AIC 2011 Midterm Meeting of the International Colour Association (AIC)

Interaction of Colour & Light in the Arts and Sciences

Conference Proceedings

Much interest is devoted to the interaction of colour & light in today's scientific and artistic research communities. New technologies, materials and media are now being deployed to enhance and stimulate our experience of daily life in real and virtual, permanent and ephemeral environments. The aim of the AIC 2011 conference is to explore how the interaction of colour & light plays a crucial role in the perception, conception and realization of spaces and platforms in different fields from both theoretical and practical points of view. Using terms and concepts such as appearance, interaction, performance, event, and by privileging the materiality, mediality, and the interactive dimension of colour & light, the conference presentations demonstrate how productive the theme of the INTERACTION OF COLOUR & LIGHT IN THE ARTS AND SCIENCES is. The fields of inquiry include education, design, art, media, lighting, architecture, theatre, dance, as well as psychology, colour science and technology. The AIC 2011 Midterm Meeting aims to further discussion and nurture the latest findings in these various fields.

The International Colour Association – Association Internationale de la Couleur (AIC) or Internationale Vereinigung für die Farbe – is a learned society whose aims are to encourage research in all aspects of colour, to disseminate the knowledge gained from this research, and to promote its application to the solution of problems in the fields of science, art, design and industry on an international basis.

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Comparative analysis of electrophotographic prints with the standard magenta and cyan in relation to the prints in which light magenta and light cyan are added

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Abstract

The satellite machine construction enables the positioning of greater number printing units which can print greater number of colours. They are most often Pantone inks and in recent times the clear varnish as well. EP machines which use the liquid EP inks (Digital Colour Offset) can contain up to 7 printing units. In this work the spectrophotometric analysis of magenta and cyan prints has been done (4 colour print) in relation to the 6 colour print (the added light cyan and light magenta). With it the continuous wedge is reproduced, containing 9 specific screen patches. The addition of lighter inks in screen reproduction does not achieve considerable visual changes in tone (ΔE_{max}=3,00). But they are more expressed in magenta ΔE_{mean}=2,16 in relation to cyan ΔE_{mean}=1.18. On prints, the light screen elements are applied up to 40% of screen value, after which they change into the full tone. Medium and dark areas contain 100% of the applied light ink to which the screen elements of the darker inks are added. With it the diameters of the screen elements range from 56,5 µm up to 96,02 µm, while diameters of the dark screen elements range from 37,64 µm up to 135,91 µm.

1. Theoretical part

For achieving the prints which have the photographic quality it is not enough to use the standard process inks only. Such inks must be transparent, which means that they must contain a transparent substance which must not change the index of refraction of the incident light beams (Thompson 2004: 480). In order to get the halftones during the application of the process inks, it is necessary to perform the screening process (changing the continuous tones of the original into the halftone screen image which will contain the numerous screen elements). With different methods of the digital screening as well as by the application of the new algorithms, printing of the intermediate tones is considerably improved (Goldmann, 2004). Improving the reproduction quality is the printing of the additional inks. Nevertheless, for the further quality increase it is necessary to eliminate the screen elements and to replace them by continuous tones. In this process the light inks are printed (light magenta= LM and light cyan=LC). (Eldred and Scarlett, 1994)

In colour prints the share of cyan (C) and magenta (M) is very high and the application of the LM and LC improve the contrast of the whole reproduction. In order to produce the LC and the LM, white pigments are added to the standard C (copper phtalocyanines) and to the standard M (dimethylquinachrydon). The most universal white pigment is titanium dioxide. It is added in 80% white inks because of the opacity which is very high. In order to get different grades of whiteness during the production it is often mixed with Zn, Al, Zr and SiO (silica). The basic parts of the components in such inks is TiO_2 (80-99,8%), while Al, Zn, Zr or SiO are in relation of 0-20% (Leach and Pierce, 1999). In the electrophotographic printing technology the application of greater number of inks has been solved effectively by the satellite machine construction. HP Indigo machines can have up to 7 BIDs which are activated during each separation and which

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apply the corresponding ink (Kiphan 1997:11). BKT cylinder is covered by a special rubber blanket which conducts electricity, which completely transfers the ink on the printing substrate during the printing process. The important detail is the warm offset blanket (T=125°C) which eliminates the liquid inking carrier (Isopar). Depending on the laser diodes power IR light (λ=830 nm) formed with varying beams diameter. The developing process is responsible for formation of ink layer on paper, in which the greater negative voltage is caused by the thicker layer of ink. The continuous tonal gradation is achieved by the combination of printing the lighter and darker screen elements. Landa et al (1988).

2. Experimental parts

For this experiment the HP Indigo form was used by which the printed native RGB image. In order to achieve the colorimetrical controlled printing, the printing form was done in two specific screen forms: in the image containing only the basic CMYK separations (method 1) and the image containing CMYK separations + LM and LC (method 2). Harlequine RIP software version 7.2 was used with the application of ICC profile ISO coated. Prints was done with the HP Indigo S 5500 with the built in 6 colours. Gloss fine art paper (130 g/m^2) was used as supstrate. For the analysis was used X-rite DTP 20 (geometry of the optics 0/45^o). The colour difference (CIE LAB ΔE_{2000}) was calculated from L*a*b* values. Image analysis of the samples was performed where the dimension of the reproduced screen elements (Δd). Different coverage some diameters were especially noticeable: the diameters of the light screen elements (d_L), diameters of the dark screen elements (d_D) and the diameters of the white screen elements d_W. Roldan et al. (2001).

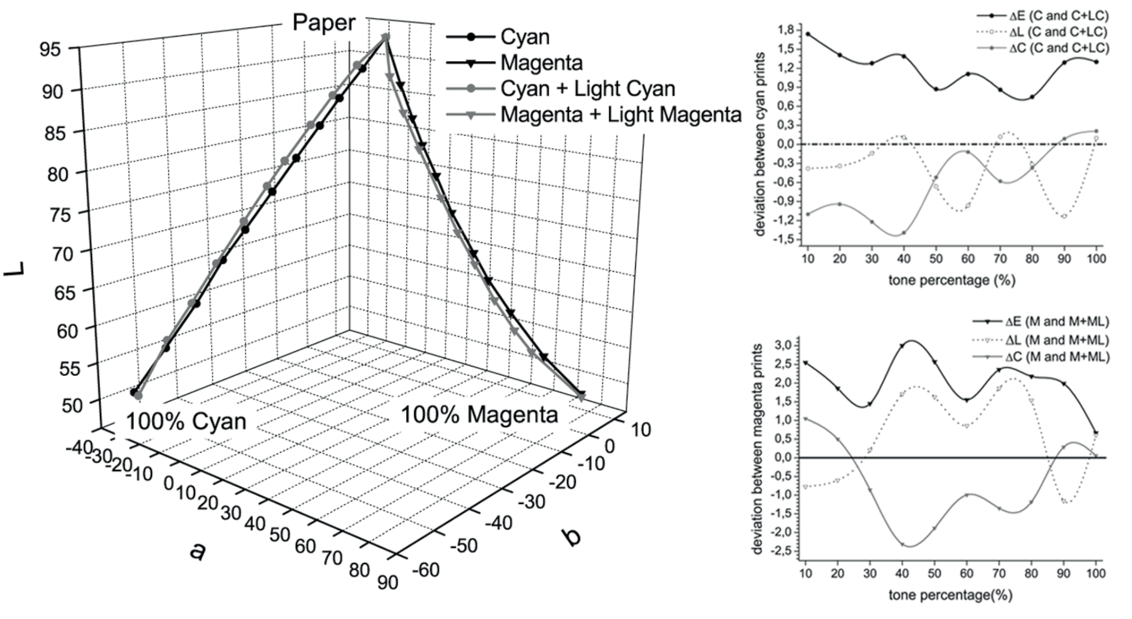

Figure1. CIE LAB differences ΔE_{2000} between C+M prints and C +M +LC +LM

Comparing the prints of C with C+LC, the greatest ΔE appears in the light area ($\Delta E_{C10\%}$=1,74) while the smallest ΔE appears in the tonal value between 50% and 80% ($\Delta E_{C80\%}$=0,75). The solid patches have considerably change in tone ($\Delta E_{C100\%}$=1.30). This is the result of trapping. Important aberration between ΔL and ΔC is noticed only in some screen areas. They are the areas of 40%, 60%, 70% and 90% of the screen value. The formed ΔE is mainly influenced by the changes in

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chroma (areas of 10%, 20%, 30% 40% and 70%). Magenta prints (M and M+ML) have greater ΔE. There are visible in all the tonal areas in which the area between 40% and 50% screen value ($\Delta E_{M50\%}$=3,00) and the area between 70 and 80% of the screen value have higher values ($\Delta E_{M50\%}$=2,36). Greater aberrations between the ΔL and the ΔC are noticed in some screen areas. They are the areas of 10%, 40%, 70% and 90% of the screen value. By the image analysis of prints created with C and M is noticed the linear growth of the screen dots up to 60% screen value. Because of the amplitude screening in the areas above 60% screen value, the dark screen elements merge, after which it is possible to follow unprinted area (figure 2a).

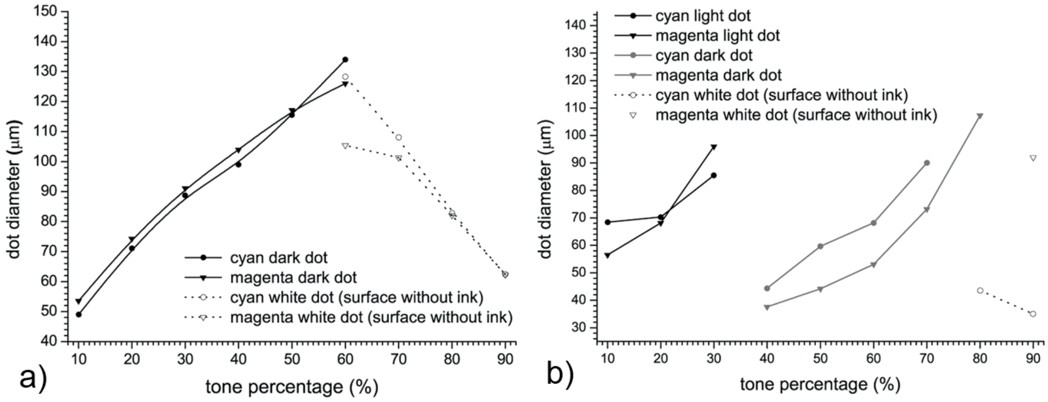

Figure 2. Results of the image analysis: a) change of the dark screen elements and the white non printed surfaces b) change of the dark screen elements, light screen elements and white non printed surfaces

The C screen elements (dark dots) have the smallest diameter of $d_{10\%=}$48,97 μm while the greatest diameter is $d_{D60\%}$=133,93 μm. The screen area of 60% screen value is the boundary one and the formation of the white dots $d_{W60\%}$=128,32 μm. By the increase of the screen value the number of the white screen dots increases and their diameter decreases d_{Wmin}=62,35 μm. The dark M dots have the smallest diameter $d_{10\%}$=53,52 μm, while the greatest diameter is $d_{D60\%}$=126,03 μm. In the boundary screen area there are more white elements ($d_{W60\%}$=105,46μm). Prints with two different light inks, except d_D and d_W, in the reproduction has to be monitored d_L. The light screen elements are possible to be noticed up to 30% screen value (figure 2b). Reproduction of the dark dots begins at 40% screen value and it is possible to be monitored up to the area of 70% screen value.

The prints with LC was reproduce smaller diameter than $d_{10\%}$=68,4 μm while the greatest diameter is $d_{L30\%}$=85,55 μm. Circularity of the elements disappeared and screen dots merge into linear chains of the average height of $h_{L30\%}$=524,75 μm. Dark dots start in 40% of the screen field ($d_{D40\%}$=44,42) and stop in 60% screen field ($d_{D60\%}$=68,19). In the screen field of 70% the elements have lost all their circularity forming the line screen with the width of $d_{D70\%}$=68,19μm; and the high $h_{D70\%}$=233,94μm. The white linear elements are formed in the area of 80% (width $d_{w80\%}$=43,54 and the height of $h_{w80\%}$=120,7), while in the area of 90% screen value, the white elements of the circular form are formed ($d_{w90\%}$ = 35,05 μm). Surfaces in which is LM reproduced have the smallest dot diameter ($d_{L10\%=}$56,5 μm), while the greatest width of the elements is $d_{L30\%=}$96,02 μm. The elements in 30% screen area are merged into the vertical chains which stretch over the whole selected image $h_{L30\%}$=2540 μm. The dark M elements start to form in 40% screen patch ($d_{D40\%}$=37,64) and they stop in 90% screen patch ($d_{D90\%}$=135,91). The dark elements lose their circularity in the 70% screen value. In higher tonal areas stretch on the whole analyzed surface ($h_{D90\%}$=2540 μm). The laser head has the greatest influence on these results. In the article Majnarić et. al. (2009) it is presented that the application of the laser head power (of 1μW/mA to 12 μW/

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mA) influences the size of the reproduced printing elements. In the calibration area (50% screen value) it is $\Delta d_{50\%C}$= 10,16 μm for cyan; and $\Delta d_{50\%M}$=16,51 μm for magenta.

4. Conclusion

Addition of the light inks (LC, LM) does not consequently have considerable visual changes in tone (ΔE_{max}=3,00). They are more expressed in M ΔE_{mean}=2,16 in relation to cyan ΔE_{mean}=1.18. The addition of light inks considerably increases the chromaticy in the area between 30 and 40% screen value ($\Delta C_{40\%M}$=2,31; $\Delta C_{40\%C}$=1,39) which is problematic for realization, because of the optical dot gain (the paper surface is completely covered with light ink which decreases the reflection of the white light from the surface). In this way the prints have greater contrast and tone of C and M is better visible.

The light screen elements on prints are applied up to 40% screen value, after which they become the full tone. Medium and dark areas contain 100% of the applied light inks to which the screen elements of the dark inks are added. The diameters range from 56,5 μm to 96,02 μm, while the diameters of the dark screen elements range from 37,64 μm to 135,91 μm. Such tone difference is visible in reproducing the high quality photos which are recommended to be made on fine art paper. The 50% higher price of prints (6 colour separations in relation to the 4 colour separations) does not give the 50% higher print quality, especially not in the case of the reproductions printed on rough papers where the difference in prints is almost unnoticeable. Because of that it is recommended to avoid the usage of the additional light inks for the graphic products of lower quality.

5. Literature

Eldred, N. and T. Scarlett. 1994. *What the Printer Should Know about Ink. 3rd edition.* GATF. Pittsburgh.

Goldmann, G. 2004. *The World of Printers*. Oce Printing Systems GmbH. Dusseldorf. Germany.

Kiphan, H. 1997. Status and Trends in Digital Multicolor Printing, Technologies, Materials, Processes, Architecture, Equipment and Market. *In NIP 13: Proc. of International Conference on Digital Printing.* IS&T. Springfield (VA). 11-19.

Landa, B., P. Ben-Auraham, J. Hall and G. Gipson. 1988. Toner for use in composition for developing latent electrostatic images, method of making the same and liquid composition using improved toner. *Patent Unite States 4,794,651, 27.*

Leach, R. and R. Pierce.1999. *The Printing Ink Manual.* Dordrecht: Kluwer Academic Publishers. Netherlands.

Majnarić, I., D. Modrić, K. Golubović and S. Bolanča. 2009. *The 4 Beam Laser Diode Array Influence on the Colour Imaging.* DAAAM International Scientific Book 2009 (ed. B. Katalinić). Vienna. Austria

Roldan, R., J. F. Gomez, C. Ataeallah, J. Martınez and P. L. Luque. 2001. A measure of quality for evaluating methods of segmentation and edge detection. *Patern Recognition*. 34 (5): 969-980. Thompson, B. 2004. *Printing Materials: Science and Technology (2nd edition)*. Pira International. Leatherhead. United Kingdom.

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