CCD-Charge Coupled Device) array. The scanner combines the data from the three parts of the CCD array into a single full-color image. The CCD converts the light to proportional voltage. This voltage is converted to digital form (binary bit pattern) by an A/D Converter (analogue to digital converter). These digital values are assigned to RAM where they make up the graphical image. The graphic can be saved on disk in standard graphic file format.

Color scanners have also some limitations as (1) not producing standard illuminant D65 by used lamps, (2) transmittion of color filters and (3) repeatable transformation of light in proportional voltage on CCD. To use the scanner as a measuring device, we have to define the relationship between the device 'color space' (RGB) and the CIE system of color measurement ($L^*a^*b^*$). In other words we have to characterize (profile) the scanner. Scanner profiles translate raw digital RGB values into a standard color space like CIELAB. The profile is generated by scanning an 'IT8' color target. Profiling software combines the digital scanner value with the data measured from target with the spectrophotometer to form a 'source' profile, which translates RGB values into CIELAB.

To convert a flatbed color scanner into a measuring device we have make a color target (similar to IT8.7/2 for photography) and a reference values file to create our own input profile for the textile materials. Multicolor fabrics were scanned and individual colors were colorimetical evaluated.

Keywords: color measurement, a flatbed scanner, color profile, color target, $L^*a^*b^*$ color space, RGB color space

EFFECTS OF TIME-VARYING COLOR ADAPTING SEQUENCES ON THE APPEARANCE OF SURFACES

Juan L. Nieves, Eva Valero, Javier Romero

The color appearance of surfaces depends on both the adaptations to previous lights or surfaces in view and on the lights or surfaces surrounding the stimulus of interest. Chromatic adaptation mediates this process and adjusts visual sensitivity depending on the light (with a given luminance and chromaticity) entering the eye.

We report experiments where subjects judged color appearance in the context of time-varying color sequences. To this end, we analyze temporal context effects for asymmetric matching arrangements rather than spatial context adaptation. The adapting color distributions were simulations of surfaces rendered under different illuminants and were displayed on a CRT color monitor. The color sequences were presented simultaneously in an upper comparison-field and a lower test-field under a 6500K or a test illuminant (a 2000K-illuminant and a 10000K-illuminant), respectively. For each contextual area 190;time-varying adapting sequence 190;observers established pairs of stimuli that appeared identical when viewed in the context of that area. We selected for the comparison and the test areas adapting color distributions along red-green and yellow-blue critical axes. Based on the color sequence selected, three kinds of experiments were developed: the 'Rg-Yb condition', the 'Yb-Rg condition', and the 'Non-selective condition'.

First, we made an additional control experiment with no illuminant change between the upper and lower areas. The results of this experiment excluded a possible influence of the time-varying adapting sequences in symmetric contextual images. Then, we proceed with the asymmetric matches. For the non-selective condition, observers' matches show almost color constant appearance. Although light adaptation does not fully compensate the color changes, we obtained average color-constancy index values of 0.75, which coincides with previous findings employing artificial rather natural environments to test color appearance.

Next, we test if the time-varying color selectivity of the adapting sequences influences the cone coordinates of the matches. Results from the two opponent conditions (Rg-Yb and Yb-Rg) show similar context effects and constancy-index values. No significant differences between each condition for the L-, S- and (L+M)-mechanisms and the three test illuminants were found. On the contrary, some degree of interaction between the comparison-field cone excitations and the color axis is found when color mechanisms are analyzed separately. This seems to be more pronounced for S-cone mechanism and suggests that color selectivity of the adapting sequences could affect match chromaticity. However statistical analysis of the data are not conclusive to this respect as those as previously obtained for spatial contrast contextual images.

Keywords: color vision, color appearance, color constancy, adaptation

COLORIMETRIC PROPERTY OF COLOR DEPTH

Gen Nishimura, Tetsuya Sato, Taeko Nakamura, Ming Ronnier Luo

In the textile industry, the concept of color depth is very important for assessing color properties of dyed fabrics. However, it is difficult to quantify the color depth, because it is one of human sensations. Therefore, we have been investigating the colorimetric properties of the color depth, and trying to express it numerically.

In this study, we tried to know the colorimetric property of the color depth through visual assessment with using dyed fabrics as samples. The fabrics have 8 hue (red, orange, yellow, yellowish green, green, bluish green, blue, and purple), 2 vividness (vivid, dull) and achromatic color. And every hue fabrics have 46 steps. The number of sample fabrics is 782. On the other hand, 4 fabrics were chosen as standards from achromatic color fabrics, and the 4 standard fabrics were compared with the sample fabrics. Then, the colorimetric values of sample fabrics assessed as same color depth of standard fabrics were plotted in the CIELAB color space. With the results, we discussed about the contribution of hue and chroma for color depth.

Keywords: color depth, textile, visual assessment, CIELAB color space, numerical expression

RAL SYSTEM RELIABILITY

Đurđica Parac-Osterman, Vidosava Šimić, Anica Hunjet, Martina Joanelli

In all technological branches that employs color management and color communication system, RAL color system is used as mean of simple and quick choice and comparison of desired color.

However, practice proved RAL system as unsuitable in a processes of reproduction in comparison with visual evaluation as well as instrumental CIEL*a*b* evaluation.

In this paper, reliability and suitability of RAL system was analyzed by means of statistical evaluations and compared to computer based CIEL*a*b* system.

Three groups of hue samples were chosen: H* 080⁰ – 090⁰ (yellow), H* 350⁰ - 10⁰ (red), H* 200⁰ – 210⁰ (blue).

Analysis were made based on Y tristimulus value that define true lightness value of one colored surface. L*, C* and H* color values were calculated as well as dE value and statistical evaluation was performed according to “t” and “F” statistical test. Results obtained showed disagreement of RAL system in compare with CIEL*a*b* system in the area of yellow and blue hues. This confirm lower reliability of RAL system for hues mentioned than for the area of red hues.

Keywords: RAL, reliability, CIE L*a*b*, statistics

QUALITY ASSURANCE IN DIGITAL PRINTING

Đurdica Parac-Osterman, Martina Joanelli

In the beginning of its development, digital printing could only be used for printing onto a paper substrate. Due to its ecological suitability, lately has been an increased interest in application of digital printing technologies to textile substrate. However, there are still many problems to be solved and one of the most important problems is lack of communication between design/coloration operations and print/production processes.

One of essential problem is the loss of color information, which happens during a process of transformation of the RGB system (input device – additive color mixing) into CMY system (output device – subtractive color mixing).

Analysis in this paper were carried out with aim of pointing out the importance of lightness value as one of the parameter of color management that indicates the problem of loss of information. Printed samples of three hue groups were tested: H* 080 – 100 (yellow), H* 260 – 280 (blue) and H* 000 – 010 and 350 – 360 (red). Results obtained, presented in a CIELAB terms through dE/Y and dE/L^* relationships, showed that problem can be expected in area of yellow hues due to a selectivity problem that occurs with increasing of lightness value.

Importance of Y tristimulus value that uniquely defines lightness of one colored surface, was also confirmed.

Keywords: digital printing, RGB, CMY, loss of information

COLORS AS LINGUISTIC ELEMENTS OF THE VISUAL COMMUNICATION SYSTEM

Vojko Pogačar

The results of extensive scientific research and observations demonstrate that the perception of colors is a kind of linguistic code in the system of visual communication. The gradual phylogenetic development of the eye and visual centers in the central nervous system is the basis for the gradual development of color perception. The cited hypothesis – we are unable to name things unless we are unaware of them – means, that colors should be perceived initially in order to be named, and used afterwards in the system of visual communications. The existing analogy between the linguistic and visual systems of communication is based on the similarity in importance of syllables and colors. In visual communications colors act like syllables, gaining new meanings and semantic values after being connected using words. In the same way that linguistic elements become more precisely articulated with Gutenberg's invention of printing, the present electronic media adds new opportunities in the development of visual communications. On the basis of the relationship between the basic characteristics of sound and color, as well as the relationships among abstract energy categories, phonologic and color categories, semantic classification was developed in acromatic scale and, finally, classification of the psycho-dramatic values of behaviour in correlation with acromatic scale.

Colors are social, and a kind of organic convention of the human body, which interprets only specific quanta of energy as a specific experience of the colors. The social context is in common agreement, which puts the color code in the common system of communication, which is consensual and internationally understood. Besides its social needs, the available electronic technology demands and allows standardization of the color codes.

Keywords: visual communication system, semantic classification, color-linguistic conventions, psycho-dramatic correlations, acromatic scale

INFLUENCE OF TRAINING SET SELECTION ON PREDICTION ABILITY OF MODELS FOR THREE COLOUR PROPERTIES OF A TITANIUM DIOXIDE PIGMENT

Karmen Rajer - Kanduč, Jure Zupan, Nineta Majcen

Titanium dioxide is the most widely used white pigment or colouring agent. It is one of the few chemical compounds in the pigment area that can not be replaced for the present. The optical properties of titanium dioxide pigment are based principally on its high unselective scattering power. The key factors are the difference in refractive index ($n_{\text{pigment}} - n_{\text{binder}}$), the particle size and chemical composition.

In the Quality Control Department lightness (L^*), whiteness (W_{10}) and hue (b^*) of titanium dioxide pigment are daily spectrophotometrically determined. In order to improve the quality control of pigments, several models for pigment's properties as lightness (L^*), whiteness (W_{10}) and hue (b^*) were built.

Each of 132 samples is characterised by 17 independent and three dependent variables. In all variations of data selection and modelling, the same set of 132 samples of white pigment was used. Models were built by linear and non-linear techniques: a standard multiple linear regression (MLR) as a linear method and radial basis function (RBF), error-backpropagation (EBP-ANN), counter-propagation (CP ANN) as non-linear methods, employing different learning strategies.

Training and test sets, each containing exactly 66 samples, were obtained by four different strategies: time-dependent selection, random selection, Kennard-Stone maximal distance approach and sampling from Kohonen self-organised top-maps. The 66 testing samples were further divided into the test (53 samples) and the control set (13 samples).

It was established that the prediction ability is importantly influenced by different modelling techniques, while different division methods do not influence significantly on prediction capability.

Keywords: division method, prediction ability, modeling method, color properties, quality control

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ANALOG AND DIGITAL ISO/IEC-COLOR CHARTS FOR DIFFERENT COLOR REPRODUCTION TESTS AND FOR THE EFFICIENT USE OF COLOR IN DESIGN

Klaus Richter

The color reproduction properties of office devices, e.g. copiers, printers, scanners and monitors may depend on many parameters of the device system, e.g. the device properties and settings, the device driver, the file format, the computer operating system, the color workflow, and the application software. Analog and digital ISO/IEC-color charts allow to get a feeling about the influence of the different parameters on the output. The ISO/IEC-color charts are an important tool to see the advantages and disadvantages of the many reproduction possibilities and to choose the appropriate one for the design application. The reproduction of all color elements of the ISO/IEC-test charts of ISO/IEC 15775 for color copiers, e.g. the 5 and 16 step color series, Siemens-stars, line screens, Landolt-rings and an image shows many reproduction properties. Most of the ISO/IEC standard tests pass if there is a linear relationship between the linear digital input data and the output data on a visual relative CIELAB scale for seven 16 step color series of the device system.

The linear relationships are important for many applications in design. They allow to see at least 16 step color series on any device system and with this linear property all the Landolt-rings of the test charts are recognized on every device. A draft ISO/IEC Technical Report describes how to linearize any device system for the different parameters. The output linearization method uses the measured CIELAB data of the 128 standard colors of a start output e.g. within the printer or device drive or within the startup directory of the software Adobe Acrobat Distiller.

Keywords: color reproduction, ISO/IEC-color charts, CIELAB

ENVIRONMENTAL COLOR DESIGN 'PERCEPTIVE TEXTURES IN THE ENVIRONMENT'

Silvia Rizzo

1) The proposed experiment intends to follow up the work presented at the AIC 2001 Conference in Rochester "Work on Color Design Installed in an Urban Environment". Those who were present will remember the large canvasses matching the surrounding environment of the city of Genoa through a bi-dimensional expression of color. With their soft surfaces, they would link up with architectural volumes. What was then painted surface, now becomes more complex: it is now texture, or rather a search for diversified texture obtained through the interlacing of colored fabric strips to form some sort of macroscopic cloth. While the previous work would offer a primary perception of colors in the environment, some sort of visual signs, with this work a more complex reaction is sought, brought about by the intertwining of colors crossing each other through never-ending interference's, still with a constant reference to the surrounding environment: perhaps, signals again. The 'cultivated' texture of this 'fabric' becomes a symbol; with its visual dynamics it is going to 'dress' our environment in all its different forms and variety of perceptions, to which each of us will react differently.

2) When thinking about a project for children, long strips of cloth could be designed with colored portions based on space measurements, to be spread over streets, squares, and on walls. The aim: to make the city environment lively and playful; from an educational point of view, to make children aware of extension and space orientation, with user-friendly elements that can be easily disassembled and assembled again.

Keywords: Genoa, texture, strips, environment, colors

SECOND SKINS AND NEW MATERIALS: THE “CHROMO-TACTILE” RANGE

Stéphanie Sagot

We are nowadays witnessing a reasoned approach of design in which the object, its nature, its function and its relationship with the user are submitted to multiple questioning, that goes for beyond mere technological rationalism. The object would therefore develop another value of use, other than its function, which would convey all the sphere of the relationships it has with the world and then with other territories it is crossed by. These territories call the intimacy of the object, currently favored by a work on texture.

In such a context, the development of matters named «second skins» which we can find again in all fields of design (architecture, packaging, fashion and so on) encourages new logics of differentiation, variation, suggesting an opportunity: before, chromatic ranges related to an object were suggested; today, the game is opened on several components, one of which is the couple color / texture that allows multiple choice equations, «chromatactile colour charts».

Keywords: texture, color styling, color design, matters design, differentiation

COLOR PREFERENCE STUDY ON AUTOMOTIVE EXTERIOR IN HONG KONG AND JAPAN

Izumi Satake, Tetsuya Sato, John H. Xin, Kenji Ando, Koichi Kuwano, Kanji Kajiwara

We elucidated color preference for automotive exterior in Hong Kong and Japan by using a set of questionnaire and painted panels.

The results were compiled from the subjects of 50 Hong Kong observers and 167 Japan observers.

Prior to this experiment, we have selected 12 colors from 104b Color Chart produced by Japan Color Enterprise Co., Ltd., according to the results of like-dislike tests of 101 people in two countries.

These emotional assessments revealed that preference for purple significantly differed between Hong Kong and Japan. The statistical analysis performed by non-parametric study calculated that the parameter consisted of two factors affected color preference.

These data suggest that the selection of automotive exterior colors is different between Hong Kong and Japan, possibly indicating from the image of the color and/or automobile. The characteristics of color preference and statistical analysis by non-parametric study in each country are discussed in detail in this paper.

Keywords: color evaluation, color preference, paint and coating, Asian study, automotive exterior

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WERNER SPILLMANN: HIS WORK, HIS INFLUENCE, AND HIS PASSION

Verena M. Schindler

Werner Spillmann is one of the founders and a great mentor of the AIC. He is internationally known: as a teacher, a color consultant, and a passionate promoter of color issues.

This paper strives to present, to the younger audience, Spillmann's contribution in the last 20 years, specially his concerns on environmental color design. Very young, Spillmann became professor at the Architecture Department of the University of Applied Sciences in Winterthur, Switzerland. He became famous with the organization of international seminars on "Color and Architecture". His preoccupations also concerned the methods of color education. In 1988, he organized an international congress in Winterthur on "Color and the Environment" which was successful. Since the beginning of his activities, he is publishing articles and essays on color concepts, color systems, color history, and color in architectural and environmental design. His collection of color books gives a tangible and impressive form to his passion.

This presentation offers a short intellectual biography, based on his publications and a recent interview, illustrated with particular documents and unknown photographs.

Keywords: Werner Spillmann, environmental color design, color education

COLOUR - STRUCTURE RELATIONSHIP IN PET FIBRES

Majda Sfiligoj Smole, Kristina Stakne, Vera Golob

Poly(ethylene terephthalate) (PET) is one of the commercially most important polymers. It is widely used in form of fibres for textile applications and technical purposes. The properties of PET fibres may be modified over a range that is limited by the inherent characteristics of the polymer. By chemical modification variants, which exhibited low pilling, cationic dyeability, etc. were developed. The mode of formation and history of a fibre determine the fibre structure and thereby the physical properties of fibres.

The importance of this man made fibre has consequently generated much basic research concerned with the relationship between processing, morphology and physical properties. There have thus been extensive investigations concerning the crystalline structure and orientation of PET over a range of thermal, stress and deformation conditions in order to achieve a qualitative and quantitative understanding of the effects of structure and properties of the polymer.

In the presentation two different types of PET fibres were studied, i.e. a normal wool-type and a low pilling modification. A detailed fibre structure was determined and the correlation between the fibre structure and its color is given. The structural morphology and crystalline orientation of the fibres was investigated by means of wide-angle x-ray scattering (WAXS), density measurements and IR spectroscopy. WAXS studies were made to determine the degree of crystallinity, crystallite orientation and apparent crystallite dimensions. The acoustic investigations and measurement of birefringence were used to study the molecular average orientation and the orientation of macromolecular chain segments in amorphous regions.

Because of the closely packed fibre structure the content of the free volume in PET fibres is very low, but for the dyeing process very important. The microwoid system was studied by means of the small angle x-ray scattering (SAXS). PET samples were conventionally dyed and the effect of the structure on color was followed by colorimetry.

Keywords: PET fibres, structure, crystallinity, orientation, color, color measurement

DETERMINATION OF THE DYEING LEVELNESS BY COLORIMETRIC MEASUREMENTS

Barbara Simončič, Mateja Kert

The aim of this research was to investigate different approaches used to determine the levelness of dyed textile substrates and to discuss about the results obtained by the used methods. For this reason the microfibre nylon 6,6 knitted fabric was dyed by 2 % o.m.f. anionic dye C.I. Acid Red 88 with and without the added anionic surfactant sodium dodecylsulphate and non-ionic surfactant Triton X-100. All dyeing processes were carried out in Launder-Ometer at pH value 4, at liquor ratio 1:150, at two different temperatures 60 °C and 80 °C for 360 minutes until equilibrium was reached. The reflectance values of the dry dyed textile substrates were measured at twenty different points on each sample using a Datacolor Spectraflash SF 600 Spectrophotometer, from which the corresponding color strength (K/S values) and CIE L^* , a^* , b^* , C^* and h° coordinates were calculated at λ_{\max} of the dyeing. K/S values, which are proportional to the concentration of the dye in the substrate, were statistically analyzed and the deviation as well as variance of the K/S values was considered as a measure, which determines the dyeing levelness. The differences between the uniformity of different dyeing were calculated with F-test. From the critical F values we determined statistically significant differences in the levelness of dyed samples. These results were compared to the values of color difference ΔE , which acts as a measure for determining the levelness of the dyed substrate, if ΔE value is calculated from the differences between CIE L^* , a^* , b^* coordinates of the representative points on the same sample. The results show that the position of the chosen standard in the dyed substrate affects the ΔE value. If the coordinates of the first measured point are taken as the standard and the other points represent the trials, the ΔE value differs significantly when compared to the one obtained by calculations when the standard coordinates represent the arithmetic mean of all the observed points. Simultaneously the meaning of the deviation of ΔE value was discussed. It can be concluded from the results that the calculation of the ΔE value itself is not sufficient to determine the dyeing levelness, and that the K/S values as well as the L^* , C^* and h° coordinates and their deviations have to be taken into account.

Keywords: dyeing levelness, colorimetry, color strength, color difference, statistic analyze

THE INFLUENCE OF SUPERMOLECULAR STRUCTURE ON DYEING PROPERTIES AND COLOR OF PA 6 FIBRES

Simona Strnad, Slava Jeler, Sonja Malej

This research focused on investigating the relationships between the structural and dyeing properties of PA 6 fibres. PA 6 monofilament yarn samples having different crystallinity degrees and different content of alpha, respectively gamma crystalline modifications were applied. The diffusion coefficients of two different acid dyes and the content of dyes absorbed by fibre samples were determined. In the second phase of the investigation the samples were dyed with the two above-mentioned acid dyes in a conventional dyeing process. The dyeability of differently modified PA 6 fibre samples was determined colorimetrically (reflection measurements and calculation of L^* , a^* , b^* , C^* , h coordinates of CIELAB color space) and color differences determined between untreated raw samples and structurally modified samples. The dyeability of PA 6 fibres does not always decrease with an increased degree of crystallinity because it also depends on the way in which crystallinity has been achieved, i.e. on the material's history. Fibres that contain only alpha or only gamma crystalline modifications show different sorption properties and dyeability. The diffusion of dyestuff and dyeability starts to lower after the crystalline degree starts to increase. Contrary to expectations, dyeability is being strongly increased when the crystalline level is significantly increased presumably owing to the formation of bigger voids in the structure.

Keywords: fibres, polyamide 6, structure, dyestuff diffusion, colorimetry

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PSYCHO-PHYSICAL STUDY OF COLOUR MEMORY

Tünde Tarczali, Peter Bodrogi

Color memory plays an important role in many practical tasks related to the choice, identification, and assessment of colors. Long-term memory colors or memory prototypes of familiar objects frequently seen in the past are often preferred by the customers of color imaging products. Color memory is also one of the factors responsible for the phenomenon of color constancy. These facts motivated the authors to build up three classes of psycho-physical methods to characterize human color memory. The so-called constant, mixing and abstract methods have been applied.

All experiments were carried out on a well characterized color monitor by using computer based experimental programs. The constant method and the mixing method had two phases: an observation/memorization phase and a decision/mixing phase. In the constant method, the subject saw and memorized an original color, and then – after a given time interval – she/he had to decide if the next color shown was equal to her/his short-term memory. In the mixing method, the subject was given more freedom: she/he had to mix the memorized color by controlling the hue, chroma, and lightness of a color patch by the aid of three sliders at the top of the screen. Both the constant method and the mixing method had two sub-types. In the first sub-type, three digital greyscale photos were used, depicting “sky”, “skin”, and “grass”. The original color and the constant color or mixed color were uniform color patches placed into a typical and identifiable part of the picture. In the second sub-type, standalone color patches were displayed on a uniform grey background thus removing the image context.

The abstract method provided even more freedom: it was built upon the direct assessment of the observer's memory prototype and thus no original colors were shown. Two sub-types of the abstract method have been implemented. In the "name" method, subjects were given the name of a familiar object, e. g. "grass", and they had to imagine the color of a real object and mix it. In the "photo" method, a digital greyscale photo was shown and the subject had to mix that color in a uniform patch within the photo which produced the most excellent fit in the photo.

The short term memory of just-seen colors often moved towards the memory prototypes in the observer's mind. Seeing an object, or even a standalone uniform color patch, displayed in several slightly different color shades after each other, lead to building a new color prototype during the experiment.

Keywords: cognitive color, color memory, visual psycho-physics

EXHAUST DYEING OF MODIFIED POLYPROPYLENE FIBRES

Anna Ujhelyiová, Anton Marcinčin, E. Bolhová

Exhaust dyeable polypropylene fibres based on commercial polypropylene PP TG 900 and modified polyethylene terephthalate PET FK were prepared in experimental work.

Polypropylene fibre modification by polyester additive results in significant, even tenfold increasing of disperse dyestuff sorption of groups in conditions of polyester fibre dyeing. The effect of reduction clearing is negligible for samples with high color strength.

The effect of polymer additive concentration in range of 10-15 % is less significant for temperatures above 100°C. A higher PET FK content in a fibre shows a positive effect to dyeing at lower temperature (90°C).

Dyed blend PP TG 900-PET FK fibres provide good fastness to rubbing and washing.

Keywords: polypropylene fibres, disperse dyes, exhaust dyeing

A NEW INTERNET BASED COLOR MANAGEMENT AND COMMUNICATION SYSTEM

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A new entirely Internet based color system for textile and garment industry and other color-using industries has been developed. There are many advantageous features that are applicable to the dyehouses, apparel retailers, and merchandisers, such as internet delivery of color management solutions, digital swatch networks giving huge reductions in lead time and communication costs, enhancing dyehouse efficiencies, removes dye sourcing hassles, allows true technical communication between dye suppliers and customers with sharing dye data. Many of the useful functions such as online shade cards, excess stock sales, e-commerce solution tools, working with existing ERP tools, and online recipes can be performed. This paper discusses the functionality of the Internet based color system and the applications.

Keywords: internet based color system, digital swatch, digital color communication

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