

Journal of Print and Media Technology Research

Scientific contributions

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*Vinay Anil Turke, Paul D. Fleming, Veronika Husovska
and Alexandra Pekarovicova*

107

Comparison of ICC and DNG colour profile workflows
based on colorimetric accuracy

Jure Ahtik

115

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during Chennai floods 2015

N. Bhuvana and I. Arul Aram

123

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Editor-in-Chief

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The journal is fostering multidisciplinary research and scholarly discussion on scientific and technical issues in the field of graphic arts and media communication, thereby advancing scientific research, knowledge creation, and industry development. Its aim is to be the leading international scientific journal in the field, offering publishing opportunities and serving as a forum for knowledge exchange between all those interested in contributing to or learning from research in this field.

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Contents

A letter from the Editor <i>Gorazd Golob</i>	105
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Scientific contributions

Decreasing metamerism of ink jet printed wood grain <i>Vinay Anil Turke, Paul D. Fleming, Veronika Husovska and Alexandra Pekarovicova</i>	107
Comparison of ICC and DNG colour profile workflows based on colorimetric accuracy <i>Jure Ahtik</i>	115
A study on Facebook and WhatsApp during Chennai floods 2015 <i>N. Bhuvana and I. Arul Aram</i>	123

Topicalities

Edited by Markéta Držková

News & more	137
Bookshelf	139
Events	145



A letter from the Editor

Gorazd Golob

Editor-in-Chief

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In the third 2017 issue of the Journal, three papers are published, from different areas of research interest. The first one covers a digital proof and small volume printing samples of very sensitive and demanding hues of the wood grain. Authors of the paper are reporting on the research results of metamerism issues and resulting colour differences when different ICC colour profiles are used and the influence of the coat and release coat characteristics on the final results.

The second paper presents the results of the comparative study of the application of two different methods in colour management in professional digital colour photography, namely the widely known and used ICC colour profiles and the DNG method, proposed by Adobe. The interesting first results are encouraging, however, the advantages and disadvantages of both methods are calling for further research.

The third paper is from the field of media studies. The role and impact of Facebook and WhatsApp social media on people affected by the Chennai floods in 2015 is reported, together with the use of the same communication channels by volunteers, police officials and various organizations giving first aid, support and supplying various goods and transportation to the victims. The positive experience of the use of social media in giving help, activation of the people and for communication between them and with their families and all others involved in rescue operations and support in case of natural disaster was confirmed.

In the Topicalities an overview of newly published or only updated and reconfirmed ISO standards is given by Markéta Držková (marketa.drzkova@jpmtr.org), together with some news from EU supported research, advances in 3D and 4D printing and 150 years anniversary celebration of Agfa, well-known company in printing. Interesting overview of the books from the field shows a wide interest of the authors and users by covering lighting reliability, necessary in advanced visual communication, image processing field, colour theory and measurement, up to materials used in printed electronics applications and next generation of displays. The readers who are interested in publications dedicated to different world regions may be interested in African and Arabic print culture and collection of reviewed papers from China Academic Conference on Printing, Packaging Engineering and Media Technology.

Three doctoral theses are presented in Bookshelf section. Fanny Tricot defended her thesis on rewritable films on flexible substrates in Grenoble. Topics of her research include laser marking technologies on glass and non-rigid substrates by using spin coating, inkjet and flexographic techniques and formulation of the inks and characterization of final results. Tuomas Happonen defended his thesis

on bending resistance of printed conductors on flexible substrates in Oulu. His research was dedicated to cyclic bending of flexible screen-printed substrates with different inks, different thickness and testing of the properties of the samples. Enrico Sowade defended his thesis on inkjet printing of photonic structures and thin-film transistors in Chemnitz. His research includes a study of material properties, demonstration of inkjet as micro- and nano-engineering technology, and also covers a study and optimization of all-inkjet production lines for transistor arrays. An overview of conferences and other events from the area of printing, packaging, materials and related fields is wrapping up Topicalities.

In September, the 44th International Research Conference of *iarigai* was held in Fribourg, Switzerland. The first research paper in this issue is revised and extended research report, already presented at the Conference. All other attendees, some of them with very impressive contributions, have already been invited to prepare and submit their full papers to the Journal. The Journal is currently the most important international peer-reviewed publication in the field of print and media technology research. With indexing and abstracting in Emerging Sources Citation Index (ESCI), the opportunities are open to all the authors with papers cited in the indexed journals, to gain in reputation and impact. This will also be an advantage for the Journal of Print and Media Technology Research, which will thus become recognized as important publishing channel in the field. Also, the confirmation from Scopus regarding indexing and abstracting in their database is near and will hopefully be confirmed in the next issue.

The Call for papers is constantly open for submission of high quality original scientific, research and review papers, including case studies, and also for publication of technical papers and professional communication. We are expecting your papers anytime, and we will do our best in double-blind peer-review, editing, and publishing process.

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Decreasing metamerism of inkjet printed wood grain

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Abstract

Today, the competitive environment in the graphics communication industry is demanding the printer to produce good quality products within short periods of time. To ensure quality reproduction of print jobs, prototyping is necessary. Rotogravure cannot be used for prototyping, because of high manufacturing cost of gravure cylinders. Such challenges can be successfully tackled by use of relatively cheap and flexible printing processes, such as inkjet. Even though inkjet printing is a cost-effective way for prototyping, it has its own limitations, especially in the case of wood grain printing. Wood grain patterns need to be printed with a release coating and adhesive. Inkjet printers are incapable of printing either release coating or adhesive, because they require a certain amount of coat weight, not possible to deliver with inkjet printing. Inaccurate color reproduction, metamerism and incompatibility with release coat are the commonly seen problems during inkjet prototyping. The main aim of this study was to resolve problems such as metamerism and close color match of inkjet and gravure printed wood grain. A design of experiments (DOE) was carried out by using different factors such as gray component replacement (GCR) settings, release coat weight and use of tie coat to analyze their effect on metamerism. Custom created ICC profiles decreased the metamerism index (MI) and ΔE^*_{ab} significantly, when compared with the generic RIP printer profile. Manual GCR adjustment in addition to custom created ICC profiles decreased MI further, but at the same time increased ΔE^*_{ab} to some extent. Increased GCR settings had considerable impact on MI , which varied per color shade. The ICC profiles for the 7 g/m² release coat plus tie coat and 10.5 g/m² release coat plus tie coat substrate were created with 160 % total ink limit values, whereas 7 g/m² release coat and 10.5 g/m² release coat samples without any tie coat were profiled with 180 % and 200 % total ink limit, respectively. Higher total ink limit samples on 10.5 g/m² release coat with no tie coat showed the highest color gamut volume and lowest total ink limit, while 7 g/m² release coat plus tie coat showed the smallest color gamut volume. ANOVA statistical analysis showed that GCR setting was the most influential factor on MI followed by the use of the tie coat. Release coat weight was an insignificant factor for MI .

Keywords: inkjet, rotogravure, metamerism, color match, gray component replacement

1. Introduction and background

Currently, most of the décor or wood grain printing is done by the gravure printing process, due to its effectiveness in achieving consistent results in long production jobs. Simplicity and comparatively fewer set up parameters make gravure printing a more controllable process among other printing processes, but its costly image carrier manufacturing limits it only for long run jobs. However, the modern gravure industry has come up with narrow press technology, with cheaper image carriers [Mathes, 2016]. But as market requirements are changing, customers are looking for more diverse wood grain designs, specifically in small quantities and

variable color palettes. Gravure printing is cost-effective only if it is used for relatively long runs because of high cost for cylinder engraving. Hence, many printers are exploring other printing processes for wood grain prototyping and production of small quantity jobs. Every conventional impact printing process requires an image carrier that increases cost. Therefore, the inkjet printing process is one of the most feasible options to print wood grain patterns in a more cost-effective way, with flexibility of short quantity jobs (Wu, Fleming and Pekarovicova, 2008). However, inkjet printing has its own disadvantages, too. An inkjet printer uses process inks (Wu, Fleming and Pekarovicova, 2008), whereas gravure uses spot color inks to print wood grain pat-

terns. Thus, color matching is one of the main concerns during inkjet prototyping and proofing of gravure printed jobs. Most likely, pigments used in inkjet inks are different from those used in gravure inks, which often leads to metamerism. Color matching issues can be resolved by implementation of color management systems into the process workflow. Metamerism can be minimized by using the same or somewhat similar types of pigments for both printing processes. It helps to get a closer spectral match between samples, but it is an expensive option. The greater is the difference between spectral power reflectance of two metameric samples, the greater is the color shift when illuminants or observers are changed. Though it is impossible to eliminate metamerism, it can be reduced to acceptable levels (Shendye, Fleming and Pekarovicova, 2010).

The degree of metamerism can be quantified (Shendye, Fleming and Pekarovicova, 2010) by calculating the metamerism index (*MI*). Metamerism indices can be of two types, general and special. General indices are spectral indices based on spectral differences between the members of the metameric pair and are independent of illuminant. Originally Bridgeman's Index (BMAN), presented by Bridgeman and Hudson (1969), was used to calculate the index but did not take into account the change in eye sensitivity in the whole visible spectrum of light. Nimeroff and Yurow indices were also used (Nimeroff and Yurow, 1965; Roy Choudhury and Chattergee, 1996). Even though the index is modified, if the spectral difference is averaged throughout the spectrum, it decreases the difference in spectral values and may be lessened as two ends of spectra are approached.

Therefore, it is important to calculate the difference, which is mainly dependent on illuminant and observer. Hence, it is more mathematically accurate to use a special *MI* than a general one. Special indices are based on XYZ tristimulus values. Especially for illuminants, there are two commonly used special metamerism indices: First, CIELAB special metamerism index, in which *MI* is calculated assuming the ΔE^*_{ab} color difference between the pair under the reference illuminant is equal to zero. Second, DIN 6172 metamerism index (Deutsches Institut für Normung, 2014), in which *MI* is calculated assuming the ΔE^*_{ab} color difference between the pair under reference illuminant is small but not equal to zero. Special metamerism indices should not be used if ΔE^*_{ab} between two samples under reference illuminant is more than 5 (Berns, 2008). CIELAB special *MI* can be calculated based on Equation 1:

$$MI = \sqrt{(\Delta L_{n_1} - \Delta L_{n_2})^2 + (\Delta a_{n_1} - \Delta a_{n_2})^2 + (\Delta b_{n_1} - \Delta b_{n_2})^2} \quad [1]$$

where n_1 is the first illuminant and n_2 is the second illuminant and Δ = Value of sample – Value of standard (HunterLab, 2008). Equation 1 is algebraically equal for

both the CIE and DIN indices, but the interpretation is different. Under the CIE index, the colors perfectly match under the first, reference illuminant and small *MI* means they match well under a second illuminant. For the DIN index, the colors are assumed to match well under the reference illuminant and small *MI* means they match almost as well under a second illuminant. In either case, if the *MI* value is high, then there is a significant color difference between the sample pair under different illuminants.

Under Color Removal (UCR) and Gray Component Replacement (GCR) basically deal with color separations of four process colors (UCR&GCR, 1996). When three process colors (cyan, magenta and yellow) are overprinted, they should create black, but in reality, they give a brownish or muddy black appearance. Overprint black percentage can be replaced with black ink by UCR or GCR. The main difference between UCR and GCR is that UCR is a process of removal of cyan, magenta and yellow, wherever black is present, whereas GCR is process of replacing the gray component with black ink throughout entire image (UCR&GCR, 1996). The GCR is preferred over UCR because UCR deals with removal of CMY inks in dark and near neutral areas. Contrary to that, GCR is capable of replacing gray component from all colors in separation including highlights. Use of GCR has multiple advantages, such as fewer trapping problems, less dot gain fluctuation and fewer registration problems thanks to the use of only one ink instead of three.

Use of GCR also reduces consumption of ink substantially, reducing cost of an ink by as much as 50 % (Nimeroff and Yurow, 1965). Also, GCR improves color gamut, because as black level increases, color gamut volume also increases to some extent (Zhou, 2012; Spiridonov and Shopova, 2013). The color gamut volume is a volume in CIELAB space that represents the number of colors that the device (here inkjet printer) can produce with a tolerance of the $\sqrt{3}$ (Chovancova-Lovell and Fleming, 2009).

The main aim of this study was to resolve problems, such as metamerism and close color match between rotogravure and inkjet print. This makes possible accurate inkjet samples, proofs and short run production. To accomplish this goal, sample patches were printed on a Roland VS 540i inkjet printer and color matched to reference gravure printed patches with ΔE^*_{ab} less than 5. Custom created ICC profiles were compared with the default printer profiles. Manual GCR adjustment was done to assess its role in color matching. A Design of Experiments (DOE) was carried out by using different factors such as GCR settings, release coat weight and use of tie coat to analyze their effects on metamerism.

2. Materials and methods

Four gravure printed shades of wood grain, selected as reference patches, were printed as solid patches for ease of the measurement (rendered approximately in Figure 1). The CIELAB values of gravure reference patches were measured using an X-Rite Ci6x spectrophotometer. Four sample patches were constructed in Adobe Illustrator by assigning previously measured CIELAB values of the reference patches. Patches were labeled as Galaxy Oak, Smooth Grey, Hunter 655 and Rustic Maple, respectively (Figure 1).



Figure 1: Sample patches, with CIELAB values

A customized ICC profile was created using X-Rite ‘i1Profiler’ software. For customized ICC profile creation, the 800-patch color chart was automatically generated by i1Profiler software. Sample patches (Figure 1) were printed on the Roland VS 540i inkjet printer by applying the standard printer profile and customized ICC profile. Patches were once again printed by applying the customized ICC profile, but with additional manual GCR adjustment. In manual GCR adjustment, a percentage of CMY inks was replaced by the same percentage of K ink. The ΔE^*_{ab} and MI for the four patches were calculated and spectral graphs were compared to determine the initial significance of custom created ICC profile over default printer profile, as well as effectiveness of manual GCR adjustment and its effect on MI .

To analyze the influence of various factors on metamerism, a DOE was conducted by using three factors – GCR level settings, release coat weight, and use of tie coat (tie coat is an acrylic based clear ink used to promote adhesion between printed ink and adhesive). Table 1 shows number of trials and factors for the DOE experiments. We used this DOE method, a full factorial, since there are only 12 conditions and any smaller design would reduce the resolution of the design by confounding factors that need to be independent. Manual GCR adjustments were done in case of the trials with maximum GCR setting and compared with other DOE trials. For ease of analysis, 12 trials were divided into 4 substrate types based on release coat weight and use of tie coat. Then, each substrate was analyzed for 3 different GCR settings. The fundamental approach behind the use of factors 1 and 2 was

to increase color gamut volume by improving total ink limit and to analyze the effect of increased color gamut volume on MI . Use of factor 3 was straightforward, i.e. to understand effect of increasing GCR setting on MI .

Trials 3, 6, 9 and 12 were conducted again with additional manual GCR adjustment in Adobe Illustrator to check its effect on MI . Spectral graphs were compared. Metamerism indices and ΔE^*_{ab} were calculated. Printed wood grain products were transferred onto the base wood by means of heat and pressure. Thus, all layers of the product needed to be printed in reverse order. All the layers of the wood grain in their respective order are shown in Figure 2.

Table 1: Trials for design of experiments

Trials	Factor 1: Release coat weight (g/m ²)	Factor 2: Use of tie coat	Factor 3: GCR levels
1	7.0	Yes	Minimum
2	10.5	No	Medium+
3	7.0	Yes	Maximum
4	10.5	No	Minimum
5	7.0	Yes	Medium+
6	10.5	No	Maximum
7	7.0	No	Minimum
8	10.5	Yes	Medium+
9	7.0	No	Maximum
10	10.5	Yes	Minimum
11	7.0	No	Medium+
12	10.5	Yes	Maximum

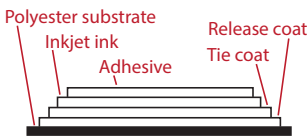


Figure 2: Schematic of wood grain layers printing

2.1 Release coat weight

After application of wood grain to the wood, release coat becomes the top layer of the wood grain that gives chemical and abrasive resistance to the wood grain product. In the absence of tie coat, the release coat is the first layer that comes in contact with the inkjet ink. Release coat weight determines the degree of chemical and abrasive resistance as well as gloss/matt finish of the product. Initially, substrates with 3 g/m² of release coat were used to create the customized ICC profile. Substrates were unable to take more than 100 % total ink limit value during media calibration for the Roland VS 540i inkjet printer. Cracks were observed after dry-

ing. The recommended minimum total ink limit as per printer manufacturer is 140 % to achieve acceptable print quality. To increase total ink limit value, substrates with higher release coat were used. Substrates with 7 g/m² and 10.5 g/m² release coat showed total ink limit higher than 140 %. Higher release coat substrates showed some cracking but it was not visible to naked eyes. Substrates with 7 g/m² and 10.5 g/m² release coat were able to accept 180 % and 200 % of total ink limit, respectively.

2.2 Use of tie coat

The vehicles in the inkjet ink make polymers in the release coat less elastic with the increased stress due to shrinking, causing cracks in a print area after drying. In wood grain printing, tie coat is usually used to promote adhesion between printed ink and adhesive, but it can also be used as an alternative to the original release coat. Tie coat contains low molecular weight polymers; hence it creates a relatively softer and more flexible layer of coating than release coat, which avoids cracking after drying. The use of tie coat leads to reduced rub resistance. Hence, tie coat is coated over release coat to maintain original rub resistance of the substrate as well as to avoid cracking. When substrates with tie coat over release coat were calibrated for Roland VS 540i inkjet printer, they showed no ink cracking. However, tie coat did not significantly improve total ink limit capability of substrate. Substrates with 7 g/m² and 10.5 g/m² release coat and with tie coat both were able to accept only 160 % for total ink limit.

2.3 Gray Component Replacement settings

Unlike older version of X-Rite profile making software Profile Maker 5.0, the new software i1Profiler does not specify percent of gray component replacement. Instead, it provides eight different steps under the name “Black Generation Curve”. Eight GCR settings options are minimum, light, light+, medium, medium+, heavy, heavy+ and maximum. To analyze effect of the GCR, three settings of GCR (minimum, medium+ and maximum) were used in the design of experiments. The fundamental approach behind the use of different coat weight and tie coat was to increase color gamut volume by improving total ink limit and to analyze the effect of increased color gamut volume on *MI*. Use of the factor 3, GCR settings were used to understand their effect on *MI*.

3. Results and Discussion

The ΔE^*_{ab} comparison of inkjet and gravure reference patches showed color difference of less than 5 for all four wood grain patches (Galaxy Oak, Smooth Grey, Hunter 655, and Rustic Maple). Galaxy Oak color match

with default printer profile, custom ICC profile, and manually adjusted GCR is illustrated in the Figure 3 under three different illuminants and Smooth Grey for the same conditions in Figure 4.

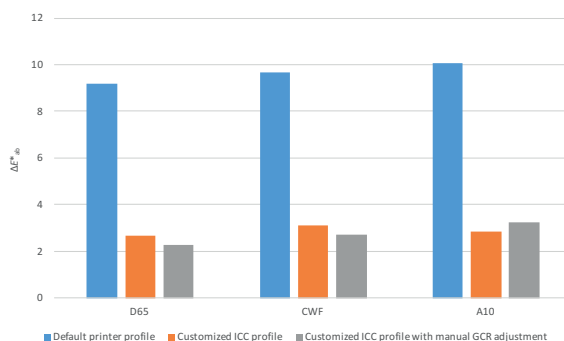


Figure 3: The ΔE^*_{ab} between gravure and inkjet printed Galaxy Oak patch using three different illuminants

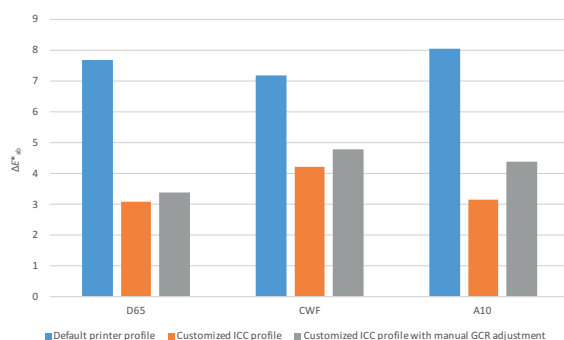


Figure 4: The ΔE^*_{ab} between gravure and inkjet printed Smooth Grey patch using three different illuminants

The customized ICC profile decreased color difference for all illuminants (Figures 3 and 4). On the other hand, manual GCR adjustment in addition to customized ICC profile increased color difference for all patches (not shown), except Galaxy Oak under D65 and CWF light sources (Figure 3). Metamerism Index comparison of all four sample patches showed that customized ICC profile significantly decreased *MI* for all illuminants (Figures 5 and 6), and unlike ΔE^*_{ab} difference, *MI* was decreased further by use of manual GCR adjustment in the custom ICC profile, except for Galaxy Oak, CWF & A10 (Figure 5). Spectral reflectance curves of gravure printed reference patches and inkjet printed patches with default printer profile, customized ICC profile and manual GCR adjustment were plotted for comparison. Spectral reflectance plots of all inkjet printed patches showed that custom created ICC profiles brought spectral reflectance curve closer to the reference gravure printed spectral curve, mainly because of improvement in ΔE^*_{ab} (especially improvement in lightness). Manual GCR setting, in addition to custom ICC profiles, improved spectral plot to some extent, in some cases. Spectral reflectance curves for Galaxy Oak are illustrated in Figure 7, and for Smooth Grey in Figure 8.

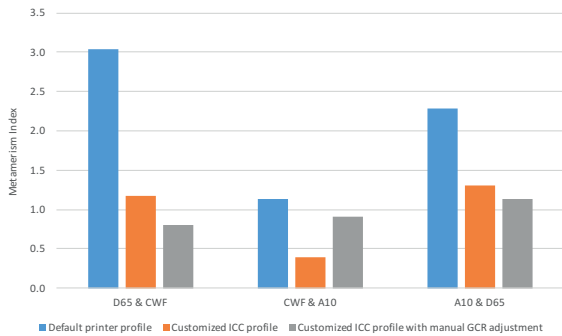


Figure 5: Galaxy Oak patch MI dependency on type of ICC profile used comparing three illuminant pairs

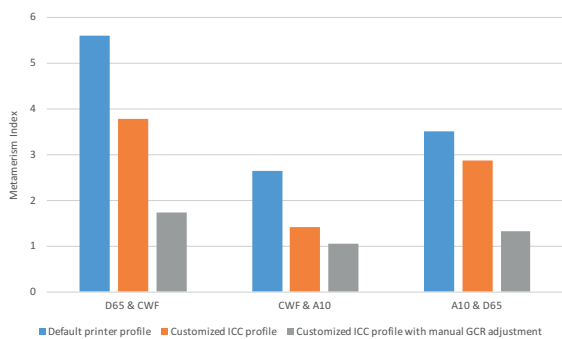


Figure 6: Smooth Grey patch MI dependency on type of ICC profile used

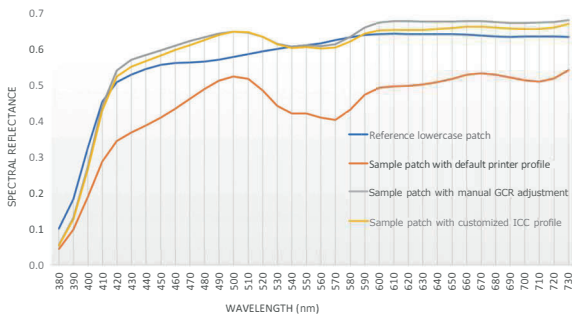


Figure 7: Galaxy Oak patch spectral reflectance curves

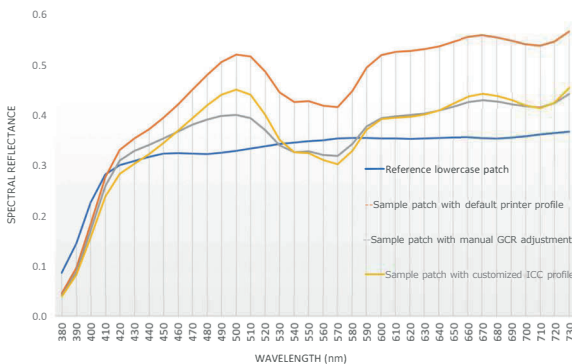


Figure 8: Smooth Grey patch spectral reflectance curves

To analyze the effect of GCR settings on ΔE^*_{ab} and MI simultaneously, GCR settings were plotted on the X-axis, whereas both ΔE^*_{ab} and MI were plotted on the Y-axis. For all types of substrates, color patches, and all illuminants (D65, CWF and A10), the minimum GCR setting showed the highest MI , whereas the maximum GCR setting showed the smallest MI (Figures 9 and 10). The ΔE^*_{ab} and GCR settings did not show any significant correlation between each other except for the Smooth Grey patch. For the Smooth Grey patch, ΔE^*_{ab} decreased significantly with increase in GCR settings; contrary to that, for rest of the patches ΔE^*_{ab} fluctuated by 1–2 ΔE^*_{ab} range. Among all patches, Smooth Grey patch showed the highest improvement in MI , Hunter 655 showed least improvement, whereas Galaxy Oak and Rustic Maple showed slightly more improvement than Hunter 655; data are given elsewhere by Turke (2016). For all trials, manual GCR adjustment neither improved MI nor ΔE^*_{ab} to a significant extent.

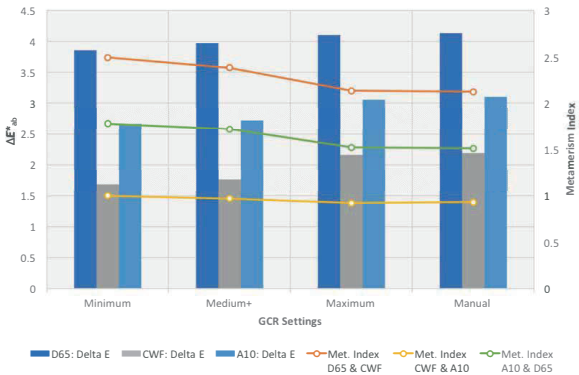


Figure 9: The ΔE^*_{ab} & MI of Galaxy Oak patch with 7 g/m² release coat plus tie coat

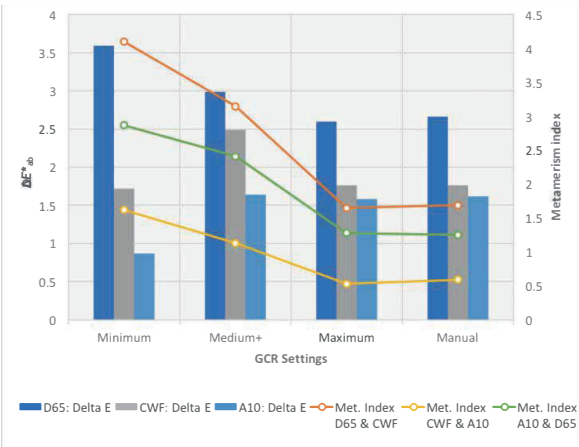


Figure 10: The ΔE^*_{ab} & MI of Smooth Grey patch with 7 g/m² release coat plus tie coat

As manual GCR adjustment did not show any significant improvement in MI , it was not included in spectral distribution curve comparisons in Figures 11 and 12.

Spectral reflectance of selected gravure printed reference patches and inkjet printed sample patches with Minimum, Medium+ and Maximum GCR setting are plotted in Figures 11 and 12. Spectral graphs of all color patches crossed reference patches spectral reflectance curve patch thrice and are thus considered to be met-amer-ic. Even though color patches were metameric, spectral reflectance curves of maximum GCR setting were closest to the spectral curve of reference patch, followed by medium GCR setting and minimum GCR setting spectral curves, respectively. Among all patches, the Smooth Grey patch showed the highest improvement in spectral curves (Figure 12), and Hunter 655 showed the least improvement, whereas Galaxy Oak (Figure 11) and Rustic Maple (data not shown) showed slightly more improvement than Hunter 655.

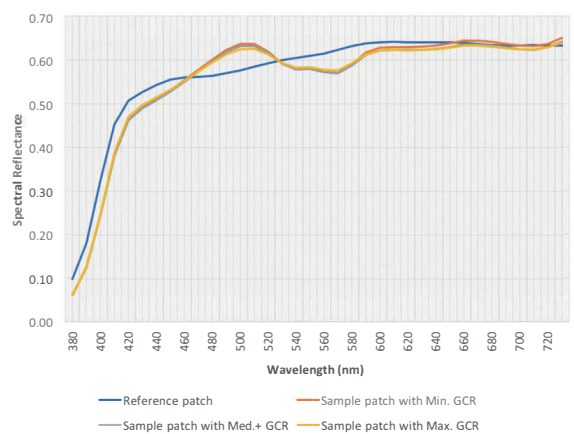


Figure 11: Spectral curve of Galaxy Oak atch with 7 g/m² release coat with different GCR settings

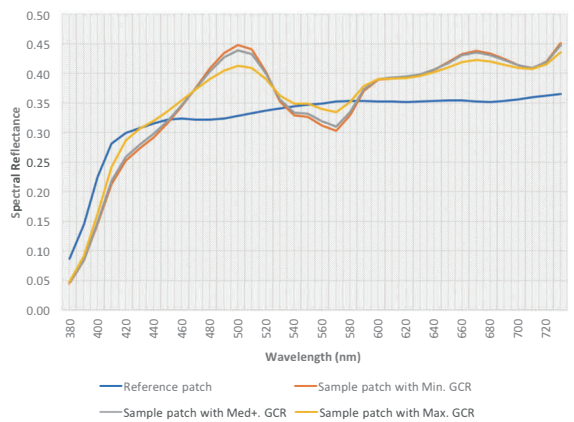


Figure 12: Spectral curve of Smooth Grey patch with 7 g/m² release coat with different GCR settings

Further, color gamut for combination of variables was examined (Table 2). The ICC profiles for the 7 g/m² release coat plus tie coat and 10.5 g/m² release coat plus tie coat substrate were created with 160 % total ink limit values, whereas 7 g/m² release coat and 10.5 g/m²

release coat substrates, without any tie coat, were profiled with 180 % and 200 % total ink limit, respectively. As expected, the highest total ink limit substrate, i.e. 10.5 g/m² with no tie coat, showed the highest color gamut volume, while the lowest total ink limit substrate, i.e. 7 g/m² plus tie coat, showed the smallest color gamut volume. Apparently, the tie coat stopped cracking of the ink, but restricted the spectral reflection from ink films, which along with low total ink limit value of around 140 % caused drastically decreased color gamut volume (Table 2).

Table 2: Color gamut volume comparison

Sample	Release coat (g/m ²)	Tie coat	Color gamut (CCU)
1	7.0	Yes	138 827
2	10.5	Yes	147 850
3	7.0	No	304 802
4	10.5	No	357 646

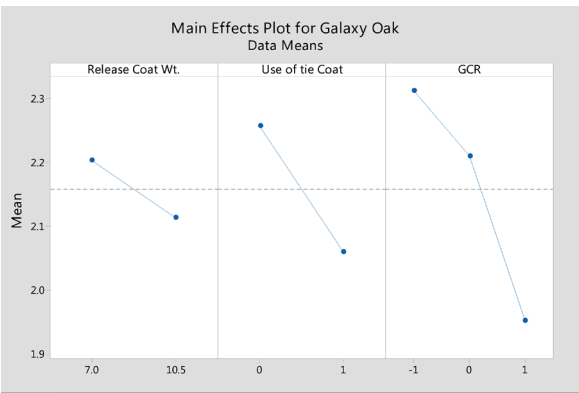


Figure 13: ANOVA main effect plot for Galaxy Oak patch MI

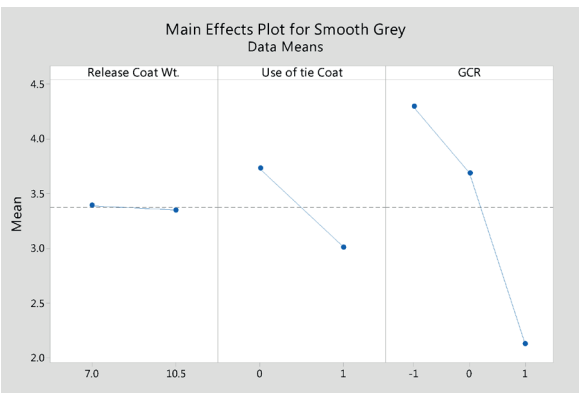


Figure 14: ANOVA main effect plot for Smooth Grey patch MI

Analysis of variance (Turke, 2016) was conducted for MI obtained from 12 DOE trials for all patches. Metamerism index ANOVA results for Galaxy Oak are illustrated in

Figure 13 and for Smooth Grey in Figure 14. Resulting P -values showed that for all patches, except Hunter 655, GCR settings significantly influenced MI , followed by tie coat. For Hunter 655 patch (data not shown), use of tie coat was the most significant factor. However, release coat weight had an insignificant effect on the MI response. This indicates that after a certain limit, there is no value in increasing the release coat weight. Based on the results, this value is about 7 g/m^2 . The comparison of main effects plots for all patches suggested that use of tie coat with maximum GCR setting would give the lowest MI for every spot color. None of the two factor interactions were significant for any of the spot colors. Full ANOVA results, including statistics, are presented by Turke (2016).

4. Conclusions

The ΔE^*_{ab} comparison of inkjet sample patches and gravure reference patches show that the customized ICC profiles significantly decreased color difference for all illuminants. Also, custom created ICC profiles decreased the MI and ΔE^*_{ab} difference significantly, when compared with the generic RIP printer profile. Analysis of spectral reflectance curves justified the significance of custom created ICC profiles over generic RIP printer profile. Manual GCR adjustment in addition to custom created ICC profiles decreased MI further, but at the same time increased ΔE^*_{ab} color difference to some extent. Design of experiments

consisting of 12 trials was conducted using different multi-level factors. Results showed that increased GCR settings had considerable impact on MI , and it varied per color shade. Darker patches showed the highest reduction in MI ; contrary to that, the response to GCR settings by lighter patches was none or insignificant. Analysis of spectral reflectance showed similar results for dark and light patches of colors. The GCR settings neither improved nor deteriorated color difference, and ΔE^*_{ab} color differences fluctuated up and down in range of 1–2 ΔE^*_{ab} units. The ICC profiles for the 7 g/m^2 release coat plus tie coat and 10.5 g/m^2 release coat plus tie coat substrate were created with 160 % total ink limit values, whereas 7 g/m^2 release coat and 10.5 g/m^2 release coat substrates without any tie coat were profiled with 180 % and 200 % total ink limit, respectively. As expected, the highest total ink limit substrate i.e. 10.5 g/m^2 with no tie coat showed the highest color gamut volume and the lowest total ink limit substrate i.e. 7 g/m^2 plus tie coat showed the smallest color gamut volume. Apparently, the tie coat stopped cracking of the ink, but restricted the color gamut volume of the substrates drastically because of low total ink limit value around 140 %. The ANOVA analysis showed that GCR setting was the most influential factor followed by use of the tie coat. Release coat weight was an insignificant factor. In addition to that, the main effects plot showed maximum GCR settings with the use of tie coat would be the best combination of those tested to get maximum reduction in metamerism index.

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Comparison of ICC and DNG colour profile workflows based on colorimetric accuracy

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Abstract

Managing colours is important for every photographer. In this paper, two of the solutions were described and researched: ICC colour profiles and DNG colour profiles. While ICC is a well-established and commonly used option, there are some disadvantages when it comes to time, price, and understanding; DNG colour profiles offer us a good response to these disadvantages but as a result the quality of colour corrections is lower. This paper gives the exact answers on how big the colour difference between both processes is and what the cases are when the use of ICC or DNG colour profiles is advised. The main focus of the research is a usability of both workflows.

Keywords: digital photography, colour management, colour reproduction, colour test chart, white balance

1. Introduction

Making a workflow faster, better and more efficient should be a goal for every professional. It is the same when it comes to colour management and photography. Solutions can be hard to understand, time-consuming, not standardised or too expensive, but implementing them into the workflow can reflect itself in a better and more manageable process (X-rite, 2017a). We can find different solutions for colour management on the market. Most commonly used and in many fields standardised possibility is using ICC colour profiles (Ashe, 2014; International Color Consortium, 2016; International Organization for Standardization, 2009; Green, 2010). When implemented into our workflow, ICC colour profiles give us an all-around solution for managing colour reproduction as they cover every step of the process: photography, scanning, printing and viewing on a display (Jackson, 2015; Green, 2010) – for all of these technologies there is a way how to measure, describe and calculate colour corrections necessary to manage and improve colours (RGB, CMYK or multichannel) on the reproduction (Ashe, 2014; Qu and Gooran, 2013). The ICC colour profiles are well-known, commonly used and in many cases the only or by far the best option (Ashe, 2014; International Color Consortium, 2016).

Photography and ICC colour profiling is a field of its own. For managing colours that way, a photographer

has to use expensive equipment (colour target and special software, for example *X-rite Eye-One Match 3*). The procedure is to take a photo of a test chart in a controlled environment, measure the colour patches of the acquired picture and compare the measurements to the stored values. Comparing the measurements and calculating the colour corrections give us the ICC colour profile that we can use to correct colours on photos taken under the same conditions that were used when making the ICC colour profile. The procedure is time-consuming and requires expensive equipment (Beretta, et al., 2011). We have to repeat the whole procedure for every time lightning conditions or exposure settings change (International Color Consortium, 2016; Penczek, Boynton and Splett, 2014). That's why photographers are using it mostly in controlled environments, such as photography studio.

In 2004 Adobe introduced a DNG (digital negative) image file format (Adobe, 2012). The main goal was RAW format standardization as the market offers many different, company based solutions. Adobe also wanted to offer the best format for archiving digital photos; DNG could be a common way of storing RAW image data from all camera manufacturers (Adobe, 2012). Main disadvantage of the current diverse situation is the constant need of software upgrades to have support for all the new formats that appear on the market. Old software versions often get obsolete as the company

stops releasing upgrades for them and photographers are forced into expensive upgrading. Although DNG was introduced as an open standard, it is being adopted by just a few camera manufacturers. Market penetration is slower than expected. In 2008 Adobe upgraded DNG standard to version 1.2.0.0 that includes support for colour management. The other way of colour correction in photography was born; we call it DNG colour profile (Adobe, 2012). The procedure of making a DNG colour profile is very similar as when making an ICC colour profile, but it's faster and easier to use and it requires less investment in the equipment.

This paper compares both of the mentioned methods – ICC and DNG colour profile based colour management. The purpose of this research is to find out if DNG colour profiles can compete with ICC colour profiles when it comes to colour reproduction.

2. Methods

The procedure of making a colour description (or a colour profile) of a device (for example digital camera) and using it, consists of following steps:

1. setting the photography scene,
2. choosing the colour test chart,

3. acquiring the colour test chart,
4. measuring the acquired data,
5. comparing the acquired data to stored values (predictions),
6. calculating the correction matrix,
7. saving the calculations into the colour profile,
8. applying the colour profile on the acquired data (for example a photo).

For all of the listed steps we have different options from which we can choose from. In the research, the steps from 4 to 7 were questioned as variables. Those steps are really the procedure of how to make a colour profile. Test chart, a method of acquiring it, and a way of using it, were constant for both of the research methods.

2.1 Choosing the colour test charts

There are many different colour test charts available and used but one of them has become a part of most of the similar researches. *ColorChecker* is a test chart standard made by X-rite that is widely used for different kinds of colour control. It is included in many of the market solutions, sometimes by its own and sometimes as a part of a bigger colour pallet (X-rite, 2017b). *ColorChecker* consists of 24 colour patches that are divided into four groups (Table 1): natural colours, miscellaneous colours, primary & secondary colours, and

Table 1: *ColorChecker* basic values, adopted from Poynton (2008)

Colours	Number	Description	Munsell notation	CIE xyY	sRGB D65 colour values
Natural	1	Dark skin	3 YR 3.7/3.2	0.400 0.350 10.1	#735244
	2	Light skin	2.2 YR 6.47/4.1	0.377 0.345 35.8	#c29682
	3	Blue sky	4.3 PB 4.95/5.5	0.247 0.251 19.3	#627a9d
	4	Foliage	6.7 GY 4.2/4.1	0.337 0.422 13.3	#576c43
	5	Blue flower	9.7 PB 5.47/6.7	0.265 0.240 24.3	#8580b1
	6	Bluish green	2.5 BG 7/6	0.261 0.343 43.1	#67bdaa
Miscellaneous	7	Orange	5 YR 6/11	0.506 0.407 30.1	#d67e2c
	8	Purplish blue	7.5 PB 4/10.7	0.211 0.175 12.0	#505ba6
	9	Moderate red	2.5 R 5/10	0.453 0.306 19.8	#c15a63
	10	Purple	5 P 3/7	0.285 0.202 6.6	#5e3c6c
	11	Yellow green	5 GY 7.1/9.1	0.380 0.489 44.3	#9dbc40
	12	Orange yellow	10 YR 7/10.5	0.473 0.438 43.1	#e0a32e
Primary and secondary	13	Blue	7.5 PB 2.9/12.7	0.187 0.129 6.1	#383d96
	14	Green	0.25 G 5.4/9.6	0.305 0.478 23.4	#469449
	15	Red	5 R 4/12	0.539 0.313 12.0	#af363c
	16	Yellow	5 Y 8/11.1	0.448 0.470 59.1	#e7c71f
	17	Magenta	2.5 RP 5/12	0.364 0.233 19.8	#bb5695
	18	Cyan	5 B 5/8	0.196 0.252 19.8	#0885a1
Greyscale	19	White	N 9.5/	0.310 0.316 90.0	#f3f3f2
	20	Neutral 8	N 8/	0.310 0.316 59.1	#c8c8c8
	21	Neutral 6.5	N 6.5/	0.310 0.316 36.2	#a0a0a0
	22	Neutral 5	N 5/	0.310 0.316 19.8	#7a7a79
	23	Neutral 3.5	N 3.5/	0.310 0.316 9.0	#555555
	24	Black	N 2/	0.310 0.316 3.1	#343434

greyscale colours (Poynton, 2008). Some of the colours are chosen from the graphic standards, others are taken from the environment and all are equally distributed in the chromaticity diagram (Figure 1). Values are publicly available.

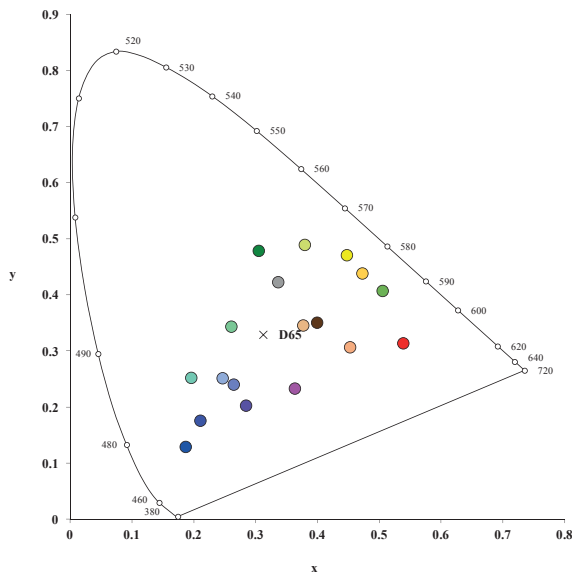


Figure 1: Distribution of colours included in the ColorChecker test chart shown in a chromaticity diagram adopted from Poynton (2008)

In the research, two of the available market solutions were used:

- *ColorChecker Digital SG*: it includes 140 colour patches (24 of the basic *ColorChecker* included); its main purpose is use in digital photography as it equally covers most of the digital camera colour gamut (X-rite, 2017b),
- *ColorChecker Passport*: this is a small and portable colour test chart that includes basic 24 *ColorChecker* patches and different patches for white balance control; it is designed specifically for making DNG colour profiles. Test chart comes with a designated software that can be used with other *ColorChecker* test charts as well (X-rite, 2017b).

2.2 Acquiring the data (taking a photo)

The procedure of acquiring data for the research was taking a photo of the test chart in a controlled environment in a dark photography studio with no additional light sources (Figure 2). Equipment used:

- *ColorChecker Digital SG* test chart,
- Nikon D700 digital camera (exposure time 1/250 s and ISO speed 100; as we used RAW workflow we were able to set white balance later in the process),

- AF-S NIKKOR 50mm/1.4G camera lens (aperture 5.6),
- two Quantum Q1250 halogen studio lights with soft-box mounted (CCT 3100 K, CRI 100, power 1000 W, and 1-meter distance from the test chart under the 45° and -45° angles),
- tripod.

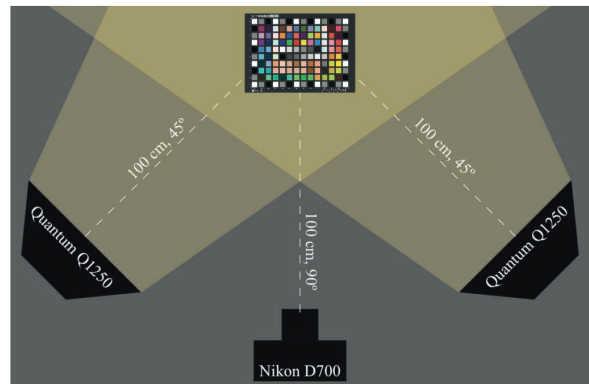


Figure 2: Photography set-up for acquiring a ColorChecker SG test chart

2.3 Making an ICC colour profile

The ICC colour profile was made with an acquired photo of a *ColorChecker Digital SG* test chart. The *X-rite Eye-One Match 3* software with *X-rite Eye-One Pro* spectrophotometer plugged in (it works as a licence hardware key for the software) was used. Before a photo of a test chart was opened in the software it was converted from NEF (Nikon RAW format) to 24-bit TIFF (using *Adobe Camera Raw 6.7* and *Adobe Photoshop CS5*), white balance was set the to 3100 K (equal as the light source used) and the pre-attached sRGB colour profile was excluded (choosing the “Don’t colour manage” option in *Adobe Photoshop CS5*). *X-rite Eye-One Match 3* recognized the test chart on a photo and calculated the ICC colour profile automatically (Figure 3).



Figure 3: X-rite Eye-One Match 3 application with a photo of a ColorChecker Digital SG test chart

2.4 Making a DNG colour profile

The DNG colour profile is a colour description of a particular digital camera, regardless the type of light source we use when taking photos. This colour profile can include two conversion matrices for colour conversion – one for CIE standard illuminant A and one for D65, where values in-between both are being interpolated based on the indicated colour temperature of the used light source. Adobe offers such profiles for most of the digital cameras on the market and in most cases correction is done very well.

Better colour correction for a particular light source, such as light source used in this research, can also be done. In this case, a RAW digital data was used of a photo of the *ColorChecker Digital SG* test chart and *X-rite ColorChecker Camera Calibration 1.1.0* application that is provided together with the *ColorChecker Passport* test chart.

For the purpose of the research the same test chart was used in both cases – ICC and DNG. Application automatically chooses the 24 basic *ColorChecker* patches (Figure 4) and creates the DNG colour profile.

While the profile was generated by using the photo, white balance value was set by hand (in our case 3100 K).

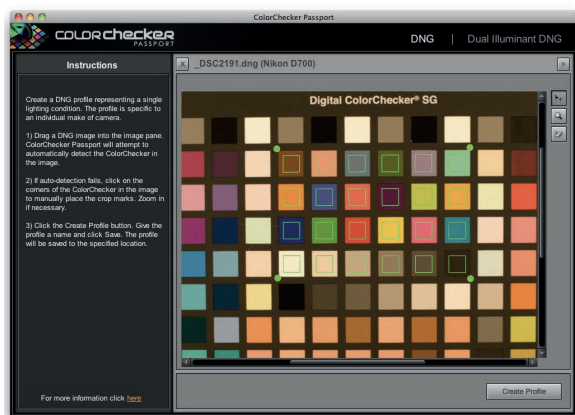


Figure 4: X-rite ColorChecker Camera Calibration 1.1.0 application with a photo of a ColorChecker Digital SG test chart

2.5 Comparison of both profiles

The comparison of both profiles was done in the following steps:

- measuring CIELAB values of 24 *ColorChecker* patches on *ColorChecker Digital SG* test chart (to obtain the real values as the chart was not brand new at the moment of the research and

the values provided by X-rite could not be trusted anymore); X-rite EyeOne Pro spectrophotometer and *GretagMacbeth KeyWizard 2.5* application (standard CIE illuminant D50 and 2° standard observer) was used,

- applying the ICC colour profile on a photo of the *ColorChecker SG* test chart; by using *Adobe Photoshop CS5*,
- applying the DNG colour profile on a photo of the *ColorChecker SG* test chart; by using *Adobe Photoshop CS5*,
- colour picking CIELAB values of 24 *ColorChecker* patches on both photos using *Adobe Photoshop CS5*,
- calculating colour differences ΔE^*_{ab} , ΔL^* , Δa^* , and Δb^* between measured CIELAB values on a real-life *ColorChecker SG* test chart and those from corrected photos – for ICC and DNG.

The main method of describing the differences was based on ΔE^*_{ab} as it is a widely used method for this kind of research (Sharma, 2006). The other possible method would be comparing colour gamuts of both profiles as some researches use (Deshpande, Green and Pointer, 2015; El Asaleh, Filicetti and Sharma, 2016). The CIELAB colour space is based on CXYZ that is in this case based on an average 2° observer and standard CIE illuminant D50 (normalised colour values).

3. Results and discussion

Results show us small to very big colour differences between real values and values obtained after the calibration. Average colour difference is 5.05 for values corrected with an ICC colour profile (Table 2) and 7.59 for values corrected with a DNG colour profile (Table 3). An ICC colour profile did a better job which was expected because 140 colour patches were used to make a profile (just 24 for a DNG colour profile).

What is surprising is, that the difference between both results is not so big – just a 2.54 colour difference between average values of all measured colours. If we take a look at CIE L^* , a^* , and b^* colour values, we can observe that the difference between an average ΔL^* is 1.12, Δa^* is 0.30, and Δb^* is 0.62. A lot better results were expected in favour of ICC where a more complex and advanced procedure is used to make the colour profile.

When we look at different colours we can observe that some of them were not reproduced very well in both cases, ICC and DNG. Cyan, purplish blue and blue were the worst in both cases (Table 4). This can be explained with the illuminant used: spectral distribution of the halogen studio lighting was very similar to standard

illuminant A, where we can observe a low emission in a first part of the visible spectrum and a very high emission in the last part of the visible spectrum.

Looking at the data we can also observe that greyscale colours were reproduced best in both workflows. That was expected because greyscale patches have none or very low chromatic values so the colour differences appeared almost only because of the change in lightness. Slightly better results were achieved with an ICC colour profile. For all the other colours, there isn't any significant pattern that would strongly correlate both methods (Pearson correlation is 0.74, Spearman correlation of ranked values is just 0.48 – correlations were calculated between ΔE^*_{ab} values of both methods).

We can see that the overall quality of the reproduction is better when we use an ICC colour profile but when it comes to usability of both workflows, a DNG colour

profile has more advantages. First is photographing the test chart. The best and also easier way to do it is by using *ColorChecker Passport* which is a pocket-sized test chart that is not hard to lit equally. Equally lit test chart is one of more important steps in the first phase of the process and the bigger the chart is, the more precise the lightning condition in our photography setup has to be.

The second advantage of DNG colour profile is time. For making a DNG colour profile we can use *Adobe Photoshop* or *Adobe Lightroom* plugins that offer us a possibility to make profiles in a very short time (Schewe, 2012). These plugins are also available for free. Shorter time can be a huge plus for every workflow. And the third advantage is a possibility to have two illuminant correction matrices in a DNG colour profile that give us a possibility of more universal use of the solution.

Table 2: CIELAB values of ColorChecker patches corrected with an ICC colour profile

Colours	Number	Description	Measured ColorChecker SG			Photo + ICC colour profile			ΔE^*_{ab}
			L^*	a^*	b^*	L^*	a^*	b^*	
Natural	1	Dark skin	32.77	18.16	21.10	33	14	21	4.17
	2	Light skin	63.24	20.64	19.63	65	19	15	5.22
	3	Blue sky	47.07	-5.35	-24.07	47	-3	-25	2.53
	4	Foliage	38.56	-16.62	29.95	38	-17	38	8.08
	5	Blue flower	51.99	8.77	-26.86	52	11	-27	2.23
	6	Bluish green	69.42	-34.11	-0.05	70	-31	0	3.16
Miscellaneous	7	Orange	60.73	38.16	71.32	61	40	68	3.81
	8	Purplish blue	36.42	10.37	-49.48	44	17	-54	11.04
	9	Moderate red	47.59	51.98	19.65	48	51	16	3.80
	10	Purple	21.98	28.25	-27.15	19	32	-26	4.93
	11	Yellow green	71.12	-23.93	64.96	71	-24	74	9.04
	12	Orange yellow	69.88	19.91	78.62	69	22	78	2.35
Primary and secondary	13	Blue	20.73	20.12	-57.22	14	27	-61	10.34
	14	Green	52.84	-43.26	38.72	54	-38	35	6.55
	15	Red	37.28	63.16	39.99	36	63	32	8.09
	16	Yellow	81.01	3.92	88.71	80	6	92	4.02
	17	Magenta	48.53	54.22	-15.69	49	56	-15	1.97
	18	Cyan	48.47	-32.69	-29.64	49	-18	-34	15.33
Greyscale	19	White	97.24	-0.71	1.48	93	1	-1	5.20
	20	Neutral 8	79.77	0.01	0.10	80	1	-1	1.50
	21	Neutral 6.5	65.82	-0.21	-0.03	66	1	-1	1.56
	22	Neutral 5	50.47	-0.11	0.52	51	1	-1	1.96
	23	Neutral 3.5	36.08	-0.25	-0.16	35	0	-2	2.15
	24	Black	17.69	-0.40	-1.02	17	0	-3	2.13

Average colour difference ΔE^*_{ab} : **5.05**

Average colour difference ΔL^* : **0.24**

Average colour difference Δa^* : **2.12**

Average colour difference Δb^* : **1.06**

Pearson correlation between measured and reproduced L^* values: **0.99**

Pearson correlation between measured and reproduced a^* values: **0.99**













Pearson correlation between measured and reproduced b^* values: **1.00**

Table 3: CIELAB values of ColorChecker patches corrected with a DNG colour profile

Colours	Number	Description	Measured ColorChecker SG			Photo + DNG colour profile			ΔE^*_{ab}
			L^*	a^*	b^*	L^*	a^*	b^*	
Natural	1	Dark skin	32.77	18.16	21.10	33	18	23	1.92
	2	Light skin	63.24	20.64	19.63	69	22	12	9.66
	3	Blue sky	47.07	-5.35	-24.07	47	-1	-32	9.05
	4	Foliage	38.56	-16.62	29.95	37	-18	38	8.32
	5	Blue flower	51.99	8.77	-26.86	54	13	-31	6.25
	6	Bluish green	69.42	-34.11	-0.05	72	-25	-7	11.75
Miscellaneous	7	Orange	60.73	38.16	71.32	66	33	76	8.74
	8	Purplish blue	36.42	10.37	-49.48	33	22	-63	18.16
	9	Moderate red	47.59	51.98	19.65	52	54	22	5.39
	10	Purple	21.98	28.25	-27.15	19	30	-25	4.07
	11	Yellow green	71.12	-23.93	64.96	74	-25	73	8.61
	12	Orange yellow	69.88	19.91	78.62	74	14	84	8.99
Primary and secondary	13	Blue	20.73	20.12	-57.22	17	36	-69	20.12
	14	Green	52.84	-43.26	38.72	54	-45	40	2.45
	15	Red	37.28	63.16	39.99	43	63	37	6.46
	16	Yellow	81.01	3.92	88.71	83	1	91	4.21
	17	Magenta	48.53	54.22	-15.69	54	58	-14	6.86
	18	Cyan	48.47	-32.69	-29.64	49	-17	-43	20.61
Greyscale	19	White	97.24	-0.71	1.48	94	1	-1	4.42
	20	Neutral 8	79.77	0.01	0.10	83	1	-1	3.55
	21	Neutral 6.5	65.82	-0.21	-0.03	70	1	-1	4.46
	22	Neutral 5	50.47	-0.11	0.52	52	1	-1	2.43
	23	Neutral 3.5	36.08	-0.25	-0.16	34	1	-2	3.05
	24	Black	17.69	-0.40	-1.02	16	0	-3	2.63

Average colour difference ΔE^*_{ab} : **7.59**Average colour difference ΔL^* : **1.36**Average colour difference Δa^* : **2.42**Average colour difference Δb^* : **1.68**Pearson correlation between measured and reproduced L^* values: **0.99**Pearson correlation between measured and reproduced a^* values: **0.98**Pearson correlation between measured and reproduced b^* values: **1.00**

Table 4: Visual presentation of the worst six reproduced colours for ICC and DNG workflows (approximate colour rendering, based on the data from Tables 2 and 3)

Colour profile	Colour patch					
	Cyan	Purplish blue	Blue	Yellow green	Red	Foliage
ICC						
DNG						

4. Conclusion

The use of ICC colour profiles is a better solution than DNG when it comes to colorimetric accuracy of the reproduction. In almost all measured colour patches better results were achieved with ICC so the altogether measurements were also better. On the other hand, ICC

colour profile requires more time, expensive equipment, and it only offers us a solution to make a colour profile for each illuminant separately, whereas DNG profiling is faster, cheaper, and with a possible use of two illuminants also more universal. We can conclude that both workflows have their advantages but because of its usability the DNG colour profiles would

be recommend for most photographers. Surprisingly, the quality is not so much lower when using DNG colour profiles and such a small colour difference is for most photography scenarios something a professional can live with. Photography conditions are in most cases not so constant that the 2.54 average colour difference would make a significantly worse result that could be easily seen with the naked eye. In cases where

we make reproductions of an artwork, where perfect colour reproduction is needed, the use of ICC colour profiles would be recommended. These are also the scenarios where more time and resources are usually available so the higher cost should not be a big disadvantage. But in almost all modern photographic scenarios the time and money saving can make a crucial difference between getting a job or not.

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A study on Facebook and WhatsApp during Chennai floods 2015

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Abstract

In December 2015, unexpected floods occurred in Chennai, which was officially declared a disaster city, and was puzzled as to what Nature had for it next. The then isolated city had all its sources of communication cut, except access to Facebook and WhatsApp through mobile phones that enabled timely update on flood news and weather forecast, a way to connect with family and friends to ensure safety, putting out SOS signals and listing out worst-affected areas that needed volunteering and basic items such as food, water and other relief to the citizens. Chennai has 3.5 million (35 lakhs) Facebook users browsed through a smartphone. Likewise, WhatsApp is used as the top smartphone app by 96 per cent of people in India. Various features of it went viral in spreading information which brought food, clothing, shelter, support and love from all ends of the globe. Apart from individuals, non-governmental organizations (NGOs) and other stakeholders also used both Facebook and WhatsApp actively during the crisis. This paper aims to provide a better understanding of how NGOs used Facebook and WhatsApp to engage with the victims during Chennai floods 2015. The results revealed that Facebook was used by NGOs to reach out the public for getting help in the rescue, relief and rehabilitation for the victims. Whereas, WhatsApp was used by various organizations, police officials and volunteers to communicate with them once on the field and also off the field. With respect to residents of Kotturpuram, the use of WhatsApp for the above set indicators seemed more timely during Chennai flood 2015 than Facebook. The usage of these communication media had turned the citizens as activists and made them take control over the situation and bounce back to normalcy during Chennai floods 2015.

Keywords: citizens, disaster management, Kotturpuram, social media

1. Introduction and background

Facebook, which was set up in 2004, has India to be the world's largest Facebook user with over 195 million users, overtaking the US by over 4 million subscribers. With the 155 million Monthly Active Users (MAUs) in India, 147 million MAUs access Facebook via mobile phones and 73 million users are active daily on mobiles. It is no doubt that the rise of Facebook in India is power-driven by the mobile phone. Smart phone penetration in Indian cellular market has made 3.5 million (35 lakhs) Facebook users to access it from a phone in Chennai. Likewise, WhatsApp is used as the top smartphone app by 96 percent of people in India. Top social networking site Facebook transformed human interaction and began ruling online culture due to its multi-modal nature of communication which enabled instantaneous interaction. In India, WhatsApp has become the biggest market worth 200 million users.

Social media act as prominent, near real-time communication channels used to share information during the times of calamities and natural disaster (Paladin, Ramos and Capulong-Reyes, 2015; Simon, et al., 2014). During a disaster, many non-governmental organizations (NGOs) and individual volunteers form groups via WhatsApp to give an overview of the situation, to know about the requirements and problems and thus reach out to victims.

There are four distinct phases in disaster management, namely mitigation, preparedness, response and recovery (Yodmani and Hollister, 2001). This is the time when there is a need for proper information sharing with collaboration and coordination. For this, the technologies pave the way for such discussion about mitigation efforts, identification of potential hazards, connectivity between response organizations of all types, warning messages to the public, and diffusion of important disaster information (Fischer, 1998).

1.1 Chennai floods 2015

Chennai is situated on the Coromandel Coast of the Bay of Bengal and placed near the equator; the north-eastern monsoon drenches it from October till December. This makes January the coolest month of the year. Every year, it is a routine in India that low pressure which forms above the Bay of Bengal hits Andhra Pradesh, Odisha and West Bengal and causes floods, while Tamil Nadu suffers under droughts. When Chennai was ready to be prepared for yet another year of drought and water shortage, it was hit with a record-breaking rain since 1918, which led to massive floods in 2015. Rapid urbanization, illegal construction, and inadequate infrastructure were some of the fundamental flaws for the occurrence of Chennai floods.

The floods that hit the city in November–December 2015 are the worst unexpected natural calamity that hit Chennai in recent times. It all started with the consistent rains from November 8 which were followed by a severe one on November 23. The very first warning of “heavy rain” had been issued on November 28. By the end of November, the level in the Chembarambakkam reservoir, which is one of the city’s main water sources, had reached its limit. But the rain did not stop, and started again on December 1 making the city waterlogged receiving a record-breaking 272 mm of rainfall. With a heavy outburst, Chennai was officially declared a disaster city on December 2.

When Chennai became waterlogged by December, the Indian army and air force were deployed to carry forward the rescue operations. The deluge in Chennai was very much unanticipated thereby killing 400 people and damaging 100 000 structures. This includes patients who died after the failure of power and oxygen supplies. Floodgates were opened, Avadi Bridge collapsed, and people were stuck in their homes with their routine life affected. Access to basic amenities including water, food supply, and power was restricted. Many areas in Chennai, which were surrounded by floodwaters, had food packets being dropped to the terrace by the Indian navy. There was also a case of a 9-month pregnant woman who was aurally rescued and admitted to the hospital, and who later delivered twin girls. Educational institutions were closed for more than a month. Several city hospitals stopped functioning, train services and flights were canceled. The lakes overflowed and the rivers clear of sewage as never before. Rivers breached their banks leading to submerging of surrounding areas with water rising up to the second floor in some places. The usually busy Chennai city then came to a standstill and puzzled as to what Nature had for it next. Thus the December 2015 crisis made communication a major problem with the mobile networks and landlines going for a toss. The city

had all its source of communication cut, except access to Facebook and WhatsApp, with the power banks for rescue to charge them to get connected.

During a natural disaster, there is a severe damage to communication infrastructure (Low, et al., 2010). Phone switches and mobile phone towers might collapse, fully or partially, thus disrupting the much-needed communication (Palen and Liu, 2007). Several natural disasters may cause the entire communications grid to black out, as infrastructure is easily damaged (Stiegler, Tilley and Parveen, 2011). As the conventional means of communication during and immediately following a disaster are limited, alternative means such as social networks become an important conduit for information gathering and sharing (Hughes, et al., 2008; Bird, Ling and Haynes, 2012; Huang, Chan and Hyder, 2010). This is when social networks and mobile apps have served as major components of crisis response when all other communication failed.

Within minutes of the December 2015 Chennai floods, the word ‘Chennai floods’ was recorded in dozens of posts on Facebook. Witnessing the heaviest rainfall seen in a century during Chennai floods, Facebook came up with ‘safety check’ feature. The feature allowed its users to mark themselves as “safe” from the floods. By clicking on it ensured the safety of the user and marked “Yes, let my friends know” where the tool automatically notified to other friends of the user (Figure 1).

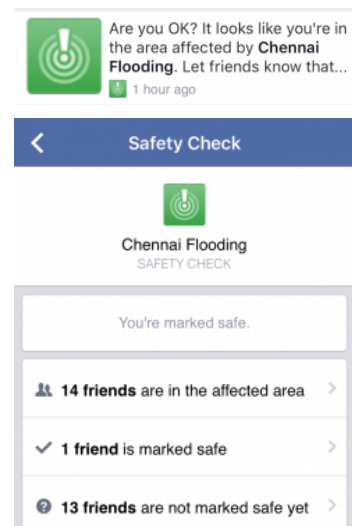


Figure 1: Facebook activated ‘safety check’ feature during Chennai floods 2015

Facebook offered the timely update on flood news to the weather forecast and a way to connect with family and friends to ensure their safety. The public communication on Facebook allowed coordinating with stranded people in water-logged areas. The emergency

contact numbers though circulated could not do much, due to weak signals. It was Facebook that directed to the 'go to' places. This helped in carrying forward the rescue effort quickly. From putting out SOS signals and listing out worst-affected areas that needed volunteering and to fulfil their basic requirements such as food, water and other relief material were possible through Facebook. The contribution on rescue and relief efforts also came from unknown people residing in different parts of the world to help the victims in the form of donations and communication. When the residents were being tormented by the heavy down-pour, Facebook was employed to bring back Chennai to normal by reassuring, warning, motivating, guiding and organizing. Despite the destruction all around, it was humanity that stood flawlessly with Facebook as the mediator making an army officer say that it was the first time he saw more volunteers than people who needed to be rescued.

Apart from individuals, NGOs and other stakeholders used Facebook actively during the crisis; NGOs like Chennai Rain Relief on Facebook came with basic tips on how to rescue people and lists of dos and don'ts. A few groups like The Pound, The Chennai Adoption Drive, and Blue Cross Chennai came to the rescue of many stranded animals through Facebook. These groups went to the level of providing medical care and temporary shelters and also helped in uniting estranged pets with their owners and also arranged homes for the homeless animals.

Another such real lifeline service like Facebook which was functional during the Chennai floods 2015 for stranded people was WhatsApp, which was especially used to send the text rather than to make or receive calls, upload photographs or videos and record audio or video. On December 2, when *The Times of India* journalist Latha Srinivasan was stranded along with many others at Global Hospital in OMR, all that was required from her was to send an SOS message on WhatsApp. By doing so, she was reached by the Public Works Department Minister who was informed by a senior official in the Tamil Nadu Government. Cases of stranded pregnant women, children and senior citizens were also routed through WhatsApp. The police officers also formed a WhatsApp group called Rescue Team to rescue stranded people. Employees at the Bank of Baroda at the Mudichur branch processed cash withdrawals of their customers although the lines were down. This was made possible by the bank official Seethalakshmi and her team. She went to the Tambaram branch and logged in where lines were up and with the help of her team who clicked pictures of the cheques on WhatsApp from the Mudichur branch, the customers could go back content with their money in their need of the hour.

Another WhatsApp message which went viral during Chennai floods 2015 was that of a dad and son. The son who is working in Mumbai had called his parents to come off to his place during the deluge as he did not want them to face inconvenience staying there. But the reply his father gave reflected the spirit of Chennai then. He said that escaping in such dire situation is not good and would like to lend a shoulder to the victims and that God would take care of them (Figure 2).

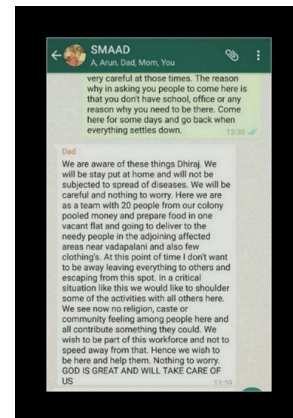


Figure 2: WhatsApp message shared between a dad and his son during Chennai floods 2015

According to Crouch (2011), the four primary ways that citizens use social media technologies during natural disasters are:

- family and friends communication – to connect with family members between affected and unaffected communities/areas (or within affected communities) for situation updates and planning responses,
- situation updates – neighbors and communities share critical information with each other such as road closures, power outages, fires, accidents and other related damage,
- situational/supplemental awareness – in a number of cases citizens rely less and less on authority communication, especially through traditional channels (television, radio, phone),
- services access assistance – citizens would use social media channels to provide each other with ways and means to contact different services they may need after a crisis.

1.2 Past natural disasters

In January 2011 during Victorian floods in Queensland, community-initiated Facebook groups instantly became active, followed by local residents along with their families and friends beyond the impacted areas. Gathering the data of local residents from the Bureau of Meteorology, State Emergency Service, Queensland and

Victorian Police Departments, local councils and news media, the administrators posted near-real-time information from the public in the group. In turn, Facebook members asked for help and advice and it was all the more useful for travelers passing through the area who could access information on road closures and flooding. Risk Frontiers surveyed the community groups CQ Flood Update-version 2 and Victorian Floods in Facebook on the usage of the group during the deluge to seek information. Social media could disseminate information and also act as a major resource to tap into and review informal communication (Bird, Ling and Haynes, 2012).

In February 2011, an earthquake occurred in Christchurch of the Canterbury region in New Zealand's South Island. This deadliest natural disaster caused damage across Christchurch killing 185 people. Twitter again acted as the fastest platform for disseminating information instantly through Twittersphere along with images and video of the destruction. The hashtags #eqnz and #chch went viral in circulating tweets among the community on the safety of individuals, families and schools (Seitzinger, 2010).

When in March 2011 Tohoku Earthquake and Tsunami ruined Japan, Facebook and Twitter were used as major means of communication. Soon after the disaster struck, the word 'Japan' was recorded in dozens of posts on Facebook and Facebook infographics. It was also used for 'Smile for Japan', a fundraising event for Tohoku Earthquake/Tsunami. Twitter had 1 200 tweets per minute coming from Tokyo Tweet-o-Meter. Apart from these, YouTube had 16 000 videos uploaded in a few hours following the earthquake. Real-time updates were got from Tumblr and Google Earth which showed damaged areas (Taylor, 2011).

In October 2012, Hurricane Sandy ravaged the coastal Mid-Atlantic States and by that time, social media had become very popular among the people. Disaster response was carried out through Twitter, Facebook and Instagram. These platforms helped to keep informed, locate families and friends and notify authorities and express support. According to analytics firm Topsy, there were over 3.2 million tweets with the hashtag #sandy being sent by users in 24 hours (Loeb, 2012). In case of Facebook, the top 10 search terms during the height of the storm were "stay safe / be safe," "prayers / praying," and "my friends" and after storm terms were like "we are ok," "hope everyone is ok," and "made it". Instagram for its part had people posting 10 pictures of hurricane each second during the height of the storm. Google created Hurricane Sandy Map specific to New York City. This map was designed exclusively for location tracking, locations of shelters, recovery centers, public alerts, present and forecasted paths, evacuation

notices, storm warnings, weather information, and live webcams. In 2013, the Federal Emergency Management Agency (FEMA), in its National Preparedness report wrote on how despite no mobile phone service, 20 million Sandy-related "tweets" filled up Twitter. During Hurricane Sandy, New Jersey's largest utility company, PSE&G overused Twitter feeds to send word about the daily locations of their giant tents and generators (Maron, 2013).

2. Methods

This study adopted both qualitative and quantitative approaches. Besides textual analysis, semi-structured interviews with creators of NGOs Facebook pages and WhatsApp groups were carried out to know their usage. A survey questionnaire was also distributed among the residents of Kotturpuram, a worst affected area in Chennai, where information, real-time operational information, situational updates, emotional appeal, and trustworthiness were set as the indicators to know the reach of the both media. According to Yates and Paquette (2011), social media has been identified as one of the potential tools for sharing information during a disaster.

According Fosso Wamba and Edwards (2014) and Houston et al. (2015), real-time operational information and situational updates are ensured by social media which provide up to date information. Choi and Lin (2009) said emotional support was sought through social media followers during a disaster. Lastly, the public's pre- and post-disaster trust of social media, level of engagement with social media during disasters, and behavior and attitude change intentions as a consequence of social media exposure (Jin and Liu, 2010; Murdough, 2009). Thus, these indicators help to make better decisions to handle the disaster response effectively.

The Facebook page of an NGO which made a difference during Chennai floods 2015 is chosen depending on the highest number of likes it had got. Further, one post is chosen for each day with the highest number of 'likes', from the time period of 1 to 20 December 2015, for which the texts are analyzed.

In the same way as mentioned above, 'Chennai Volunteers' Facebook page <https://www.facebook.com/chennaivolunteers/> was chosen with the highest number of 'likes' being 10 807. 'Chennai Volunteers' is a social initiative launched by Bhoomika Trust and Mecheri Foundation in August, 2011. They aim to nurture civic engagement and ensure that non-profits can engage with volunteers in a sustainable and meaningful way, thereby enriching the experience of both the partners.

3. Results and discussion

The results reveal that the use of WhatsApp for indicators like information, real-time operational information, situational updates, emotional appeal, and trustworthiness were timely during Chennai flood 2015 among the residents of Kotturpuram. Viewed from the perspective of the flood victims of Kotturpuram, it is found that they were comfortable and accessible more with WhatsApp than Facebook. It is also clear that Facebook was used by NGOs to reach out the public for getting help in rescue, relief and rehabilitation for the victims. Apart from that, again WhatsApp was used by various organization, police officials and volunteers to communicate with them once on the field and also off the field.

3.1 Posts on the Facebook page

There were a total of 39 posts in the Facebook page of 'Chennai Volunteers' from 1 to 20 December 2015. In this time period, one post is chosen for each day with the highest number of 'likes', for which the texts are analyzed.

1 December 2015

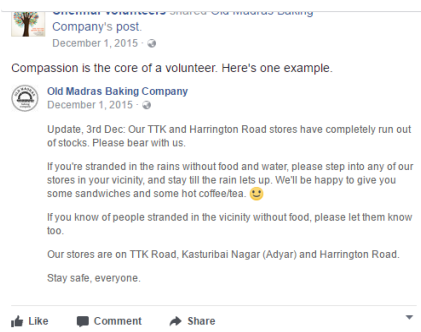


Figure 3: Update of information by 'Chennai Volunteers'; 60 likes, 1 share

The post was an incident update of how Old Madras Baking Company's branch Harrington Road and TTK road were inviting people who were stranded in rain with sandwiches and hot coffee/tea. This post sets an example of humanity and lifts the spirit of Chennai.

2 December 2015

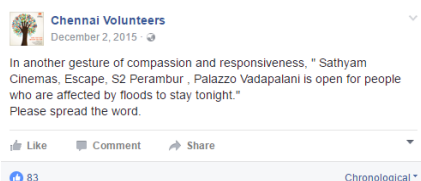


Figure 4: Image update of information by 'Chennai Volunteers'; 83 likes

The post was spreading the message that Sathyam Cinemas, Escape, S2 Perambur and Palazzo Vadapalani were open for people who were affected by floods to stay in a gesture of compassion and responsiveness.

3 December 2015



Figure 5: Photograph of victims collecting medicines and provisions; 18 likes

The post was a series of seven photographs. It shown volunteers visiting the victims and distributing them medicines, provisions and spreading smiles. The victims were shown desperate.

4 December 2015

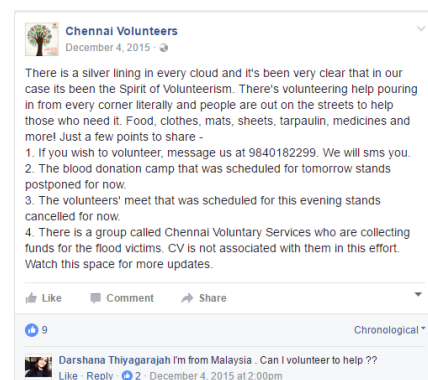


Figure 6: Calling for volunteers; 9 likes

The post was calling for volunteers to help the victims during Chennai floods 2015. It also informed on the postponement of the blood donation camp which was scheduled the next day.

5 December 2015

The post shared the various activities of the 'Chennai Volunteers' were into, like information on setting up of a community kitchen at Narada Gana Sabha, followed by a work session at the central hub of relief activity in Chennai, #chennaiainrelief2015 control room and a community kitchen for 20 000 people, then about Loyola College which was converted into a relief camp and finally a late evening center for packing dry provi-

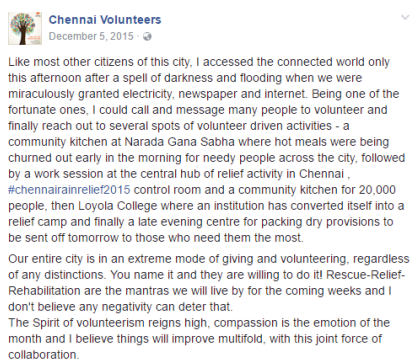


Figure 7: Update of information by 'Chennai Volunteers';
94 likes, 40 shares, 5 comments

sions to be sent off the next day to those who needed them the most. The post was spreading the spirit of volunteerism and compassion towards each other where rescue-relief-rehabilitation were the mantras for the upcoming weeks then.

6 December 2015



Figure 8: The dos and don'ts during Chennai floods 2015;
29 likes

The post was the link to the dos and don'ts for Chennaites to stay healthy during Chennai floods 2015. This included 13 important dos and don'ts with easy language represented using visuals. It read "avoid contaminated water, use boil water, wash hands, cover open wounds, use mosquito repellents, don't touch open wire, avoid well water, don't use food standing for two hours, get rid of garbage, throw cooked food, bathe regularly, ensure vaccination and don't allow your pets to be outside".

7 December 2015

The post was a thanking the volunteers of Chennai Rain Relief 2015. It also welcomed more such volunteers who were in need for the community kitchens to

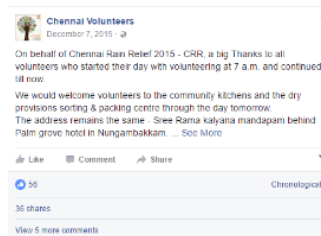


Figure 9: Thanking the volunteers;
56 likes, 35 shares, 5 comments

sort the dry provisions and pack it for the next day. The comments were by the members who were willing to volunteer and were asking for more information like time and date.

9 December 2015



Figure 10: Photograph of Bharath who lost his life during
Chennai floods 2015; 650 likes, 465 shares, 21 comments

The post was an article link which read "Chennai Fallen Hero". The article was about a brave young volunteer Bharath from Saidapet who lost his life during Chennai floods 2015. He was pulled away by the current of water and fell into a manhole during the rescue operation. The article link had his photograph where he smiled and showed the symbol of victory. It said India lost a brave young man. The article immersed a feeling of guilt for people who were not helping the victims and a great sense of responsibility. The comments and article endings read 'RIP'.

11 December 2015



Figure 11: Photograph of volunteers in action;
61 likes, 33 shares, 3 comments

This was a series of 15 photos of the compassionate volunteers of 'Bhoomika Trust' in sorting, packing and sending relief materials.

13 December 2015



Figure 12: Poster requesting to contribute to ration kits/cooking vessels for the victims; 14 likes

This post was a poster requesting to support the victims by contributing to ration kits/cooking vessels for family/combined ration and vessel kit. On a white and green background with a watermark of the victims behind it read the list and cost of ration kits/cooking vessels.

14 December 2015



Figure 13: Photograph of volunteers in action; 23 likes

This particular post is the attachment of a photograph of volunteers involved in segregating and packing of relief materials. It said "Every volunteer minute counts in making a difference". By doing so, 'Bhoomika Trust' gives importance to each of its volunteers in contributing their time and thus making a difference.

16 December 2015

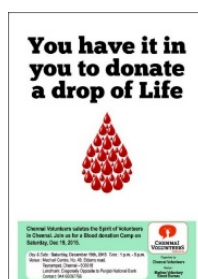


Figure 14: Poster on calling blood donors; 25 likes, 37 shares

This post is an attachment of a poster calling for blood donors to donate blood for children suffering from Thalassemia. 'Bhoomika Trust' mentioned that it wanted to make a big difference in the lives of many young ones. It also kindled the positivity by referring 'Chennai Volunteers' saluting the spirit of volunteers in Chennai.

18 December 2015

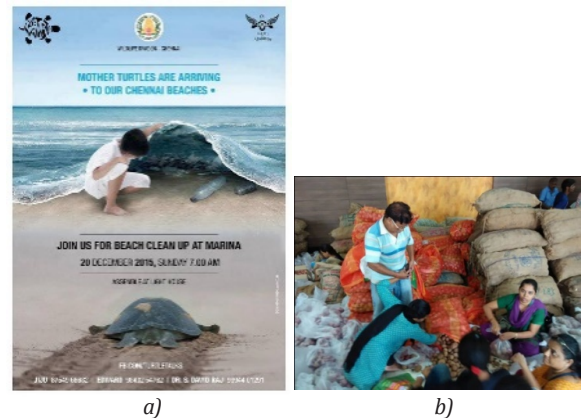


Figure 15: Poster on calling volunteers to clean 'Marina' (a), and photograph of volunteers in action (b); 39 likes, 103 shares

The post comprised snapshots of three posters and two photographs filled with positivity and action. It called for volunteers to work with Bhoomika Trust, giving the time, dates, venue and contact number. The poster was calling for volunteers to clean the 'Marina' beach and donors to donate blood. Another poster was a collage of volunteers involved in cleaning process in the areas affected by Chennai floods 2015. The photographs included packing of dry provisions and passing it over.

20 December 2015



Figure 16: Photograph of social work students being briefed by 'Bhoomika Trust'; 14 likes, 1 share, 1 comment

The post is a series of eight photographs of social work students who were being briefed by Bhoomika Trust before they left for a re-assessment of relief needs across 25+ areas in Chennai. These photographs

indicate that the volunteers were ready to roll up their sleeves for action with a van boarded with relief items despite the sunny day then. The effort taken by Bhoomika Trust was the post-flood relief offered to the victims. The post mentioned it as a rare snap having the volunteers (field heroes) and silent force of Bhoomika Trust (authorities in the photo) in the same lens. It also called for more volunteers to show that Chennai cares. The post mentioned that it looks forward to friends and families to assemble at the central hub at 'Sree Rama Kalyana Mandapam', Nungambakkam. The single comment was an enquiry by a member willing to join the volunteering team.

3.2 The survey

Apart from the textual analysis of the NGOs Facebook posts, a survey was conducted among 102 residents of Kotturpuram where information, real-time operational information, situational updates, emotional appeal, and trustworthiness were set as the indicators to know the reach of Facebook and WhatsApp during Chennai floods 2015.

The survey resulted that 94.7 % survey participants were not a member of any Facebook page, and 66.7 % were a member of some WhatsApp group during Chennai floods 2015.

With respect to information, it was WhatsApp that was used to send, receive and forward information about oneself to family and friends. It was also useful to record audio/video.

Real-time operational information results that the WhatsApp was used to know about weather forecasts, evacuation or road closures, public transports, power supply, water supply and to provide disaster response, recovery, and rehabilitation.

Situational updates had WhatsApp being useful to know about warnings and state of emergency declaration, locating flooded areas using crisis maps, requesting for rescue and relief efforts, contributing for rescue and relief efforts, knowing about personal safety, health and hygiene, knowing about working of schools, colleges and offices and useful to read on dos and don'ts during a disaster.

The survey found that it was again WhatsApp which fulfilled the emotional appeal. It was used to provide and receive disaster mental/behavioral health support, to express emotions, concerns, well-wishes, to thank volunteers, neighborhood's citizens, Government and also to express anger towards Government illegal constructions, and bureaucrats. In case of trustworthiness, survey resulted that both Facebook and WhatsApp mis-

led users. But at the same time, WhatsApp had proved to be a trustworthy medium which contributed to one's safety.

The reach of WhatsApp has been so successful among the residents of Kotturpuram with 41.2 % expressing the ease of use, other factors found are presented in Figure 17.

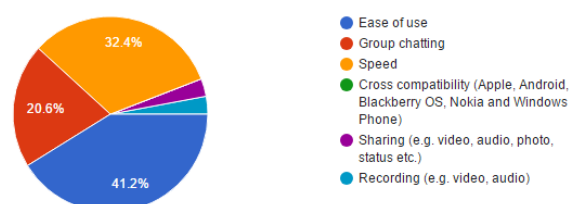


Figure 17: Representation of factors by which WhatsApp was successful among the residents of Kotturpuram during Chennai floods 2015

Thus WhatsApp has proved to be the best medium to have reached the residents of Kotturpuram during the Chennai floods 2015 with 70.6 % opting for WhatsApp.

3.3 Semi-structured interviews

To understand the organizations' point of view, six experts were interviewed to know about the usage of Facebook and WhatsApp during Chennai floods 2015. They were owners of organizations, editor of a reputed Tamil newspaper, a police officer and a senior volunteer.

Rinku Mecheri

Rinku Mecheri is a dynamic, optimistic, bold and hardworking woman who is the founder of 'Chennai Volunteers'. 'Chennai Volunteers' is a social initiative that aims to foster civic engagement and ensure that non-profits can engage with volunteers in a sustainable and meaningful way. The initiative, along with Mecheri Foundation, has partnered with over 70 NGOs providing service needs.

During Chennai floods 2015, 'Chennai Volunteers' was part of the volunteering activity run by 'Chennai Rain Relief' of Bhoomika Trust. Rinku Mecheri shared about the various contributions their team was involved in rescue and relief efforts. She said rescue, relief and rehabilitation are the three aspects considering Chennai floods 2015. In case of the rescue, 'Chennai Volunteers' helped only in coordination, as mentioned she did not have trained people. So, they set up call centers and informed corporation, boat service and other people on the need. For the relief, 'Chennai Volunteers' facilitated the materials that were passed on to them by the people for the victims. It included

some of the corporates, who as part of their Corporate Social Responsibility (CSR) gave away relief materials including Coke, water, Minute Maid juice, dry milk, oats, salt and sugar. Apart from that, she said 'Chennai Volunteers' along with 'Chennai Rain Relief' set up a large-scale kitchen with a huge space provided at Rama Kalyana Mandapam. It was the rehabilitation that was done partnering with many NGOs. She added that relief camp was set in 'Chennai Volunteers' office space too.

She emphasized that without their Facebook pages and WhatsApp groups any contribution would not have been possible. According to her, Facebook was an excellent medium to reach people for giving and receiving updates. 'Chennai Volunteers' gathered relief volunteers, donors, etc., during the deluge only through these platforms. It included short term and long term volunteers, celebrity volunteers like Suhasini Maniratnam (actress), T.M. Krishna (singer), Anil Srinivasan (pianist) and many more. #Chennai Rain Relief, #Bhoomika Trust and #Chennai Volunteers were the hashtags that were used to reiterate the messages. For her, WhatsApp was action oriented, personalized and an active response mechanism.

When asked about the how mainstream media had to take a back seat during the deluge, she said it was due to the time lap in broadcasting which made the social media stand out.

Lastly, she ended up saying that Chennai floods 2015 were because of climate change for which we were not been prepared mentally or physically then.

Aruna Subramaniam

Aruna Subramaniam is a founder of 'Bhoomika Trust'. 'Chennai Rain Relief' is an initiative of a group of dedicated individuals and organizations which includes 'Bhoomika Trust', 'Sri Arunodayam', 'Aid India', 'Udhavum Ullangal', 'Bhumi', 'Chennai Volunteers', 'CIOSA', and more. This group got together to reach out to those adversely affected by the heavy rainfall and flooding in Chennai, starting off by guiding people who needed help in terms of rescues, as well as providing cooked food and dry rations.

Aruna Subramaniam said that both Facebook and WhatsApp played a vital role during Chennai floods 2015. She recollected how 'Bhoomika Trust' along with many other NGOs set up a control station on which they were communicating with the Government for rescue and relief efforts. She said that it was only through Facebook and WhatsApp that the information of the stranded people were verified and send across. She exclaimed that the shares, comments and forwards of flood rescue and relief messages which were done

through 'Bhoomika Trust' Facebook page, her personal Facebook page and WhatsApp groups made a huge difference. It made many unknown people wanting to help the victims and almost a 10 000 volunteers to work for them which was phenomenal.

She wanted to mention about her important donor 'Christie's' who is an international auction house to hold annual sales, reinforcing longstanding commitment to the artistic and cultural heritage of a region. World's largest arts auction house, Christie's held its third consecutive contemporary India art sale in Mumbai on 15 December 2015, which for the first time had a dedicated section on classical art. During Chennai floods 2015, Christie's came to know about the disaster through their Facebook page and came forward to help them in auctioning around 1 000 000 (10 lakhs) for the cause. Aruna Subramaniam said that this was possible only because of social media.

When asked about the rehabilitation work they were up to, she said it included repainting of buildings, renovating schools, classrooms, school toilets, libraries and flooring. Apart from this they have released a booklet on how one should be prepared if there is a flood which is collaborative initiative of 'Bhoomika Trust' and 'Dinamalar' Tamil newspaper.

Lastly, she added "Chennai is the most disaster-prone in terms of climatic condition in the country because we are in the sea level. Every disaster provides an opportunity. So it is important to learn how not to encroach and how to unclog waterways. Anyway, it is going to take a decade to restore things which only government and NGOs like us can implement it".

Dr. Srimathy Kesan

Dr. Srimathy Kesan is the Director of Space Kidz India. She is a senior volunteer having her own group of volunteers to do volunteering services. They also have partnered with many NGOs.

During Chennai floods 2015, her community gathered relief volunteers and donors only through Facebook and WhatsApp. She said her donors included 'Big Basket', Illayaraja (film composer), Maria Zeena (Director, Sathyabama University), T.R. Rajagopalan (Senior Advocate), Aquafina, Nutrin, Parry and many more. She said her group also helped in evacuating water in MCN Higher Secondary School. She added unknown people willingly donated notebooks, milk powder, Horlicks sachets, etc., which happened only because of their WhatsApp group 'Chennai Version 2.0'. Their community was also involved in conducting a medical camp for the students of MCN Higher Secondary School, cleaning of classrooms in Kodambakkam Government

aided School and rescuing the boys of Juvenile Home at Kellys. Constant updating on her Facebook page also made many volunteers and also donors to help numerously. She was happy to share that one of their rehabilitation efforts included buying books and coaching a girl from Kotturpuram for her Civil Service examination which was cleared by her.

She ended up saying that the Chennai floods 2015 left them with a terrible scar as they lost their group member Bharath who fell into a manhole, pulled away by current of water during rescue operation.

Bharathi Tamizhan

Bharathi Tamizhan is the Online Editor of *The Hindu* (Tamil). He talked about the 'Chennai Rising', 'The Hindu volunteers', 'Go Green volunteers' initiatives by *The Hindu* (Tamil) and a group of volunteers to help the victims with rescue and relief efforts. He told a rescue and relief camp near Chepauk cricket stadium, at a place called Blue Gate was set up. There, three godowns were taken and covered with shamiana where nearly 400–500 relief volunteers worked like for a marriage function. Following this, owners of Ispahani Center Mall, Anna Salai also gave their new building to use it for a warehouse purpose during the Chennai floods 2015 for them.

He said, the Facebook page of *The Hindu* (Tamil) has created a lot of impact among users. During Chennai floods 2015, they listed the needs of the flood victims to their readers and users through the paper, online, website, Facebook page and requested them to contribute whatever they could. The amount of response they received was unimaginable. He said they managed to distribute Rs. 120 million (Rs. 12 crore) worth relief materials to the flood victims of over 200 000 (2 lakhs) families with the help of their volunteers.

Peter Van Getit

Hailing from Belgium, Peter Van Getit has made Chennai his home for the last 17 years. Founder of the 'Chennai Trekking Club', a 26 000 member non-profit

volunteer-based group which organizes outdoors, adventures, sports and environmental conservation activities throughout the year for people.

The 'Chennai Trekking Club', very spontaneously set up a relief effort camp during Chennai floods 2015 in a School in East Tambaram. They collected and distributed relief materials like dhoti, saree, rice, pulses, blankets, medicines which could suffice a family. He said they took pictures of the worst affected areas during Chennai floods 2015 and posted it via Facebook and WhatsApp. This went viral and made many volunteers to join for the cause. Hashtags #Chennai Rains and #Green Chennai were used constantly to update about rescue, relief and restoration in the city.

Lastly, he said that since the volunteers of 'Chennai Trekking Club' were good at adventurous sports activity like swimming in open water, they were able to swim and be part of rescue and relief efforts and reach to more difficult areas which were not accessible. So being an outdoor and sports group which had a lot of endurance and stamina pushed them to places probably the other average citizen might not have been.

4. Conclusion

An instant messaging app WhatsApp has redefined communication, especially during a natural disaster, making it possible to communicate a large number of people at a jiffy. It is only possible because of Internet which had become an essential network during the crisis. WhatsApp has made people chose it for communicating families and friends during a disaster.

Further, WhatsApp cannot be superseded by any medium for disaster management communication but can be enhanced to increase its capacity to prepare for, respond to, and recover from events that threaten people and infrastructure. Thus, the use of Facebook and WhatsApp made the citizens turn into activists and take control over the situation and bounce back to normalcy. The effect of the calamity can be still reduced with proper planning and usage of WhatsApp.

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TOPICALITIES

Edited by Markéta Držková

CONTENTS

News & more	137
Bookshelf	139
Events	145

News & more

Changes in ISO standards for graphic technology

For the third time, here is the autumn summary of changes in ISO standards prepared by ISO technical committee TC 130 Graphic technology since October 2016. While almost twenty standards are in early preparatory stages, three standards are in the stage of final draft: ISO/FDIS 20690 Graphic technology – Determination of the operating power consumption of digital printing devices, under a slightly changed name, ISO/FDIS 12636 Graphic technology – Blankets for offset printing, Edition 2, and ISO/FDIS 17972-4 Graphic technology – Colour data exchange format (CxF/X) – Part 4: Spot colour characterisation data (CxF/X-4), also in Edition 2.

The list of reviewed and confirmed standards includes ISO 2834-3:2008 Graphic technology – Laboratory preparation of test prints – Part 3: Screen printing inks, ISO 12040:1997 Graphic technology – Prints and printing inks – Assessment of light fastness using filtered xenon arc light (for the third time), ISO 12635:2008 Graphic technology – Plates for offset printing – Dimensions, ISO 12642-1:2011 Graphic technology – Input data for characterization of four-colour process printing – Part 1: Initial data set, ISO 12644:1996 Graphic technology – Determination of rheological properties of paste inks and vehicles by the falling rod viscometer (fourth time), ISO 12647-8:2012 Graphic technology – Process control for the production of half-tone colour separations, proof and production prints – Part 8: Validation print processes working directly from digital data, ISO 15930-1:2001 Graphic technology – Prepress digital data exchange – Use of PDF – Part 1: Complete exchange using CMYK data (PDF/X-1 and PDF/X-1a), and also ISO 16684-1:2012 Graphic technology – Extensible metadata platform (XMP) specification – Part 1: Data model, serialization and core properties.

ISO 2846-1:2017

Graphic technology – Colour and transparency of printing ink sets for four-colour printing

Part 1: Sheet-fed and heat-set web offset lithographic printing

The third edition published this August instead the 2006 version has been revised to replace the APCO II/II reference substrate by the new one, C2846.

ISO 12634:2017

Graphic technology – Determination of tack of paste inks and vehicles by a rotary tackmeter

For the second edition published this September, instrument specifications and test method settings of the 1996 version have been entirely revised.

ISO 12647-7:2016

Graphic technology – Process control for the production of halftone colour separations, proof and production prints

Part 7: Proofing processes working directly from digital data

The changes in the third edition from November 2016 address anomalies identified in the 2013 version by industry experts; also substrates,

H2020 Partner Search on the Participant Portal



The European Commission Research & Innovation Participant Portal now features a possibility to

find partners for a new project proposal among the participants in past EU projects. The search criteria include a keyword or a topic of a past call, involvement in a particular EU-funded programme, geographical criteria, organisation type, its name, and Participant Identification Code (PIC). It is then possible to contact the selected organisation through the portal (the EU account is needed to authenticate).

Direct 4D Printing

Considering the huge progress in the technology and innumerable applications of 3D printing, stepping into the 4D can be considered an inevitable next step, exploring the potential of transforming a structure of 3D-printed components by heat, light, humidity, or other treatment. Such added functionality significantly extends the range of components or products made by 3D printing. This is reflected in a gradually growing number of 4D printing research projects and publications in the past few years. One of recent advances has been presented by a research team led by Martin Dunn (Science Advances 3(4), E1602890, 2017), introducing a new approach that markedly simplifies the 4D printing process and increases its capabilities. The method comprises incorporating the mechanical programming post-processing step directly into the 3D printing process, which substantially saves printing time and materials used. The required high-resolution components can be designed by computer simulation, 3D printed, and then directly and rapidly transformed into new permanent configurations by heat.

AGFA after 150 years

Established in 1867 as a colour dye factory and a few years later registered as the 'Aktien-Gesellschaft für Anilin-Fabrikation', AGFA celebrates this year a century-and-a-half history with colour imaging. Present Agfa Graphics builds upon integration and optimisation of the plate, processor, ink and pressroom chemistries and workflow.



In March, a new Offset Technical Competence Center was opened in North America as a centralized resource showcasing innovations helping to reduce waste, eliminate chemicals, lower ink consumption, and save energy. The lab features Agfa Graphics integrated prepress and pressroom solutions to demonstrate various applications in commercial, packaging, newspaper and UV printing, presented by technical experts charged with product development, benchmarking, field testing and training.

Among the software solutions, Agfa Graphics in 2017 launched Asanti 3.0, workflow software for sign & display printers, as a single tool to manage all data and all devices in wide-format applications. It features automatic image quality analysis and improvement, convenient proofing support, smart image repetition possibilities, better support for tiling, a wizard for managing colours and shortening throughput time, new white printing options, overruling special spot colours, and more. Asanti 3.0 also allows for integration with third-party print equipment and management information systems, as well as with Agfa Graphics software like PrintSphere and StoreFront. The latter is a cloud-based web-to-print solution, now in version 4.0 offering e.g. responsive stores for easier access on mobile devices and advanced packaging algorithms for cost-effective shipping. Relying on industry standard formats, such as PDF and JDF, it is not compatible only with Apogee and Asanti workflow solutions, but also with other print production tools. Within Apogee Suite, WebApproval has been improved.

measurement specification and wording have been modified to reflect current practice. Moreover, approximately equivalent CIEDE2000 colour difference values and basic support for spot colour inks have been added.

ISO 13655:2017

Graphic technology – Spectral measurement and colorimetric computation for graphic arts images

The third edition of this important standard is available since July 2017 as a revision of the previous version from 2009. It clarifies the requirements of measurement mode M1, restricts the use of too wide bandpass and sampling intervals (5 nm are recommended for both), as well as the adjustment method of predicting the fluorescent reflectance factor to UV-activated substrates, and provides a more realistic set of spectral tolerances on the white backing materials.

ISO 16613-1:2017

Graphic technology – Variable content replacement

Part 1: Using PDF/X for variable content replacement (PDF/VCR-1)

The new standard published this August describes the use of PDF as a page template into which the variable content data is substituted in real time immediately ahead of the rendering and printing, allowing to keep security-related information only temporarily, among other practical features.

ISO 16762:2016

Graphic technology – Post-press – General requirements for transfer, handling and storage

Available since November 2016, this new standard covers the requirements on job information, incoming goods inspection, intermediate product, processing, operating and testing environments, inspection and measurement, packing, storage and transportation for various post-press processes.

ISO 17972-3:2017

Graphic technology – Colour data exchange format (CxF/X)

Part 3: Output target data (CxF/X-3)

This new standard for colour data exchange, published in September 2017, aims to support the use of CxF3 as a common format, extended beyond the ISO 12642 series targets – including those with non-CMYK input values.

ISO 19594:2017

Graphic technology – Test method for the determination of the binding strength for perfect-bound products – Page-pull test working upwards

The new standard for devices performing the page-pull test by pulling upwards is available since this February.

ISO 20654:2017

Graphic technology – Measurement and calculation of spot colour tone value

Published in August 2017, this new standard defines a method for the Spot Colour Tone Value (SCTV) calculation from measured reflectance factors or colorimetric values, producing approximately uniform visual tone spacing.

Bookshelf

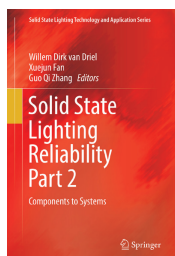
Solid State Lighting Reliability Part 2: Components to Systems

This book complements the first part, published in 2013, to provide a complete and up-to-date reference set for the reliability of solid-state lighting. This topic is also in part reflected in the third book published in the Solid State Lighting Technology and Application Series – Thermal Management for LED Applications from 2013. With digitisation and solid-state sources, i.e. semiconductor light-emitting diodes, organic light-emitting diodes and light-emitting polymers, massively spreading into general illumination applications, from indoor spaces, both private and public, to outdoor lighting, the importance of their reliability increases as well.

The first book has introduced the technology and quality of solid-state lighting, encompassing the reliability issues of the LED modules and other components, as well as of the luminaires or the system of luminaires. It covers failure mechanisms and analysis of failure modes, degradation mechanisms in LED packages, driver electronics reliability engineering, highly accelerated testing methods, solder joint reliability, interfacial delamination and the effect of microscopic surface roughness on polymer-metal adhesion, discussing also system reliability for solid-state lighting, prognostics and health management, fault tolerant control of large LED systems, LED retrofit lamps reliability, hierarchical reliability assessment models for novel LED-based recessed down lighting systems, design for reliability and colour consistency reliability of LED systems, and concluding with reliability considerations for advanced and integrated LED systems.

The second part reflects the progress witnessed during the last few years, with new processes, materials and components, revealing new or previously unknown failure modes, and the corresponding development of new standards and testing methods. With respect to graphic arts implications, especially the chapters on colour quality, LED-based luminaire colour shift acceleration and prediction, and chromaticity maintenance in LED devices are of a great interest. The book also explores chip-level degradation, LED early failures, reliability and lifetime assessment of optical materials, the influence of phosphor and binder chemistry on the aging characteristics, thermal characterization of die-attach material interface of high-power LEDs, reliability of phosphor-converted white led packages, degradation mechanisms of mid-power white-light LEDs, capacitor-less LED drivers, corrosion sensitivity of LED packages, lightning effects on LED-based luminaires, the employment of statistical analysis and numerical simulation, and other advances.

With the editorial and author team coming from both the academic sphere and industry, and building on current research findings and relevant industry data, these books provide a thorough insight into the topic.



Solid State Lighting Reliability Part 2: Components to Systems

Editors: Willem D. van Driel, Xuejun Fan, Guo Q. Zhang

Publisher: Springer

1st ed., July 2017

ISBN: 978-3-319-58174-3

606 pages, 401 images

Hardcover

Available also as an eBook



African Print Cultures: Newspapers and Their Publics in the Twentieth Century

*Editors: Derek R. Peterson,
Emma Hunter, Stephanie Newell*

Publisher: University
of Michigan Press
1st ed., September 2016
ISBN: 978-0472073177
460 pages, Hardcover
Also as an eBook

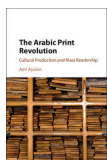


Published as the first volume in the African Perspectives series, this book features essays on the diversity, heterogeneity and significance of African newspaper publishing.

The Arabic Print Revolution: Cultural Production and Mass Readership

Author: Ami Ayalon

Publisher: Cambridge
University Press
1st ed., September 2016
ISBN: 978-1107149441
234 pages, 10 images
Hardcover

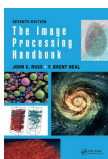


Building on earlier work by the author, this well-referenced study in a comprehensive manner analyses how the emerging print culture, with the growing public reception and distribution of print, has implied a significant change in the Middle East.

The Image Processing Handbook

Editors: John C. Russ, F. Brent Neal

Publisher: CRC Press
7th ed., November 2015
ISBN: 978-1498740265
1035 pages, 1175 images
Hardcover
Also as an eBook

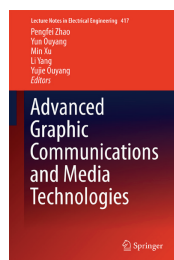


The 7th expanded and reworked edition of this established handbook features the sections on acquiring images, human vision, correcting imaging defects, spatial-domain image enhancement, frequency-space image processing,

Advanced Graphic Communications and Media Technologies

This collection of selected reviewed papers from the 2016 China Academic Conference on Printing, Packaging Engineering & Media Technology presents the recent research findings from the field, with a development supported by the stable growth of Chinese printing and packaging industry. Almost 150 contributions included in the book are organised into ten parts, covering both general and regional topics.

Color science and technology part deals e.g. with colour management algorithms, gamut modelling, spectral reconstruction, and regional culture preferences to LED light colour rendering. The parts on technology of image processing and digital media offer image quality assessment methods, algorithms for image denoising, night image enhancement, etc., and research on augmented reality, information publishing system, interactive courseware, presswork to eBook conversion method, respectively. The printing, packaging and mechanical engineering technology sections discuss a new reflectance model, electrostatic imaging quality, fidelity of inkjet dots, various effects of substrate choice, printed electronics applications, corrugated performance factors, barrier properties, feeding mechanisms, control and diagnostics systems, etc. The last four parts present studies on inks, papers, films and functional materials technology, such as corrosion protection of aluminium pigments, pigment wettability, various functional inks, ink optimisations, liquid imbibition models, advances in substrate coatings, and preparation and characterisation of special films and other materials.



Advanced Graphic Communications and Media Technologies

*Editors: Pengfei Zhao, Yun Ouyang,
Min Xu, Li Yang, Yujie Ouyang*

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Available also as an eBook

Bio-Inspired Computation and Applications in Image Processing

Presenting the approaches capable to solve many challenging issues and optimisation problems in image and signal processing with ever-increasing complexity, especially if should be done in real time, this book summarizes the latest developments in selected nature-inspired algorithms, especially those linked with deep learning, such as ant colony or particle swarm optimisation, bat or firefly algorithms, and cuckoo search. The theory of the key bio-inspired methods and techniques is complemented by real-world image processing applications and a discussion of future research trends.

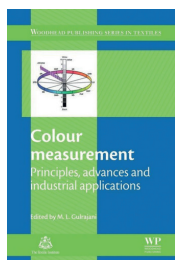
Bio-Inspired Computation and
Applications in Image Processing
Authors: Xin-She Yang, João P. Papa

Publisher: Academic Press
1st ed., August 2016
ISBN: 978-0-12-804536-7
374 pages
Hardcover
Available also as an eBook



Colour Measurement: Principles, Advances and Industrial Applications

This is another paperback edition of the book published by Woodhead Publishing a few years ago, see also the Bookshelf in 5(2016)4. The first part comprises an overview of theories, principles and methods of colour measurement. It goes through colour vision, scales and colour order systems used for communicating colour, numerical expression of colours, visual and instrumental evaluation of whiteness and yellowness, use of artificial neural networks and cameras in colour measurement, colour shade sorting, determining uncertainty and improving the accuracy of colour measurement, and colour-fastness assessment. The second part presents the applications of colour measurement in various industries, starting with textiles, including grading of cotton by colour measurement, over colour measurement of paint films and coatings, up to colorimetric evaluation of food, teeth and hair. Thus, the intended readership of this book written by the international team of authors with the academic or industrial background ranges from product developers and colour quality inspectors to designers on one side and dentists on the other.

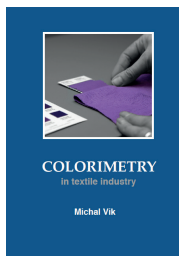


Colour Measurement:
Principles, Advances and Industrial Applications
Editor: M. L. Gulrajani
Publisher: Woodhead Publishing
1st ed., August 2016 (Hardcover August 2010)
ISBN: 978-0-08-101442-4
424 pages
Softcover
Available also as an eBook

Colorimetry in Textile Industry

This book has been written to merge the physics, physiology and psychology viewpoints on colour. It starts with the basic terms – light, blackbody radiation, colour, and colour vision. The second chapter deals with visual evaluation of colours, i.e. colour order systems and experimental visual colour assessment. The next two chapters present CIE colorimetry and colour difference measurement, including a discussion of uniform colour space and individual colour-difference formulae. The fifth chapter is dedicated to whiteness – to its visual evaluation and objective measurement, and yellowness index. The following chapter briefs shade sorting. Finally, the last chapter discusses applied colorimetry, going through visual assessment of colour difference, various aspects of measurement, including source of errors and uncertainty, colour tolerance specifications, metamerism and on-line measurement up to the final reminder. The book concludes with references and five appendices. The PDF version of the book is freely available to download.

Colorimetry in Textile Industry
Author: Michal Vik
Publisher: VUTS
1st ed., March 2017
ISBN: 978-80-87184-65-3
188 pages
Softcover



segmentation and thresholding, binary images processing, image and feature measurements, shape characterising, correlation, classification, identification and matching, 3D imaging, processing and measurement, and surfaces imaging. Its paperback edition is available since August 2017.

Advertising by Design: Generating and Designing Creative Ideas Across Media

Author: Robin Landa

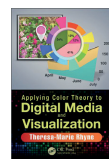


Publisher: Wiley
3rd ed., November 2016
ISBN: 978-1118971055
264 pages
Softcover
Also as an eBook

The new edition of this guide that is popular among both students and professionals has been updated to cover the current range of media channels used for advertising campaigns and branding, clearing up the new concepts and strategies for social and digital media. The keys to successful and effective advertising are communicated using case studies, interviews, essays and visual examples. The content is supported by a comprehensive index and a glossary of fundamental terms; a bibliography refers to the sources recommended for further reading.

Applying Color Theory to Digital Media and Visualization

Author: Theresa-Marie Rhyne



Publisher: CRC Press
1st ed., July 2017
ISBN: 978-1138413542
184 pages, 139 images
Hardcover
Also as an eBook

This concise resource written by a respected expert summarises colour theory concepts and shows how to efficiently deal with colour in a range of current applications. It features rich illustrations, many of which were created or adapted by the author.

Microwave Materials and Applications

*Editors: Mailadil T. Sebastian,
Rick Uhic, Heli Jantunen*

Publisher: Wiley
1st ed., May 2017
ISBN: 978-1119208525
927 pages
Hardcover
Also as an eBook

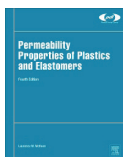


Microwave dielectrics comprise an important group of materials with a substantial potential in rapidly growing areas of wireless communication, flexible electronics, printed electronics, and other applications. This two-volume set first presents the factors influencing microwave dielectric properties, their measurement and modelling; then it describes various materials and their applications, such as perovskites, high-permittivity materials, millimetre-wave materials, glasses and bulk glass ceramics, as well as high-temperature, low-temperature, and ultralow-temperature cofired ceramics, continued by voltage tunable microwave dielectrics, dielectric inks and properties of printed layers, polymer-ceramic and rubber-ceramic composites.

Permeability Properties of Plastics and Elastomers

Author: Laurence W. McKeen

Publisher:
William Andrew
4th ed., October 2016
ISBN: 978-0323508599
374 pages, Hardcover
Also as an eBook

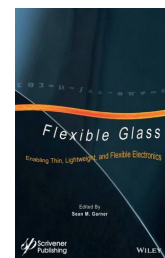


The 4th edition of this reference that serves in a broad range of industries reflects the changes on the market since the 2011 edition, covering the chemistry and permeation data of styrenic and polyester plastics, polyimides, polyamides, polyolefins, polyvinyls and acrylics, elastomers and rubbers, fluoropolymers, high-temperature/high-performance polymers, environmentally friendly polymers, and multilayered films.

Flexible Glass: Enabling Thin, Lightweight, and Flexible Electronics

This book recaps the advances in a development of flexible glass as a substrate and of the technologies utilising it to produce a functional component or device with the aim to foster the research on optimised materials and fabrication processes, manufacturing equipment, and new electronic and opto-electronic device designs enabled by the unique properties of flexible glass. The first part introduces flexible glass substrates, their mechanical reliability, and properties allowing for ultra-thin applications. The second part presents flexible glass device fabrication processes – roll-to-roll processing, thin-film deposition by plasma processes, and solution-based printing processes. This chapter includes flexography, gravure printing, screen printing, and emerging printing techniques, namely the reverse offset and gravure offset processes developed to meet the requirements on high resolution, among conventional printing processes, and inkjet as the digital one, with the printed organic photovoltaic cell on ultra-thin flexible glass as an example printed electronics application. Finally, the third part reviews current flexible glass device applications – flexible glass in thin film photovoltaics, ultra-thin glass for displays, lighting and touch sensors, guided-wave photonics in flexible glass, and flexible glass for microelectronics integration.

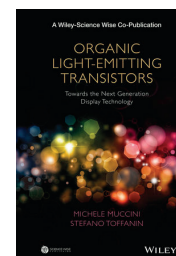
Flexible Glass:
Enabling Thin, Lightweight, and Flexible Electronics
Editor: Sean M. Garner
Publisher: Wiley-Scrivener
1st ed., August 2017
ISBN: 978-1-118-94636-7
378 pages
Hardcover
Available also as an eBook



Organic Light-Emitting Transistors: Towards the Next Generation Display Technology

The authors first introduce the structure and functionality of organic light-emitting diodes and then compare their architecture and characteristics with those of organic light-emitting transistors, which are in focus of this book, highlighting the fundamental differences in the working principle and key technological features of both groups of devices. The remaining chapters detail design and optoelectronic characteristics of the main types of organic light-emitting transistors, properties of corresponding dielectric layers, emissive ambipolar semiconductors and charge-injecting electrodes, charge-transport and excitonic processes employed, resulting photonic properties, such as quantum efficiency, brightness and emission directionality, and organic light-emitting transistors applications and challenges.

Organic Light-Emitting Transistors:
Towards the Next Generation Display Technology
Authors: Michele Muccini, Stefano Toffanin
Publisher: Wiley
1st ed., April 2016
ISBN: 978-1-118-10007-3
288 pages
Hardcover
Available also as an eBook



Bookshelf

Academic dissertations

Rewritable Films on Flexible Substrates

This thesis was dedicated to the further development of the laser marking technology that utilises thin photosensitive Ag:TiO₂ films coated on glass for a production of either rewritable or permanent patterns. The aim was to adapt it for potential large-scale production on non-rigid substrates, namely the polyethylene terephthalate plastic foil and the special paper intended for printed electronics, and thus to enable its use e.g. for security labels. With respect to thermal properties of both types of flexible substrates considered, the required mesoporous film must be prepared without a calcination step. During the research, two principal solutions were explored; the one based on the modified sol-gel process and the new one employing the formulation of an aqueous inkjet ink. The characterisation then comprised the testing of the photochromic behaviour under UV radiation and visible light exposures and the determination of other relevant properties, including the long-term stability of prepared films and resulting patterned samples, with a discussion of differences in structure and performance.

After the introduction, the dissertation first presents the chosen approach, materials and methods, and then describes the individual steps in detail, along with the results and their analysis. For the sol-gel route, the studied options involved preparation of a mesoporous TiO₂ film with its subsequent impregnation by silver or with a direct incorporation of silver into sol used for film production. Three deposition techniques (spin coating, inkjet printing and flexography) are compared and optimised, as well as appropriate post-deposition treatments. For the procedure utilising inkjet ink, its composition and proper dispersion of TiO₂ nanoparticles in aqueous suspension were important. The optimisation of ink formulation and printing process is also discussed, together with relevant measured characteristics. The studies of optical properties of Ag:TiO₂ films produced on both substrates have shown their reversible colouring and bleaching; in case of sol-gel films on plastic foil, also permanently coloured patterns were achieved.

Doctoral thesis – Summary

Author:

Fanny Tricot

Speciality field:

Materials for Optics-Photonics

Supervisors:

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Francis Vocanson

Didier Chaussy

Defended:

3 February 2016, Laboratoire Hubert Curien, Université Jean Monnet de Saint Etienne & LGP2, Grenoble INP Saint-Étienne, France

Language:

French

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Reliability Studies on Printed Conductors on Flexible Substrates under Cyclic Bending

The focus of this thesis was solely on the bending reliability of conductors printed on flexible substrates, with the presumption that it can be affected by design choices. Therefore, the effects of line cross-sectional geometry, substrate properties, conductive material composition, printing methods, bending direction and bending radius on the long-term electrical performance of printed traces were studied. Each of the selected design parameters was varied by at least three values to distinguish its significance. The width of lines ranged from 125 to 2 000 µm and their thickness from 12 to 36 µm, with the latter modified by printing from one to three layers. The total length of the test sample was between 65 and 161 mm. Similarly to the selected aspects, the choice of materials and methods is clearly explained. The materials used in the study included three plastic films and three paper sheets with different thickness and other characteristics as a substrate and three silver pastes differing in conductivity as a printing ink,

Doctoral thesis – Summary

Author:

Tuomas Happonen

Speciality field:

Measuring Technology

Supervisor:

Juha Häkkinen

Defended:

13 June 2016, University of Oulu Oulu, Finland

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all commercially available and commonly used. The two fabrication methods consisted of screen printing as a sheet-based semiautomatic process and as a roll-to-roll fully automated process. Statistics was employed in data processing to increase the validity of the results, where the lifetime of each test population (10 samples) was assessed by the Weibull analysis. The concise and systematic approach is reflected also in the dissertation structure, with chapters going from the introduction over the theoretical background and experimental details to the overview and analysis of results, their discussion and overall summary. In accordance with the objective of the thesis, the presented results and conclusions can be exploited to achieve more reliable printed electronics structures. Each studied design parameter influenced the characteristic lifetime of a test population. The lifetime increased with decreasing the line width, the number of printed layers, the substrate thickness. Further, the paste with the smallest volume fraction of conductive silver particles and sheet-fed printing process improved the reliability. From the application point of view, compression is more favourable than tension and the lifetime considerably increased with larger bending radius. The highest reduction of strain was achieved by decreasing the substrate thickness, making it the most significant one from the studied variables.

Doctoral thesis – Summary

Author:

Enrico Sowade

Speciality field:

Functional Inkjet Printing

Supervisors:

*Reinhard R. Baumann
Senentxu Lanceros-Méndez*

Defended:

*9 June 2017, TU Chemnitz,
Mechanical Engineering, Institute
for Print and Media Technology,
Department of Digital Printing
and Imaging Technology
Chemnitz, Germany*

Contact:

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Inkjet Printing of Photonic Structures and Thin-Film Transistors Based on Evaporation-Driven Material Transportation and Self-Assembly

This dissertation embraces the research progress achieved in the area of functional inkjet printing of colloidal suspensions benefiting from the evaporation-driven self-assembly. After providing the necessary fundamentals and specifying the experimental materials and methods, it starts with the studies of the evaporation-driven self-assembly of nanospheres in inkjet-printed droplets on non-absorbent substrates and the influence of surface energy. That enabled to develop highly ordered structures with photonic properties by means of inkjet printing of both organic and inorganic nanospheres, demonstrating inkjet printing as a micro- and nano-engineering technology capable to produce desired droplet deposit morphologies. The next part deals with the inkjet printing of spherical colloidal assemblies, exploring how is the morphology of printed deposits affected by the waveform and how the spherical colloidal assemblies are developed. Advancing the layer formation process from the substrate to the ejected droplet in-flight makes it independent on substrate wettability and surface morphology. Using this method, finite, ordered spherical colloidal assemblies of both SiO₂ and polystyrene nanospheres were reproducibly manufactured with variable diameters. The attention is paid also to the optimisation of employed processes and parameters, including prepress issues, ink formulation and orientation angle of the print layout, which was found to influence resulting geometry as well as function. In addition, the coffee-ring effect is exploited to reduce the dielectric layer in the center area of the deposit and thus achieve thin and smooth dielectric layers applied in thin-film transistor. Finally, the dissertation describes the development of a process chain for the manufacturing of all-inkjet-printed thin-film transistors on flexible polymer substrates and up-scaling of the developed manufacturing workflow towards transistor arrays produced by industrial inkjet printheads. In this way, thousands of thin-film transistors on flexible polymer films were manufactured in common ambient conditions. For small transistor sizes and optimised transistor design, manufacturing yields exceeded 90 %. Throughout the dissertation, the findings are supported by in-depth characterisation and analysis, including an overview of failures detected in inkjet-printed layers of the all-inkjet-printed thin-film transistors.

Events

Printing Future Days 2017

Chemnitz, Germany
4–6 October 2017

PRINTING FUTURE DAYS 2017 The International Scientific Conference on Print and Media Technology for junior scientists and PhD students is for the seventh time organized and hosted by the Institute for Print and Media Technology, Department of Digital Printing and Imaging Technology, Technische Universität Chemnitz, Germany. This year again under the auspices of iarigai, awarding the winner of the Best Paper of the Conference election the free admittance to next year's iarigai Conference in Warsaw. The 2017 programme covers the functional printing, applications, graphic printing and media, roll-to-roll, digital fabrication, and smart textiles and wearable electronics topics in ten oral sessions overall. Each of them includes also a keynote presentation given by senior scientist or industry representative, the latter one being Bernhard Buck dealing with 'Challenges and solutions for the digital printing on three-dimensional objects' and Vahid Akhavan speaking about 'Manufacturing of wearable printed electronics'. The oral sessions are complemented by the Interactive poster session, scheduled on the second conference day.

PrintIstanbul2017 2nd International Printing Technologies Symposium

Istanbul, Turkey
11–13 October 2017



This biennial symposium is hosted and organised by the Marmara University, School of Applied Sciences, Department of Printing Technologies, with the objective to follow the significant changes in printing and print media technology, important for the commercial sector and challenging for the education and research institutions, no matter whether the development is directed towards highly innovative new technologies and products or driven by the need to increase the sustainability and environmental friendliness of the existing ones.

In its second year, the symposium offers ten invited talks – 'Advancing flexography' by Tim C. Claypole, 'Paper industry in Turkey and the world' by Arif Karademir, discussing also waste paper and its relationship with print and ink, 'Trends of developing me-commerce web-to-print' by Yung-Cheng Hsieh, examining the e-commerce focused on individual print consumers, the three presentations from global industry suppliers, and the talks in Turkish, mainly given by the representatives of industry associations and dealing with current issues faced by printing and packaging companies in Turkey. Similarly, the poster and oral presentations also cover a wide range of topics, from printability and relevant physical properties of various special composite materials, over influences on colour gamut in heatset printing, to effects of Industry 4.0 on digital printing industry, and more.

Fall Conference 2017

St. Louis, Missouri, USA
9–11 October 2017



The Fall Conference of FTA (Flexographic Technical Association) in 2017 celebrates 20th anniversary of the Flexographic Image Reproduction Specifications & Tolerances (FIRST) and presents the new edition – FIRST 6.0. The second focal point is the project combining flexography and digital printing, showcasing the solutions for process calibration, fingerprinting and characterisation, production process control, and results analysis developed by this year's Technical Innovation Award Winners.

The 2017 SGIA Expo

New Orleans, Louisiana, USA
10–12 October 2017



Besides the printing trade exhibition, over 40 expert sessions and various networking events, the 2017 SGIA Printed Electronics Symposium is organised on Tuesday. In addition, two workshops are offered the day before – on steps to business success and on wide-format inkjet printing.

OSHA Compliance for Printing Workshop

Warrendale, Pennsylvania, USA
11–12 October 2017



Printing Industries of America now provides an opportunity to learn about occupational safety, health and environmental issues, such as injury reporting, hazard communication, machine guarding, and electrical safety, as well as to understand the respective regulations.

ICGIP 2017 9th International Conference on Graphic and Image Processing

Qingdao, China
14–16 October 2017



In 2017, the conference is supported by the Ocean University of China and features eight keynote speakers, coming from all over the world. The keynotes include '3D image analysis for virtual reality and digital storytelling' by Peter Eisert, examination of complexity and simplicity of images or patterns by Godfried T. Toussaint, 'Proper use of colour schemes for image data visualization' by Vít Voženílek, discussion on intelligent pattern recognition, big data and applications by Patrick Wang, and more.

IPEX 2017

Birmingham, UK
31 October to 3 November 2017

The 2017 edition of the IPEX, the print industry's event with a very long history, claims to focus on



Print in Action, with new speakers and contributors taking part in panel discussions, interactive sessions, keynote sessions on technology and trends with the IPEX 2017 conference programme, complemented by the Future Skills Seminars on changing workflow to keep pace with requirements on new content, including the utilisation of mobile devices and online publishing, combining social media and print marketing, increasing print experience understanding using brain scanning and eye tracking, recommendations for family-run or owned businesses, recruitment trends, apprenticeships and students engaging, introduction to the circular economy, building a sustainable future for the print industry, as well as printed electronics for smart packaging and other applications.

ESMA events



Besides the three conferences detailed below, the autumn series of events organised by ESMA, the European Association of Specialist Printing Manufacturers, offers also the training prepared in cooperation with Fraunhofer IPA and Hochschule der Medien, taking place from 6 to 9 November 2017 in Stuttgart, Germany. As suggest the name – ESMA Akademie: Industrieller Digitaldruck – the workshop is intended for German-speaking representatives of companies that plan or just started to implement the piezo inkjet technology.

TheIJC 2017 4th Annual Inkjet Conference



TheIJC.com Dusseldorf, Germany
24–25 October 2017

This growing event, each year attracting new companies, provides an opportunity to learn and discuss about various aspects of inkjet engineering and chemistry, as well as the business context of inkjet applications. The two-day programme newly features three tracks. Each day starts with a plenary session, with continuous inkjet, bulk piezo ceramics in industrial inkjet printhead, nozzle architecture design, thermal inkjet, special treatment using functional materials, recirculation inkjet printhead, and the new printing modes as the topics. The day before the main event, three afternoon workshops can be attended for free – the first one introducing to the basics of inkjet, including practical demonstrations, the second one discussing the means of innovation, and the third one focused on current bottlenecks of digital textile printing. In addition, the new ESMA Expert Café opens to provide a platform for questions and discussions.

Direct Container Print

Dusseldorf, Germany
27–28 November 2017



Reflecting the packaging market growth and need for high print quality, this conference was inaugurated in 2015 to present the potential of direct to shape printing for various market applications to printers, packaging manufacturers and brand owners. The 2nd edition combines lectures outlining the opportunities and foreseen development in near future with presentations of producers and suppliers, introducing the relevant technology – printing machines, inks, UV sources, colour management solutions, etc., complemented by a panel discussion and a tabletop exhibition.

GlassPrint



GLASSPrint2017 Dusseldorf, Germany
29–30 November 2017

The 7th GlassPrint conference is organised jointly with Chameleon Business Media, immediately following the Direct Container Print conference and having the same format with technical presentations, keynotes on major trends, a panel discussion and a tabletop exhibition, all dedicated to glass decoration. The topics include the compliance to health and safety regulations, new research outcomes, decoration of architectural glass, and more.

Printing for Fabrication 2017 Materials, Applications, and Processes – the 33rd International Conference on Digital Printing Technologies (NIP)



Denver, Colorado, USA
5–9 November 2017

This already well-established conference continues to demonstrate the existing achievements of printing in three dimensions, as well as to set the opportunities to shape its future development. Throughout the programme, numerous technology networking events are scheduled, including the ones on security printing, intellectual property, and 3D printing and pharmaceuticals. The first of the five conference days is reserved for eighteen short courses. For 2017, the new ones cover intelligent packaging, formulation of water-based inkjet ink, namely stabilising pigments and dyes with dispersants, 2D and 3D printing as additive manufacturing tools, industrial inkjet, and advanced materials for printed electronics. In addition, the short course introducing to 3D printing of metals can be attended on Tuesday.

The technical programme opens the keynote of Masahiko Fujii, presenting 'Evolution theory of ink jet technologies – progress by component or architectural knowledge', followed by Jason Rolland's keynote 'From prototyping to production: rethinking materials for additive manufacturing'. Tuesday keynote of Ghassan Jabbour deals with 'Reactive inkjet printing in nanoparticle manufacturing and device applications', Wednesday one by Takashi Fukue with 'Attractive and innovative solutions for highly qualified 3D printing process development in next generation', and finally the Thursday one by Shlomo Magdassi reviews the state-of-the-art 'From Gutenberg Bible to 4D printing'. Technical contributions are divided to sessions on inks, toners, and substrates, workflow for digital printing, security printing, printed electronics, ink jet processes, 3D and additive printing, industrial digital printing, and special topics, comprising lectures on 'Design and application of a 3D printing digital workflow', '3D fakes: chemical fingerprinting in additive manufacturing, from pharmaceuticals to engines', and 'Towards printing of medicine in 2D and 3D'. All that is again complemented by interactive paper sessions, demonstrations and other social events.

WCPC Annual Technical Conference 2017



Swansea, UK
6–7 November 2017

The 13th Annual Technical Conference of WCPC (Welsh Centre for Printing and Coating) features the keynote on flexography for packaging by Giuseppe Tripaldi, discussing technological advances and packaging markets specific in terms of safety and environmental regulations, as well as public perception. Among invited speakers, the lecture of Patrick Gane stresses the importance of pore network structure and surface design for printed functionality, the talk of Martin Krebs is focused on possible electrochemical systems for rechargeable printed batteries, and Paul Meredith named his presentation 'Scaling physics of printable thin film solar cells & large area optoelectronics', exploring how the limitations of scaling physics can potentially be overcome. Traditionally, the two-day agenda is mainly filled with presentations on a wide range of research topics studied at WCPC, from underlying principles over materials and technologies to particular devices.

Active & Intelligent Packaging World Congress and Hackathon 2017

Amsterdam, Netherlands
2–3 November 2017



As this event presents the advanced technology and trends in packaging, its programme, running in four tracks, naturally reflects also current developments related to print. The audience can learn about printed and hybrid manufacturing for intelligent packaging applications, with printed electronics listed among key drivers for new generation of anti-counterfeit or brand protection solutions for smart packaging, together with digital printing accelerating value creation, and about packaging specifics of the Internet of Things, implementing both silicon and printed electronics, and the role of the customer.

ERA Packaging & Decorative Conference

Barcelona, Spain
7–8 November 2017



Besides advances and developments in technology and markets for packaging and decorative gravure printing, the 2017 conference focuses also on digital printing as a complementary technology. Presentation of the European Packaging and Decorative Gravure Award 2017 is scheduled on Tuesday.

SEMICON Europa

Munich, Germany
14–17 November 2017

SEMICON EUROPA This large event for semiconductor manufacturing joins 2017FLEX Europe and conferences on advanced chip packaging, materials, power electronics, and much more.

Print Media Conference

Naples, Florida
14–17 November 2017

The main programme of this event sponsored by the Gravure Association of the Americas starts on Wednesday, going through print supply chain optimisation, media opportunities at the museum, uncertain times coming, lessons in leading, print in multi-channel communications, Golden Cylinder awards ceremony, debate on the current challenges, end-user communications forum, postal governance, and the annual outlook for gravure publishing papers.



Digital Print Japan

Tokyo, Japan
5 December 2017

This one-day event starts with a review of trends and technology in packaging, commercial and industrial inkjet at the IT Strategies Executive Conference, followed by the IMI Europe Inkjet Technology Showcase.



High Security Printing Asia

Melbourne, Australia
4–6 December 2017

At the Australian edition of this event, five pre-conference seminars are scheduled in two tracks, dealing with a complex process of developing a new series of banknotes from concept to circulation, currency features and their simulations as evaluated by unattended payment systems, banknote storage, processing and distribution arrangements (this seminar open to central banks only), a practical overview of the various methods used for altering, tampering with and counterfeiting identity documents, and a proper use of the biometric passport. The next two days are reserved for presentations, followed by the post-conference tours.



ICDAR2017

14th IAPR International Conference on Document Analysis and Recognition

Kyoto, Japan
9–15 November 2017



Sponsored by the International Association for Pattern Recognition (IAPR), this biennial event in 2017 consists of four-day workshop and tutorial programme and three conference days, each starting with a keynote speech. The first one by Rangachar Kasturi reviews a historical perspective and recent advances of graphics recognition. In the second one, Andreas Dengel is about to discuss the significance of the document analysis and recognition community in developing the indicators capable to respond to an increasing demand for multidimensional and qualitative methods to evaluate a scientific work, such as citation polarity or authority of an author, that would overperform the traditional quantitative approaches. On the final day, the keynote of Xiang Bai brings a new look on deep neural networks for scene text reading. The oral sessions on character, graphics and both offline and online handwriting recognition, document image processing, spotting and information retrieval, segmentation and layout analysis, scene text understanding, historic document image analysis, and font, writer and style classification then split in two tracks, on the first two days followed by reports of competitions, objectively comparing the quality of algorithms, and poster sessions, while the final day concludes by the Future Workshop outcome presentation and discussion at the panel.

European Paper Week

Brussels, Belgium
28–30 November 2017



The Confederation of European Paper Industries (CEPI), celebrating its 25th anniversary, is the main organiser of the European Paper Week events that are open to the public, including a special 'Five senses exhibition' to touch, feel, smell, see, and hear paper. In addition, members-only meetings are held by all participating associations. The open sessions offer the presentations of eight finalists of the Blue Sky Young Researchers Europe award, analysis of the World Energy Outlook 2017 report, the pulp and paper market projections, discussion of opportunities for further development, the evaluation of the global forest products industry's performance, and defining conditions for forest supply chain digitalisation. Students are welcome for free.

Digital Print for Packaging Europe

Berlin, Germany
5–7 December 2017



The theme of this year is 'Getting closer to the consumer', defining the main focus of presentations – how to use digital print to provide products that consumers value and want to buy, supported by real-life case studies. The workshop on adoption of digital print into packaging can be attended on the first day.

Call for papers

The Journal of Print and Media Technology Research is a peer-reviewed periodical, published quarterly by **iarigai**, the International Association of Research Organizations for the Information, Media and Graphic Arts Industries.

JPMTR is listed in Emerging Sources Citation Index, Index Copernicus International, PiraBase (by Smithers Pira), Paperbase (by Innventia and Centre Technique du Papier), NSD – Norwegian Register for Scientific Journals, Series and Publishers, and ARRS – Slovenian Research Agency, List of Scientific Journals.

Authors are invited to prepare and submit complete, previously unpublished and original works, which are not under review in any other journals and/or conferences.

The journal will consider for publication papers on fundamental and applied aspects of at least, but not limited to, the following topics:



Printing technology and related processes

Conventional and special printing; Packaging; Fuel cells, batteries, sensors and other printed functionality; Printing on biomaterials; Textile and fabric printing; Printed decorations; 3D printing; Material science; Process control



Premedia technology and processes

Colour reproduction and colour management; Image and reproduction quality; Image carriers (physical and virtual); Workflow and management



Emerging media and future trends

Media industry developments; Developing media communications value systems; Online and mobile media development; Cross-media publishing



Social impact

Environmental issues and sustainability; Consumer perception and media use; Social trends and their impact on media

Submissions for the journal are accepted at any time. If meeting the general criteria and ethic standards of scientific publishing, they will be rapidly forwarded to peer-review by experts of relevant scientific competence, carefully evaluated, selected and edited. Once accepted and edited, the papers will be published as soon as possible.

There is no entry or publishing fee for authors. Authors of accepted contributions will be asked to sign a copyright transfer agreement.

Authors are asked to strictly follow the guidelines for preparation of a paper (see the abbreviated version on inside back cover of the journal).

Complete guidelines can be downloaded from: <http://www.iarigai.org/publications/>

Papers not complying with the guidelines will be returned to authors for revision.

Submissions and queries should be directed to: journal@iarigai.org



Vol. 6, 2017

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