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A mission statement

To meet the need for a high quality scientific publishing platform in its field, the International Association of Research Organizations for the Information, Media and Graphic Arts Industries is publishing a quarterly peer-reviewed research journal.

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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- Packaging
- Fuel cells and other printed functionality
- Printing on biomaterials
- Textile and fabric printing
- Printed decorations
- Materials 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

- Media in a sustainable society
- Environmental issues and sustainability
- Consumer perception and media use
- Social trends and their impact on media

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Submissions are invited at any time and, if meeting the criteria for publication, will be rapidly submitted to peer-review and carefully evaluated, selected and edited. Once accepted and edited, the papers will be published as soon as possible.

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Contents

A letter from the Editor

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In the second issue of the Journal in 2018, the interdisciplinarity of the field, which is covered by the papers accepted for publication, is again evident. The first paper presents a study of the use of Fast Fourier Transform method of acquiring sharpen images, in this case in the post-press process operations. Using this method, where only a simple digital camera is needed as hardware, and image analysis of the sharp image of the prints is used, it is possible to recognize the shape and the position of the print elements, which increases the reliability and performance and reduces the possibility of errors in the manufacturing process.

The second paper presents an overview of the relatively extensive research on the use of font optimization that reduces the use of printing ink, mainly in the office communication. A part of the research is based on previous publications by other authors. The identified deficiencies in the basic method of evaluation of legibility or the likeness of the text is adequately improved, which adds value to the published paper.

The third paper is from the field of electronic media. This time a discourse analysis is made of a television campaign in the Tamil language, to raise awareness and take action against the spread of HIV/AIDS.

Associate Editor Markéta Držková (marketa.drzkova@jpmtr.org) again reviewed and edited the news in the field. The updated content and subject area of Paperbase brings well-organized overview of publications from the field, which is also partly covered by the Journal. The possibilities of cooperation and access to resources and information provided by Mendeley are also introduced. The Intergraf economic report is a relatively optimistic overview of the economic and market situation in the graphic industry. Interesting here is the choice of terminology, because in the title of the report the term “graphic industry” is used, unlike the previously more usual “printing industry” or “graphic arts”. The selection of newly issued books is mainly oriented in the field of inkjet, laser and functional printing, color science, inks and pigments, typography and publishing.

Among the doctoral theses, an overview of the work of Jian Chen in the field of mechanical behavior of the paper, defended at the Technical University of Darmstadt, is presented. Further, at the Linköping University, Paula Žitinski Elías obtained a Ph.D. on the up-to-date subject of image quality and multi-channel printing. Towards history oriented Rosie Shute, who studied spelling variations and printed texts of William Caxton, the first English printer, to obtain her Ph.D. at the University of Sheffield.

The Topicalities conclude with a review and presentation of international conferences, workshops, and other events from all over the world, which enable us to obtain information, knowledge and exchange of experiences in the entire field, that we consider as our research area.

The next issue of the Journal will be released in September, just before the International Conference of iarigai. This year it is organized by the Department of Printing Technology of the Warsaw University of Technology, simultaneously with the Conference of the International Circle of Educational Institutes for Graphic Arts Technology and Management (IC). The participation of iarigai and IC, two important international organizations, at the joint conferences in Warsaw is a good opportunity to deepen the cooperation between both organizations and their members in research and publication of the results both at conferences and in the Journal.

Ljubljana, June 2018

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Robust Fourier-based focusing method for post-press inspection

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Abstract

Post-print optical inspection of printed sheets becomes more and more substantial in job printing in order to reduce both errors and setup time in the cutting process. This paper provides a new method for on-sensor based focusing for cameras using a two-dimensional FFT (Fast Fourier Transform). Deriving from contrast based focusing and two-dimensional FFT an approach is shown which uses the amplitude spectrum provided by FFT. Emphasizing high frequencies and therefore masking the power spectrum results in a method which presents sufficiently accurate focusing on stacks of paper sheets. A variety of tests have been performed to verify the method provided in this paper. Four different types of paper were tested using four different test charts in order to cover a broad span of print layouts found in job printing.

Keywords: power spectrum, two dimensional Fast Fourier Transform, job printing, inline inspection

1. Introduction and background

1.1 Optical inspection in post processing

With the aim to increase efficiency in the printing process, post processing comes into focus as the level of automation is low compared to pre-press and press. Cutting represents a bottleneck in the printing process as succeeding processes such as hemming, gathering and binding rely on the results. As the size of printed sheets in job printing increases to include more jobs on a single printing plate and therefore reduce cost and setup time, minimizing errors during the cutting process becomes even more crucial. Even though job data is available, disruptive factors of the printing process influence the printed sheets resulting in deformation thus the job data does not match the physical data anymore. Consequently, quality inspection is a main target of manufacturers of cutting systems.

The cutting process allows stacks of sheets of various dimensions to run through the process. The maximum dimensions are given by the size of the machine table of the cutting machine, while the minimum sliceable dimensions are usually smaller than 10 cm. While the change of width and depth between jobs means that the measuring range of an inspection system has to be adaptable, the change of the height of the paper stack means that the inspection system has to adjust its focus for every job. In this respect, the inspection task differs from most tasks seen in inline inspection systems where objects and distances usually stay the same as shown for example in Pawlowski (2011).

In this paper we provide a method for focusing with an industrial standard 5 MP area scan camera with no built-in focusing functions by adjusting the distance between the surface of a stack of sheets and the camera using the power spectrum of a two-dimensional Fast Fourier Transform (FFT). The method is tested on different types of paper with different printed test patterns. To optimize the significance of the method and reduce calculation time the frequency range is adjusted.

1.2 On-sensor focusing methods

In order to focus on a subject just by using data from the imaging sensor, a difference in brightness is needed as the imaging sensor only detects brightness. Figure 1 shows the two borderlines. On the left side, a blurred digitalized edge resulting in a brightness gradient

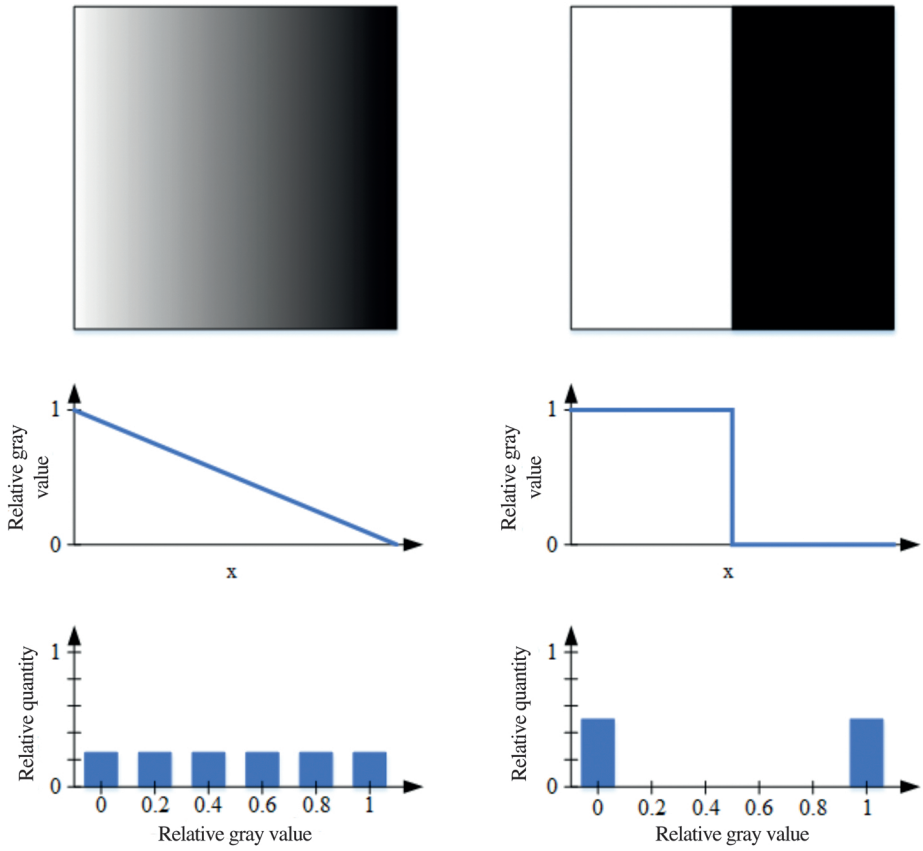

Figure 1: Blurred and sharp edges (left and right, respectively) and their corresponding brightness distribution

is shown with uniformly distributed gray values. On the right side the same edge is digitalized with maximum sharpness. The difference in gray values at the edge and thereby the contrast is at the maximum what allows the assumption that the image is focused.

As seen in Figure 1, the sharpest image is associated with maximum gap in gray values histogram. Evaluation of the gap of an image histogram performs well for simple printing jobs, where the amount of different gray values is at a minimum. However, evaluation gets complicated for an unknown distribution of gray values where the histogram tends to be more uniform. Without a priori knowledge of the printed motive another method is required for focusing a camera on the large variety of printing products.

In order to improve accuracy and robustness, a focusing method based on FFT is provided. Low-pass filters reduce contrast on edges by adapting gray values of pixels according to their neighborhood. As a result, the image gets blurred (Chaudhuri and Rajagopalan, 1999; Utcke and Burkhardt, 1999; Vision & Control, 2007). By implication this means that high frequencies occur most if the image is focused at its best. A popular method in image processing therefore is the two-dimensional FFT (Burger and Burge, 2005).

1.3 Aim of research

The aim of this research is to provide a robust method, which allows adjusting the focus plane independent of the print layout on the sheets by varying the distance between camera and surface of the stack of sheets, when only data from the imaging sensor is available and no further sensor should be used. First, we introduce the method in section 2.1 before the test rig and the test charts which are used are presented in section 2.2. After discussing the results of our research in section 3, we conclude and provide an outlook in section 4.

2. Materials and methods

2.1 FFT-based focusing method

Image processing using the frequency domain offers a variety of opportunities as it allows operating with features which are not detectable in spatial domain (Bredies and Lorenz, 2011). Furthermore, processing effort decreases due to different mathematical approaches such as the FFT (Erhardt, 2008). Figure 2 shows the fitting of an ideal step as seen in Figure 1 on the right side with Fourier series with different parameters.

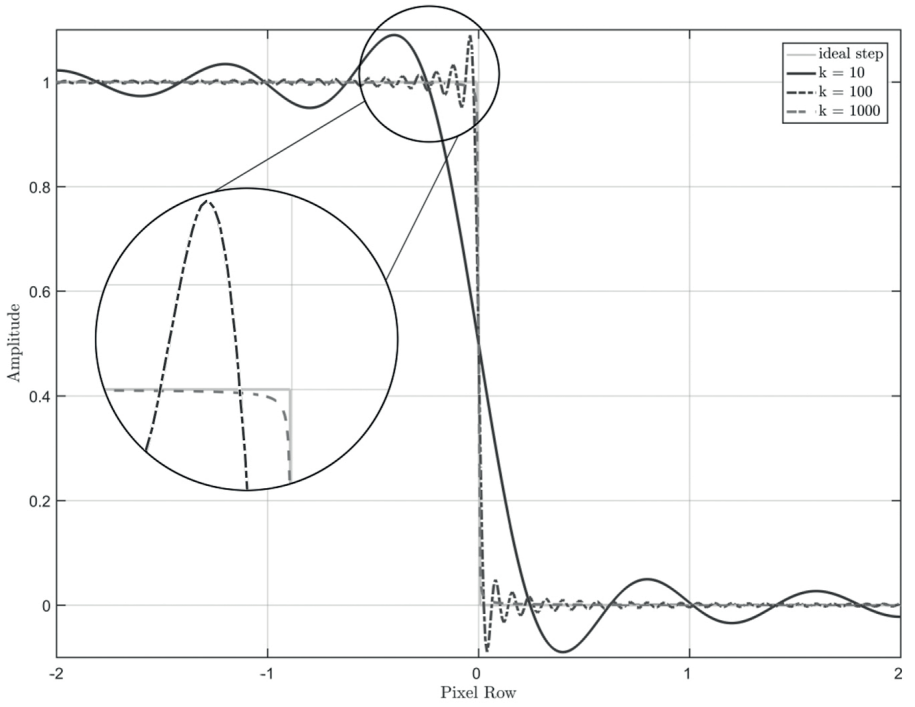

Figure 2: Fitting an ideal step at zero with Fourier series with k = {10,100,1000} terms; crop not true to scale

After capturing an image, the data is available in the spatial domain. Each pixel is usually encoded with 8 bit resulting in 256 gray values. As a result, a gray image $\boldsymbol{G}(x,y)$ captured with an imaging sensor with m pixels in height and n pixels in width is represented by a $m \times n$ matrix. Because of further processing steps, the 256 gray values are in the interval from 0 to 1. Each pixel implies a gray value $g_{m,n}$ representing the brightness at the position specified by m and n of the image $\boldsymbol{G}(x,y)$, as shown in Equation [1].

$$\boldsymbol{G}(x,y) = \begin{pmatrix} g_{1,1} & \cdots & g_{1,n} \\ \vdots & \ddots & \vdots \\ g_{m,1} & \cdots & g_{m,n} \end{pmatrix} \qquad [1]$$

As an image in general is composed by sine and cosine waves, any image is describable as a combination of sine and cosine waves with customized coefficients (Jähne, 2005, p. 43ff.), where u and v represent the frequency of the wave. Every pixel $g_{m,n}$ of the image $\boldsymbol{G}(x,y)$ with $1 \le x \le m$ and $1 \le y \le n$ of an input image is transformed into freqency domain by a discrete two dimensional FFT described by Equation [2]. The resulting complex valued Fourier image $\boldsymbol{F}(u,v)$ has the same size as the image $\boldsymbol{G}(x,y)$.

$$\boldsymbol{F}(u,v) = \frac{1}{\sqrt{m \cdot n}} \sum_{x=0}^{m-1} \sum_{y=0}^{n-1} \boldsymbol{G}(x,y) \cdot \left\{ exp\left(-i2\pi \cdot \left(\frac{u \cdot x}{m} + \frac{v \cdot y}{n} \right) \right) \right\} \qquad [2]$$

Image $\boldsymbol{G}(x,y)$ is multiplied with the exponential function elementwise and added up over rows and columns of the image matrix $\boldsymbol{G}(x,y)$ and then scaled. Sine and cosine as initial functions for FFT are represented through the exponential function in the complex range of numbers. The Fourier image $\boldsymbol{F}(u,v)$ contains the frequency and phase information of the spatial image $\boldsymbol{G}(x,y)$. An example of a spatial image and the corresponding amplitude spectrum is shown in Figure 3. A high gray value in the amplitude spectrum originates by high amplitude of detected FFT frequency $|\boldsymbol{F}(u,v)|$ in image $\boldsymbol{G}(x,y)$ with phase $\arctan(\boldsymbol{F}_{\mathrm{Im}}(u,v)/\boldsymbol{F}_{\mathrm{Re}}(u,v))$, where $\boldsymbol{F}_{\mathrm{Re}}(u,v)$ and $\boldsymbol{F}_{\mathrm{Im}}(u,v)$ are the real and imaginary components, respectively.

The square of the value of the Fourier transformation presented in Equation [3] is called power spectrum according to Süße and Rodner (2014). It describes the contribution of single frequencies u and v to the image $\boldsymbol{G}$.

$$\boldsymbol{P}(u,v) = |\boldsymbol{F}(u,v)|^2 \qquad [3]$$

As can be derived from section 1.2 and Equation [3], the power spectrum at high frequencies is most pronounced in a perfectly focused image. To cut down processing time herein a customized section of the power spectrum is discussed. For this purpose, only the high frequency range $\Psi(b)$ of the spectrum with the low limit frequency b is considered (see Figure 4) which we further call the frame frequencies.

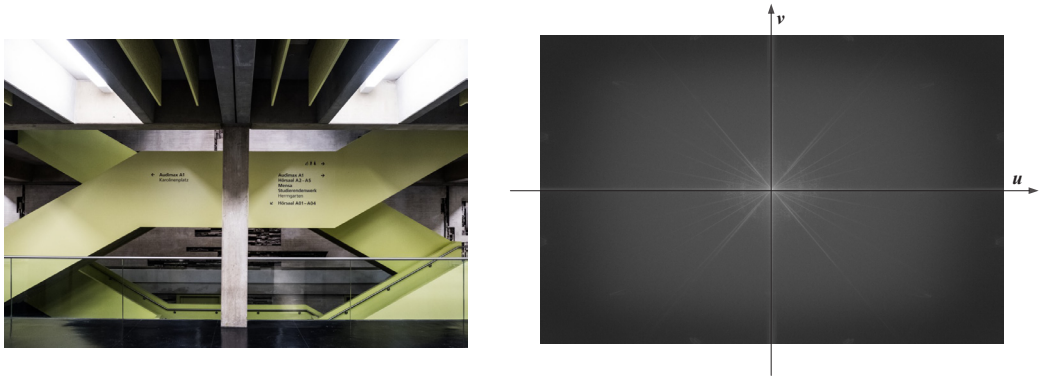

Figure 3: Input image (left) and resulting amplitude spectrum of a two dimensional FFT (right)

For the perfectly focused image three low limit frequencies with different frequency ranges are defined in the image processing, which are $b_{\text{high range}} = 3.7075\ \text{mm}^{-1}$, $b_{\text{medium range}} = 5.0950\ \text{mm}^{-1}$ and $b_{\text{low range}} = 6.4825\ \text{mm}^{-1}$.

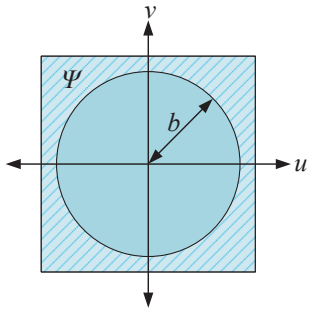

Figure 4: Frame Ψ (hatched area) with low limit frequency b, which is used in the FFT in order to concentrate on high frequencies

By adjustment of Equation [3], the power spectrum of the frame $\Psi(b)$ – further called frame power $\widehat{\boldsymbol{P}}_{\text{b}}$ – is calculated and shown in Equation [4]. Herein u and v represent the frequency of the wave in the Fourier image $\boldsymbol{F}(u,v)$, whereby u, v, x and y are elements of integer numbers $\mathbb{Z}$.

$$\widehat{\boldsymbol{P}}_{\text{b}} = \frac{1}{n_{\Psi(b)}} \sum_{u,v \in \Psi(b)} |\boldsymbol{F}(u,v)|^2 \ \text{with}\ u,v,x,y \in \mathbb{Z} \quad [4]$$

Frame power $\widehat{\boldsymbol{P}}_{\text{b}}$ therefore can be described as a high-pass filtering with additional summation of the elements in the remaining frame $\Psi(b)$ with low limit frequency b of the power spectrum normalized by the number of elements $n_{\Psi(b)}$ in the frame $\Psi(b)$.

2.2 Experimental setup

For the experimental setup the 5 MP industrial monochrome area scan camera P83M-GigE-AS from PicSight (Leutron Vision, 2010) was used in combination with the Fujinon 25 mm f/1.4–22 lens HF25SA-1 (Fujifilm, 2010). As camera and lens are not equipped with an automatic focus or aperture, the focal plane of the optical system can be assumed to be in a constant distance from the imaging sensor. As a compromise between light intensity and accuracy of the setup an aperture of f/4 was used, resulting in a focal depth of ± 4 mm around the actual point of focus (equivalent to a focal plane distance of f = 0 mm). The left side of Figure 5 illustrates the geometry used for identifying the stack's height using the best focus.

In the test rig (see Figure 5 on the right) the camera is mounted to a room gantry which allows us to move and vary the height of the camera above the machine table on which the stack of sheets will be inspected once the best focus for its height is found. For the investigation, the camera is once focused manually at a specific height on a single test-chart the height of which is assumed negligible. The resulting spatial resolution of the optical setup in this camera position is 72 µm per pixel. Subsequently a series of 75 images is taken of every test chart, while the camera is moved 1 mm upwards after the acquisition of each image, beginning from the lowermost camera position. By this, the focal plane is moved through the pre-defined point of focus. Thereby the spatial resolution is inevitably changed for every image. For testing the developed method of focusing through varying the cameras height above the stack and calculating the frame power from the power spectrum, test charts were designed for two categories (see Figure 6). The first category encloses a text sample as well as a color and monochrome picture, which are closely related patterns for print jobs. In the second category, image patterns with generic frequency distributions are used. A stroke pattern essentially contains one frequency with a clear orientation of the phase vector (u,v). In contrast, a broad spectrum extending to high frequencies, but without any preferential orientation is represented by the random binary noise pattern. In addition, it is assumed that the spectral characteristics of a real printing product lie in between of those of the generic frequency test charts. All charts are shown in Figure 6.

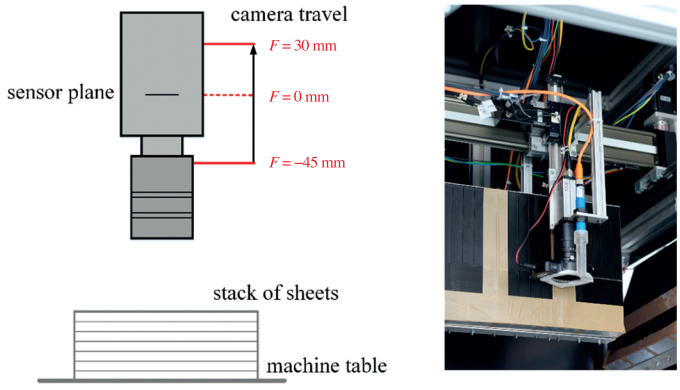

Figure 5: Geometry for identifying the height of the stack of sheets (left) and test rig (right)

Figure 6: Test charts used in the experiment, where the first category is closely related to printing products and encloses an image in monochrome as well as colored and a text pattern, whereas the second category is build up by generic frequency distributions with a stroke pattern and a binary noise pattern

The text pattern is used as a special case of a stroke pattern, and to study the effect of a preferential direction (PD). Therefore, four different orientations were defined with angles 0°, 15°, 45° and 75° to a reference direction at which the text was aligned during the experiment. For investigating the robustness of the algorithm, the test charts were printed on four different types of paper with a laser printer. These include one glossy (Luxo Magic 150 g/m^2), one matte glossy (Zanders Ikono Matt 150 g/m^2), one matte (Tauro Offset 100 g/m^2 SB) and one slightly rough paper (Lorsatzpaper 100 g/m^2 SB). A constant lighting setting was established by using a circular LED camera light.

3. Results and discussion

The frame power $\widehat{\boldsymbol{P}}_{\mathrm{b}}$ is calculated for each image of the series and scaled to the maximum frame power of the series $\widehat{\boldsymbol{P}}_{\mathrm{b,\,max}}$. By implication, we assume that the test chart is focused when the maximum frame power $\widehat{\boldsymbol{P}}_{\mathrm{b}}$ is achieved and that it is in between the borders of focal depth.

All results shown are based on the matte Tauro Offset paper, but for the comparison between matte/glossy, the glossy Luxo Magic paper is used in addition. Results for the three other papers are very similar to the results on Tauro Offset paper.

When comparing different low limit frequencies b = {3.7075 mm^{-1}; 5.0950 mm^{-1}; 6.4825 mm^{-1}} (listed from high range to low range) from two different test charts (binary noise and text aligned at 0°), the results show a very similar appearance qualitatively before entering the focal depth (see Figure 7).

The magnitude increases with a larger frame range for both test patterns in the same way. For a low limit frequency of b = 6.4825 mm^{-1} resulting in the smallest frame the lowest frame power is observed as well as for a low limit frequency of b = 3.7075 mm^{-1} resulting in the largest frame the largest overall frame power is observed. Therefore, a lower low limit frequency also considers lower frequencies, which on the one side are detectable earlier even when the test pattern is not in focus and secondly the percentage of lower frequencies in image data is higher by implication. We can confirm that the focus is found with each of the considered low limit frequencies, but because of the most distinctive results and reasons of computational speed upcoming experiments are only done with a high frequency range, considering frequencies from b = 3.7075 mm^{-1}.

Results of frame power obtained from color and monochrome pictures show a similar appearance before entering the focal depth, but the absolute magnitude of the frame power $\widehat{\boldsymbol{P}}_{\mathrm{high\ range}}$ is larger for the colored picture (see Figure 8).

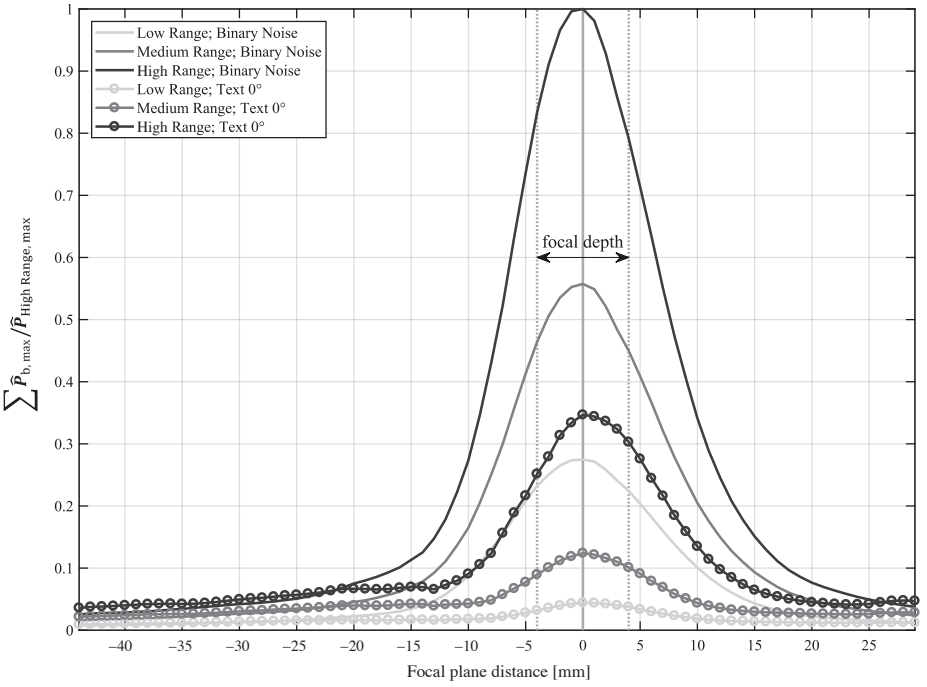

Figure 7: Power spectra of binary noise (solid lines) and text aligned at 0° (circled lines) test chart using Low, Medium and High Ranges of frequency bandwidths

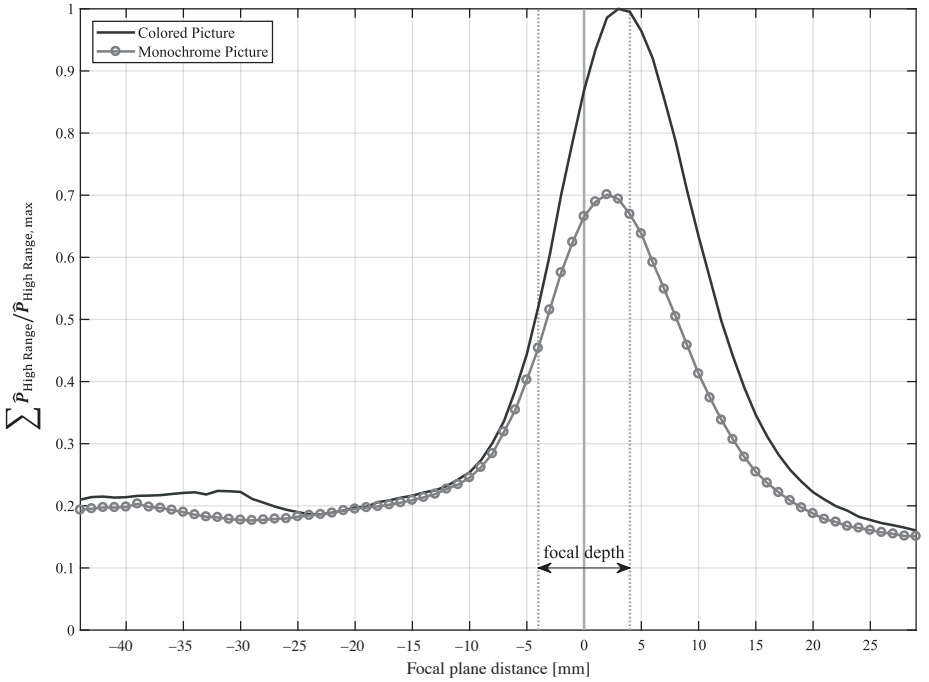

Figure 8: Power spectra of colored picture and monochrome picture test chart using the high frequency range

Digitalized image of the colored picture is noisier than the monochrome picture as cutouts show in Figure 9. Also differences in the printing screens of colored and monochrome picture printouts can be detected in visual control. For a distinct association further investigations are required.

Continuing, in the experiments a major influence due to different angles of text cannot be detected. Figure 10 shows the results of text aligned at 0°, 15°, 45° and 75° using the large frame range with a low limit frequency of b = 3.7075 mm^{-1}. These results hereby match the statement that frequency spectra are invariant of input

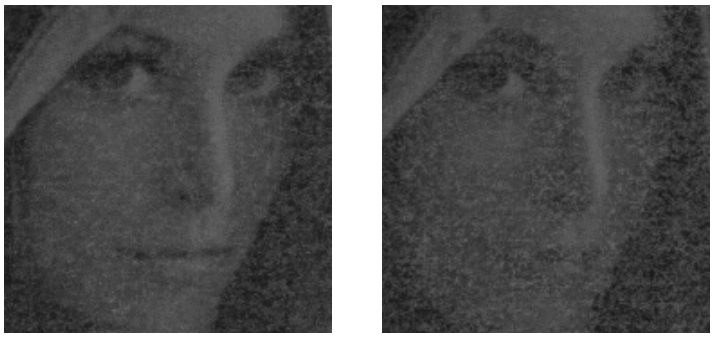

Figure 9: Cutouts of the digitalized monochrome (left) and colored (right) picture test pattern using a monochrome camera

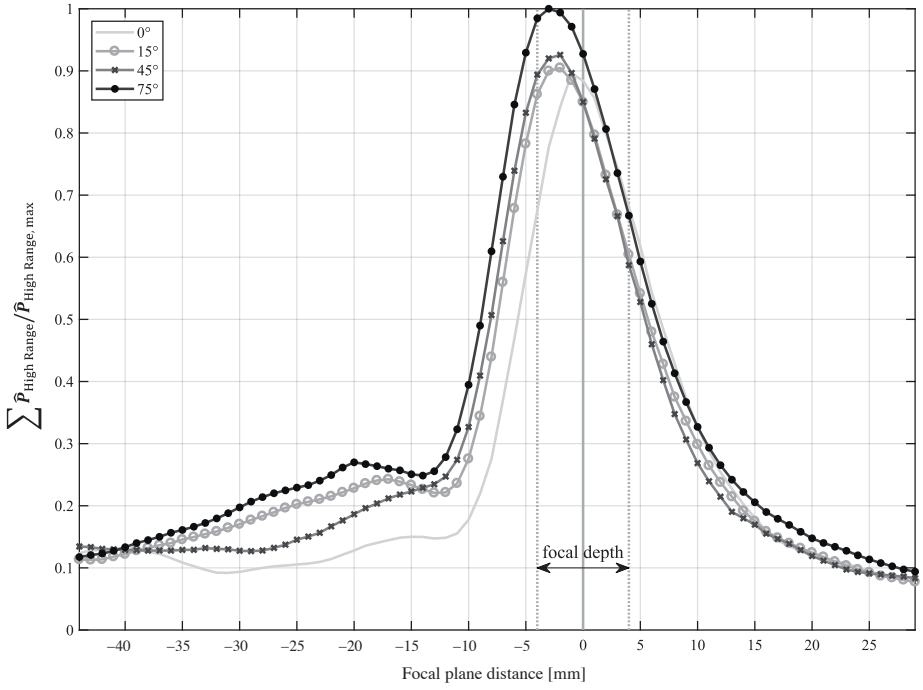

Figure 10: Power spectra of text test chart aligned at 0°, 15°, 45° and 75°, using the large frequency range

image rotation (Ó Ruanaidh and Pun, 1998). Beside a global peak of the frame power $\hat{\boldsymbol{P}}_{\text{high range}}$, small local peaks are existent (see Figure 9), when using the sample text pattern.

Figure 11 shows the results of the sensor filling stroke pattern and a windowed stroke pattern. The behavior of local peaks is even more remarkable and invariable which is noticeable for all investigations using the stroke pattern, when it fills the camera's sensor completely (see solid line in Figure 11). The deviation between the maximum frame power $\hat{\boldsymbol{P}}_{\text{high range, max}}$ and the actual point of focus f = 0 mm, which is defined by $|\Delta f(\hat{\boldsymbol{P}}_{\text{b}})|$, goes up to $|\Delta f(\hat{\boldsymbol{P}}_{\text{high range, max}})|$ = 5 mm. This behavior occurs because of strokes entering the image due to upwards camera travel resulting in a larger acquisition area (see Figure 12 on the left side). Reducing the printing size of the test chart so that the complete pattern is detected in the lowermost camera position (see Figure 12 on the right side) prevents local peaks from occurring. The magnitude of the power spectrum of the windowed stroke pattern is much lower because the region of interest, or more precisely the area that contains a frequency pattern is much smaller. Even though the frequency and amplitude of the windowed stroke pattern is the same, less harmonics are found by our FFT algorithm in the reduced area, what decreases the power spectrum by more than 80 %.

Nevertheless, we can confirm that windowing the stroke pattern and hereby preventing strokes from entering the acquisition area eliminates local peaks. Furthermore the accuracy increases as the deviation between maximum frame power $\hat{\boldsymbol{P}}_{\text{high range, max}}$ and the actual point of focus f is reduced by 1 mm to $|\Delta f(\hat{\boldsymbol{P}}_{\text{high range, max}})|$ = 4 mm.

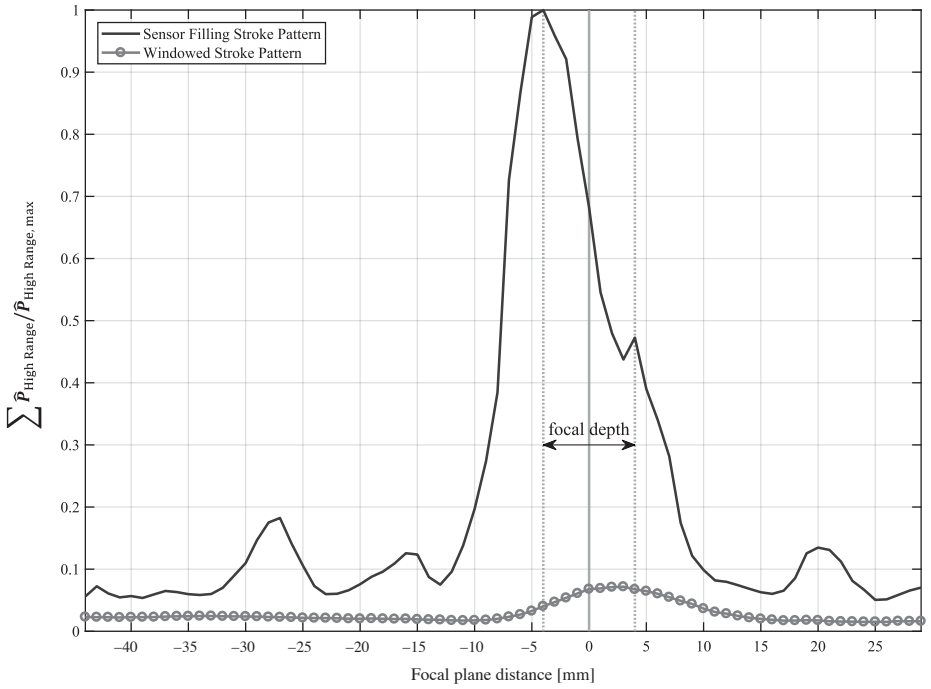

Figure 11: Power spectra of sensor filling stroke pattern and windowed stroke pattern showing local peaks besides a global maximum occur with the sensor filling stroke pattern, while the windowed stroke pattern is preventing local peaks in power spectrum; a large frequency range is used

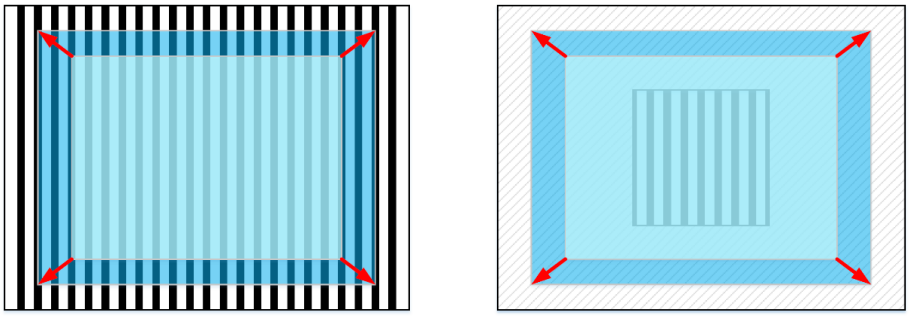

Figure 12: Sensor filling stroke pattern (left) and windowed stroke pattern (right); the acquisition area in the lowermost camera position is highlighted in light blue, in the uppermost position in blue, the red arrows mark the enlargement of the acquisition area

However, we assume that an image sensor filling stroke pattern is not found frequently in real printing products, therefore the suitability of the introduced method is not less applicable because of these results.

Contrary to the indistinct results of the sensor filling stroke pattern, outcomes of the binary noise pattern are highly convergent (see Figure 13). In visual control, we detect a major influence caused by the circular light though. Because of parallelism of lighting direction and the cameras optical axis, partial reflections of the light source are captured in the images when using glossy papers. This biases the results of FFT and thus the power spectrum. For correction a light diffusor is installed which prevents sharp reflections on glossy surfaces. The reflectance of the paper sheet influences the absolute values of the power spectrum as well. The frame power $\hat{\boldsymbol{P}}_{\text{high range}}$ is raised by usage of glossy papers without exception (see Figure 13), what possibly is explained through higher contrast. Hence a resulting higher contrast of the image leads to higher amplitudes of the corresponding FFT functions, what implies larger absolute values of the FFT and thereby the power spectrum (see Figure 11). Deviations of $\hat{\boldsymbol{P}}_{\text{high range max}}$ to the actual point of focus, when using the binary noise test chart, lie in a span of $\Delta f(\hat{\boldsymbol{P}}_{\text{high range max}}) = \pm 1$ mm. Out of focus, small structures of the noise pattern become indistinct, hence the edge contrast is reduced dras-

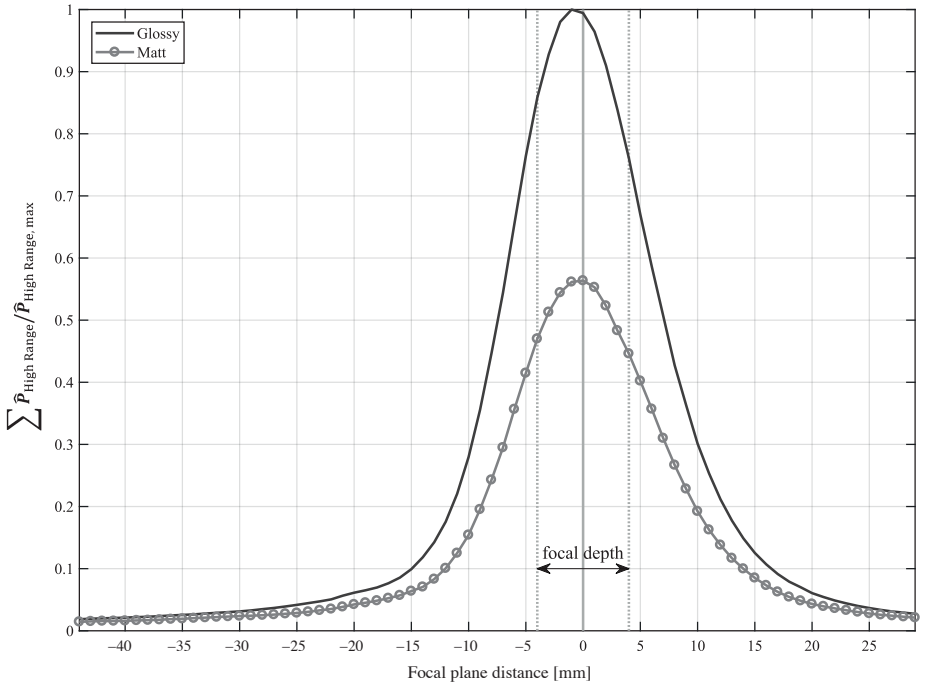

Figure 13: Power spectra of random binary noise pattern for glossy and matt paper using a large frequency range

tically. Inside the focal depth, structures are distinguishable and the high spatial resolution of the pattern results in a sudden detection of high frequencies. Out of all experiments, the results of the noise pattern show the best results. Nevertheless scaling the frame power to the maximum of the series of a single test pattern is essential for obtaining a distinct statement of which image is focused best. Yet we can confirm that the presented algorithm found a maximum frame power for each series of images inside the focal depth of the acquisition assembly for all the used test patterns.

4. Conclusions

The method shown in this research serves as a robust alternative for focusing tasks where only data from the imaging sensor is available. No further sensor is needed within the system. The method was evaluated by using four different test charts representing a large variety of print layouts found in printing jobs. Deviations of $\widehat{\boldsymbol{P}}_{\text{b, max}}$ to the actual point of focus for all experiments done lie in a span of $\Delta f(\widehat{\boldsymbol{P}}_{\text{b, max}}) = \pm 4\text{mm}$. While a decrease in low limit frequency and thus considering also lower frequencies results in a higher frame power $\widehat{\boldsymbol{P}}_{\text{b}}$, even a low limit frequency of just $b = 6.4825\ \text{mm}^{-1}$ results in precise prediction of the actual focus. However, for the most distinctive results and because of computational speed a low limit frequency of $b = 3.7075\ \text{mm}^{-1}$ is considered the best.

A variety of glossy and matte papers were tested and even though glossy paper caused difficulties with partial reflections due to circular lighting and power spectrum performed on matte sheets showed lower maxima, the method still worked sufficiently.

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Use of Ecofont software in digital printing on permanent papers

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Abstract

The durability of paper and permanence of printed text is important for publications and documents in libraries and archives, among them for long-lasting correspondence, that is mostly produced by using digital printing techniques. Nowadays, a very important issue is sustainability, that requires a sustainable graphic design of printed documents. The use of Ecofont software enables printing text documents with up to 50 % less use of printing ink. The purpose of the presented research was to establish the permanence of text, which was printed on permanent paper in two different font types (Times New Roman and Arial) and four sizes, from 8 pt to 14 pt. Two printing techniques were used for each font type, inkjet, and electrophotography, along with the Ecofont software. The research has shown that the use of the Ecofont software is appropriate for printing documents with the requirement for longer stability period, but the choice of printing technique, material and type combination is important and must be taken into consideration. In our research, the best combination was font Arial in size 12 pt printed with Ecofont software using inkjet technique. Generally, the combination of Ecofont software and electrophotography resulted in lower durability than Ecofont software-processed text printed with inkjet technique.

Keywords: legibility, text permanence, sustainability, accelerated ageing

1. Introduction

The permanence of printed documents and publications is mostly needed in archiving important documents. It is of great significance for publications and documents in libraries and archives. For this purpose, standards ISO 9706, ISO 11108, and ANSI/NISO Z39.48 have been published, which state the required properties of a printed substrate, i.e. paper (International Organization for Standardization, 1994; 1996; National Information Standards Organization, 1992). These properties enable longer permanence of printed documents in a controlled environment (Adcock, 1998).

Besides durability of substrates, the stability and permanence of printed text and images are important for long-lasting publications and documents. The overall durability of prints is a function of the ink, substrate and any printing, pre- or post-printing processing steps, which need to be optimized for the conditions that the print is expected to endure (Bugner and Gordon, 2012). With the growth of the quantity of digital prints in libraries, museums and archives, complete assessment of image and text permanence, including heat and light stability, fastness to humidity and atmospheric pollutants is very important (LaBarca, 2014). The influence of temperature, humidity, and light on typographic and colorimetric properties of inkjet prints in order to establish an appropriate typeface style for business correspondence was studied by Rat, et al. (2011) and Možina, et al. (2010). In the study of Venosa, Burge and Nishimura (2011), lightfastness of various digital prints (inkjet, electrophotography, dye sublimation, digital presses with liquid and dry toner) was examined. It was shown that prints undergo colorant fade, but in general digital prints were less sensitive to light than traditional prints, with some exceptions.

Digital prints are known to yellow as a consequence of different deterioration processes (Nishimura, et al., 2013). They are sensitive to oxidation of the colorants and image fading as well, though in general, digital prints tend to be less reactive with various enclosure types than traditional prints (Burge and Rima, 2010). Determination of the print permanence of digital prints to a variety of environmental conditions showed

that the electrophotographic prints were generally more resistant than offset prints (Burge, Farnand and Frey, 2012). Color stability of prints depends on the type of accelerated ageing, printing technique, a composition of ink and paper characteristics (Grilj, Muck and Gregor-Svetec, 2012).

Digital printing is considered as more environmentally friendly printing technique compared to the traditional printing techniques, such as offset printing (Viluksela, Kariniemi and Nors, 2010). Nowadays, the concept of sustainable printing will have an important influence on the future of print design. One of the key factors of environmentally responsible graphic design is designing a product that uses less material and energy. Aside of carefully selecting the inks depending on their levels of harmful substances, minimizing the ink coverage and with it, the quantity of ink needed for printing is an important part of the sustainable graphic design (Romano, 2014). Some studies have shown that changing the typeface can reduce ink consumption considerably. Bigelow, et al. (2011) claimed that changing the default font for office applications and printing from e-mail could reduce ink consumption by 30 %. Use of Century Gothic font instead of Arial can save about 1.5 % ink consumption. On the other hand, thicker and larger fonts, such as Book Antiqua, increase also the consumption of paper, because they require more leading to increase legibility (Carver and Guidry, 2011).

By using Ecofont, ink consumption is reduced by placing holes or striations in a given font (Bigelow, et al., 2011). Ecofont software enables up to 50 % lower level of used printing ink, while it reforms the text letters so they contain some voids (Ecofont, 2013). With this way of printing, the printed surface is smaller, which enhances the level of recyclability but keeps the legibility of the text good enough for a reader not to see the difference.

The goal of the present research was to evaluate the permanence of printed text processed with Ecofont software and printed on paper marked as permanent paper. We wanted to determine if the use of Ecofont software is appropriate for correspondence, such as business correspondence, where information permanence needs to be ensured for a longer time. This is achieved with dry heat ageing method since this type of documents is mostly stored in stacks and in closets, which eliminates the effect of light. Since this is our first research on this topic, it is not designed to be broad, but merely give insight in the behavior of printed text in some circumstances. Effect of humidity is planned to be observed in another research.

2. Materials and methods

2.1 Paper properties

In the research, uncoated paper Fedrigoni Arcoset declared as permanent paper, was used. Before printing, some physical properties of the material were determined. Among basic physical properties, basis weight, thickness, density and moisture content of paper were measured. The method of cold water extract was used for evaluating pH value of paper. The mechanical properties of paper were evaluated by determining folding resistance, bursting strength, tensile strength, strain at break, elastic modulus and bending stiffness. Bending stiffness was determined with cantilever bending, where bending of the sample originates from the weight of the sample itself. Elastic modulus was calculated from the measured propagation of sonic waves in material and paper density. The ISO brightness was determined with the spectrophotometer, surface roughness by a surface roughness tester TR-200. Results of measured characteristics presented in Table 1 have con-

Table 1: Paper properties

Paper characteristic	Method	Average value	Standard deviation
Grammage	ISO 536	129.26 g/m^2	0.10 g/m^2
Thickness	ISO 534	0.17 mm	0.002 mm
Density	ISO 534	762.23 kg/m^3	11.47 kg/m^3
Moisture content	ISO 287	3.60 %	0.90 %
pH	ISO 65881	8.3	0
ISO brightness	ISO 2470	95.50 %	0.29 %
Roughness – R_a	ISO 4287	3.44 µm	0.34 µm
Folding endurance	ISO 5626	258 in MD; 136 in CD	60.7 in MD; 63.1 in CD
Bursting strength	ISO 2758	297 kPa	11.6 kPa
Tensile strength	ISO 1924-2	114 N in MD; 60 N in CD	1.4 N in MD; 0.8 N in CD
Strain at break	ISO 1924-2	1.90 % in MD; 4.00 % in CD	0.10 % in MD; 0.13 % in CD
Elastic modulus	Sonic velocity	4.14 GPa in MD; 2.26 GPa in CD	0.108 GPa in MD; 0 GPa in CD
Bending stiffness	Clark method	1.71 Nmm in MD; 0.92 Nmm in CD	0.05 Nmm in MD; 0.02 Nmm in CD

(MD – machine direction; CD – cross direction)

firmed good mechanical properties of paper which are in accordance with the requirements for durability of paper and its long-lasting performance.

2.2 Test form

The first test form was created using programs Microsoft Office Word 2010 and Adobe Illustrator CC. It contains test patterns and text written using fonts Times New Roman and Arial in size of 8 points (pt), 10 pt, 12 pt and 14 pt. Different font sizes were chosen regarding the frequency of their use in various printed text documents, while two fonts were chosen due to their differences in design. With font Times New Roman the permanence of serifs and unevenly thick strokes are tested after the exposure to accelerated ageing, while with font Arial the permanence of sans serif fonts is observed. Differences between the digital form of letter 'a', that is computer generated in its printed versions, are also taken into consideration.

The second test form was designed in the same way as the first one, but with applying the Ecofont software. With this step the text is modified as shown in Figure 1. Both test forms were placed in one document and positioned so they fit on one A4 page. The test form used for printing is shown in Figure 2.

2.3 Printers

Three digital printing techniques were used. First, inkjet technology, since it is widely spread in office environment where printed documents should also have permanence over a longer time (Le, 1998). Second,

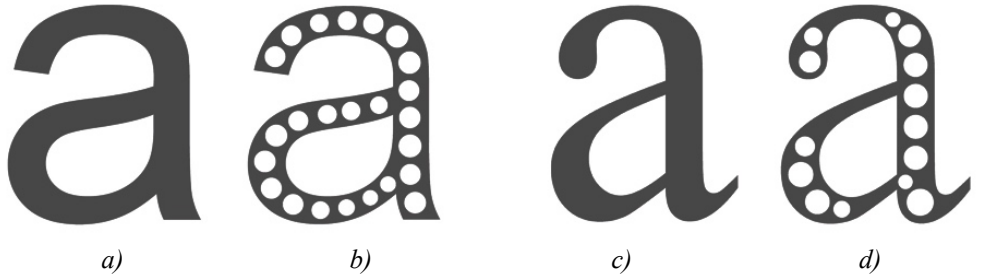


Figure 1: Digital form of letter 'a': (a) Arial, (b) Ecofont software-processed Arial, (c) Times New Roman, (d) Ecofont software-processed Times New Roman

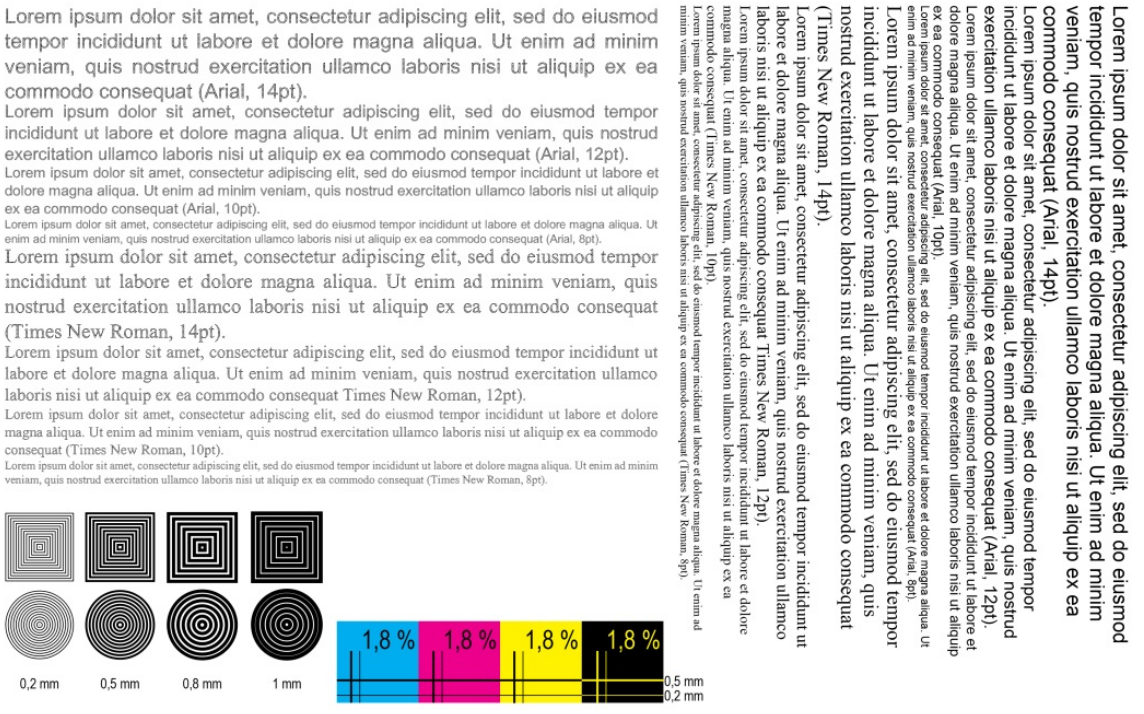


Figure 2: Test form, with test patterns and Ecofont software-processed Arial and Times New Roman on the left side, and text with respective conventional fonts on the right side

LED-UV inkjet printing technique, while it gives longer permanence to printed images and text (Majnarić, Bolanča Mirković and Golubović, 2012). It is used in order to make a comparison among printing techniques regarding stability of prints. Third, electrophotography is used, which is commonly used in offices and is known for its' precision, which is much higher than with inkjet technologies (Majnarić, 2015).

For inkjet printing, a multifunction device Brother MFC J5320SW0020 (abbreviated as IJ) was used as a representative of inkjet print-on-demand technology. Second used printer (LED-UV curing system) was Roland LEC300 (abbreviated as IJECO). The third, electrophotographic printer was Canon C1+ (abbreviated as EF). All selected printers used resolution of 300 dpi for printing test forms.

2.4 Evaluation of prints – ink surface coverage

Three prints made with each of the three printers were evaluated. To digitalize printed text at high enlargements, a microscope Nikon SMZ800 equipped with a camera Nikon D700 was used. The same camera settings were applied for taking pictures of the letter 'a' in all possible combinations; printing technology, font type, type size, with and without the use of the Ecofont software. Photographs were cropped to the size of 1800 px × 3000 px and transformed to binary pictures using ImageJ software. With the same software, the coverage of the paper surface with printing ink was determined (ImageJ, 2015).

Prints were aged using dry heat treatment at 105 °C and exposed to this temperature for 72 hours according to the standard ISO 56301 (International Organization for Standardization, 1991). After the ageing process, measurements of ink coverage were performed again.

2.5 Evaluation of prints – legibility

Printed test forms after dry heat ageing were optically scanned using a multifunction device Brother MFC J5320SW0020 with the resolution of 600 dpi and saved in PDF files. This provided images with a number of details to clearly recognize various transformations of text. By using Adobe Photoshop CC the scans were cropped and individually saved as images in TIFF format in original resolution. Paragraphs were separated by the font type and font size, e.g. Arial 14 pt. Then they were matched with the corresponding Ecofont software-processed version from the same test form. Both paragraphs combined formed new image used for legibility analysis. This lead to 48 different images used to test legibility: four for Arial (8, 10, 12, and 14 pt) and four for Times New Roman (8, 10, 12, and 14 pt), each combination repeated two times due to two printing technologies and another three times due to three prints of test forms.

Images for assessing legibility were shown to 42 observers on screen. The observers were asked not to read the text in the images, but merely observe the shape of the text whether they find it pleasing. According to that and the capability to see the difference among version of the text which was or was not processed with Ecofont software, the observers marked the image with one of the following three marks:

- 2: second paragraph (Ecofont software-processed) is visually more pleasing,
- 1: there is no difference between the paragraphs,
- 0: first paragraph (original font) is more visually pleasing.

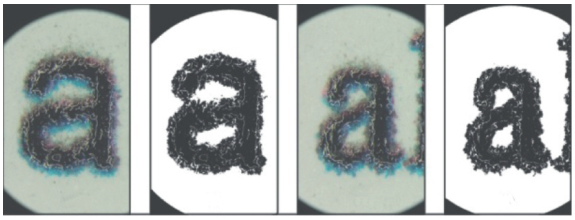
The numbers 0, 1 and 2 were then used for calculating *PC*-index according to Equation [1], where n is the number of observers, m is the number of samples and v_i is the value with which the observer marked the test form (0, 1 or 2). The *PC*-index values vary from 0 to 200, where 200 represents perceiving the Ecofont software-processed text as a good quality text, while 0 corresponds to poor text quality.

$$PC\text{-index} = \frac{\sum_{i=1}^{n} v_i}{2 \cdot n \cdot (m-1)} \cdot 200 \qquad [1]$$

Since the images were formed using text paragraphs in Latin (Lorem ipsum) and the analysis was performed on observers who have no knowledge of this language, it can be stated that the meaning of the text does not influence the readers' perception of the shapes to the extent which would affect legibility itself. This kind of legibility testing method has been proven effective in the research made by Milošević, et al. (2016), therefore it was found applicable in this case.

3. Results and discussion

When printing with the printer IJECO, difficulties occurred. As shown in Figure 3, where photographs of letter 'a' and their binary versions of prints made with IJECO are presented, there was a problem with the presence and registration of a cyan layer (Figures 3a and 3c), which resulted in a higher coverage of surface after binarization compared to other samples. Another problem was a high gloss of the print, which resulted in some reflections of the surface, seen as white marks in the letter (Figures 3b and 3d). This could be corrected with retouching but again this would lead to mistakes, especially when evaluating the ink coverage at Ecofont software-processed text. For these reasons, prints made with the printer IJECO were eliminated from further evaluation.



a) b) c) d)

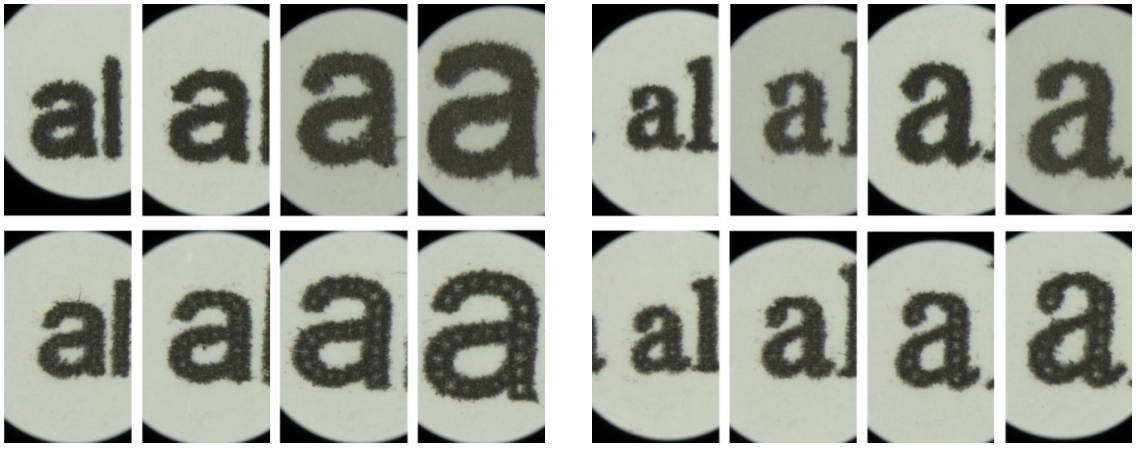
Figure 3: Photographs and binary pictures of letter 'a' printed with the printer IJECO: (a) and (b) Arial, (c) and (d) Times New Roman; all in 12 pt size

In Figures 4 and 5, photographs of the letter 'a' printed with the printers IJ and EF in all four sizes of fonts Arial and Times New Roman printed with and without using Ecofont software are presented. The difference between used printing techniques is obvious.

3.1 Surface coverage with ink

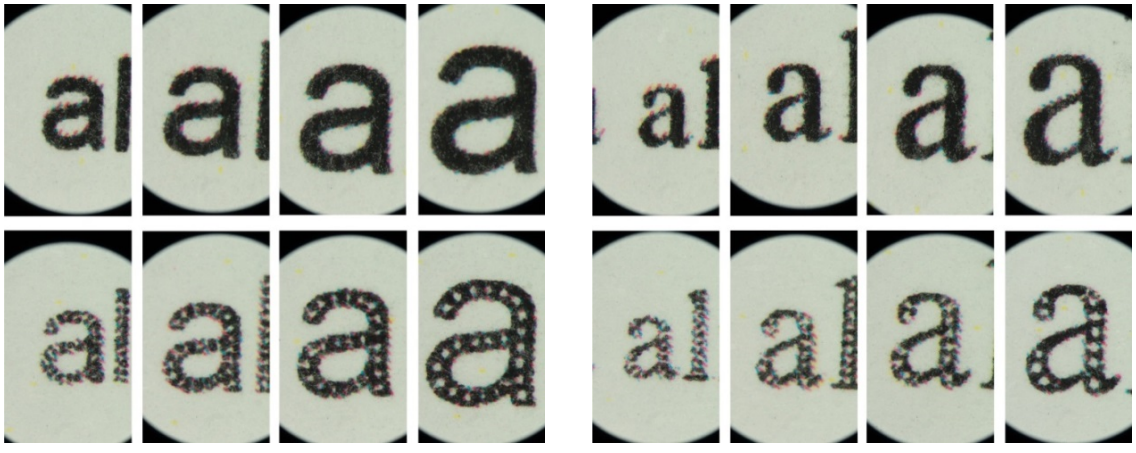
In Table 2, ink saving values when using Ecofont software are presented. Computer modulated letters 'a' in various sizes and their Ecofont software-processed versions were used for these calculations. Obtained results correspond to the previously stated (Ecofont, 2013) ink saving value, up to 50 %. Savings vary depending on the font and font size. Arial has higher ink saving value than Times New Roman in general.

Differences within one font indicate that not only one form of a letter is generated by the Ecofont software, but they are generated according to font size, since one ink saving value does not repeat in any other font and font size combination. In Figure 6, the differences between the surface coverage of digital shape of letter 'a' and of the printed letter 'a' using printers IJ and EF



a) b)

Figure 4: Photographs of letter 'a' in all four sizes printed with IJ: (a) Arial, (b) Times New Roman; first row: unprocessed text, second row: Ecofont software-processed text



a) b)

Figure 5: Photographs of letter 'a' in all four sizes printed with EF: (a) Arial, (b) Times New Roman; first row: unprocessed text, second row: Ecofont software-processed text

Table 2: Ink saving when printing with Ecofont software for two fonts and four font sizes

Font	Font size	Ink saving [%]
Arial	8 pt	51.97
	10 pt	49.86
	12 pt	51.07
	14 pt	51.22
Times New Roman	8 pt	42.78
	10 pt	42.37
	12 pt	40.85
	14 pt	40.41

of different fonts and font sizes are presented. All values are positive, which indicates spreading of ink at printing for both printing techniques. The gain at prints made with the printer EF and font Arial was higher than the gain with font Times New Roman for all font sizes. This is a consequence of typographic features of used fonts, while Arial has thicker and more even strokes, which results in bigger amounts of applied ink and furthermore in higher wicking. With bigger font size, the difference in coverage is also increasing. The gain in comparison to the digital form of the letter is much higher when using Ecofont software. The differences are more obvious in Arial font, where the difference is

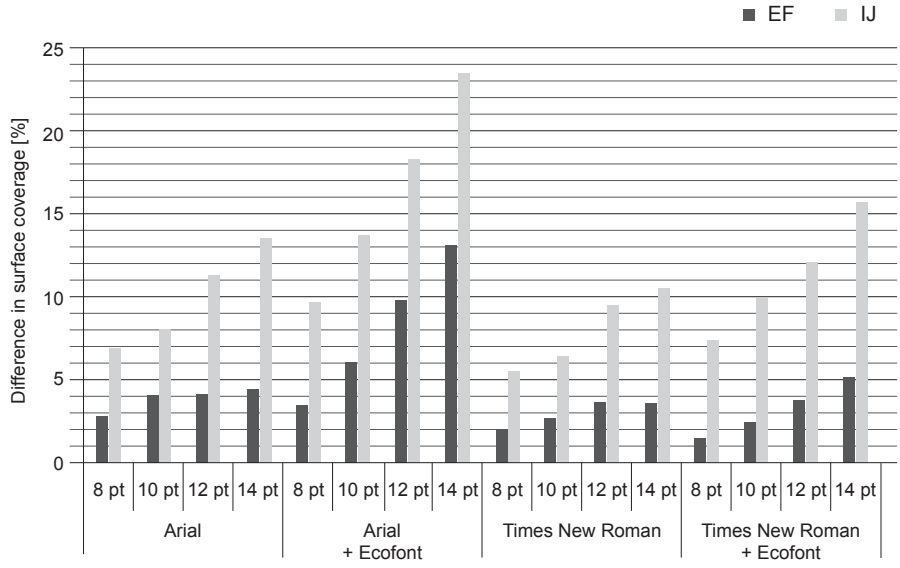


Figure 6: Differences in surface coverage between digital form of letter 'a' and printed letter 'a' in prints made with the printer IJ and EF

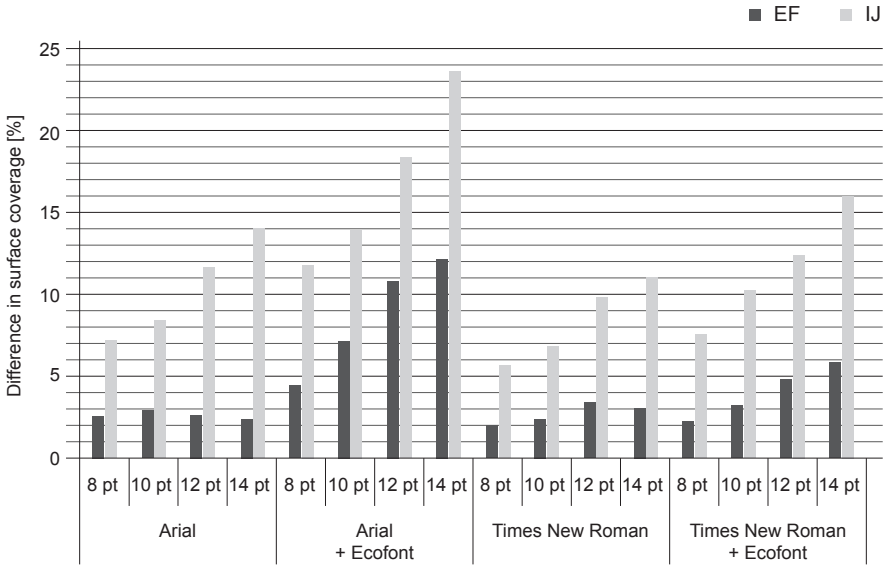


Figure 7: Differences in surface coverage between digital form of letter 'a' and printed letter 'a' in prints made with the printer IJ and EF after ageing

14 % at size of 14 pt. When comparing font Times New Roman, the differences between Ecofont software-processed and conventional fonts, are minimal, which suggests the higher quality of EF print. The measurements have confirmed the expected result, that the gain at surface coverage with ink is much higher when using inkjet technology in comparison to electrophotography. Consequently, the differences between prints with and without the use of Ecofont software are much higher.

3.2 Surface coverage with ink after accelerated ageing of prints

The surface coverage of the digital shape of letter 'a' and surface coverage of printed letter 'a' using IJ and EF printers after accelerated ageing with dry heat was determined. The differences between the digital and aged printed letter 'a' obtained for different fonts and font sizes are presented in Figure 7. All obtained values are positive, which means that dry heat treatment did not damage the prints to the level where the ink would cover less surface than it has been originally printed. The difference between surface coverage of the computer generated letter and the printed letter is in general increased with bigger letter size. Derogation of this trend is only seen at prints made with the electrophotography for font Arial.

3.3 Comparison of surface coverage before and after accelerated ageing of prints

When comparing the differences of surface coverages with ink on the prints and the original surface coverage of computer-generated letter 'a' for prints before and after exposing them to the accelerated ageing with a dry heat (Figure 8), some values were negative. Font size affects the permanence of letter 'a' differently. The measurements show that with the use of the printer IJ and font Arial there is no significant change in the surface coverage before and after ageing of the prints, regardless of the font size. The same trend was obtained at prints printed with the printer IJ and font Times New Roman for both, conventional and Ecofont software-processed text. When using Ecofont software with font Arial, big differences are seen. With smaller letter size the applied ink is spreading much more, which results in closing the empty spaces generated with Ecofont software. In addition to that, strokes of letters start to merge, which leads to illegibility.

When using Ecofont software on EF prints, the font size does not have different effects on the permanence of prints. The deviation from the trend can only be seen with combination Arial + Ecofont software + 14 pt, which can be marked as a feature of prints, since it is observed with all three printed test forms for this type combination and we cannot find an explanation that would be consistent with the effects of accelerated ageing method. Otherwise, the results are consistent in their category. With ageing, prints with normal type are damaged more than the ones where Ecofont software is used. Negative values mean that the surface, which is covered with printing ink, has shrunk after accelerated ageing. However, these negative values do not indicate damage to the surface coverage to the extent, which would result in disappearing text. This is already stated in sections 3.1 and 3.2 since the difference in surface coverage on all prints is positive.

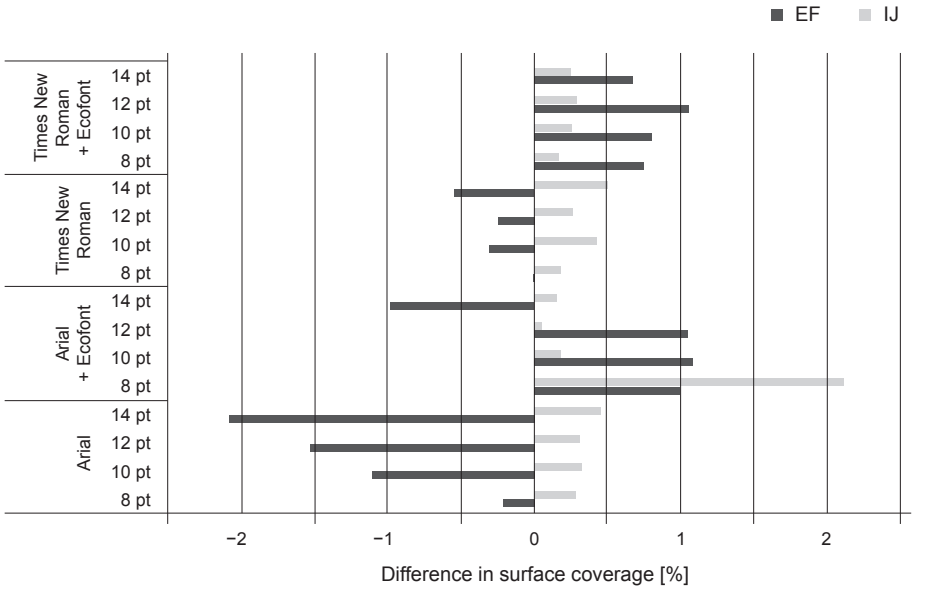


Figure 8: Differences in surface coverage of digital form of letter 'a' and printed letter 'a' between prints made with the printers IJ and EF before and after ageing

The reason for negative values (Figure 8) is the lower stability of ink (dry toner) used at EF printing, which is affected differently by temperature than IJ printing ink. At IJ printed samples the covered surface is expanding with ageing, or in other words, the ink continues to spread via fibres and forms even higher degree of 'wicking'. With EF, the toner is 'peeled' off the surface, resulting in smaller surface coverage.

Although all of these values vary from –2 % to 2 % in surface coverage difference, which is not obvious on the first sight, it is interesting to observe, that the most damaged prints are the ones without the use of Ecofont software in case of EF. This means that normal type is less stable than the Ecofont software-processed type. It can be assumed that the cohesive forces of the applied toner are stronger than the adhesion forces between the toner and substrate. With ageing this can lead to 'peeling' of larger clusters from the surface of the paper. Since the amount of toner applied with normal type is bigger than with Ecofont software-processed type it can be concluded that the clusters are in this case bigger. This would result in quicker degrading of printed text.

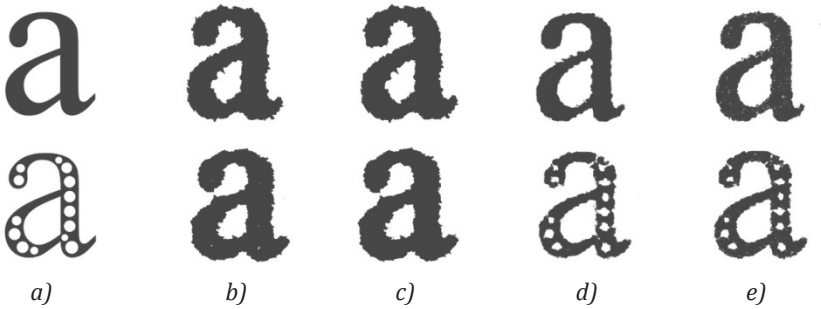
In Figures 9 and 10, binary versions of the letter 'a' are presented in fonts Arial and Times New Roman printed with IJ and EF. Computer modulated version of the letter is also shown. With visual control of letter 'a' shown in Figures 9 and 10, we can see how ageing method affects the prints. Comparing samples of the same fonts and the same font size before and after ageing give us a general impression of the changes occurred while ageing the prints.

The comparison clearly shows that with ageing of IJ prints (Figures 9 and 10, samples (b) and (c)) the surface coverage is bigger than before ageing. This is especially visible when comparing the Ecofont software-processed versions of the letters (Arial and Times New Roman), where all generated gaps inside the letters have been completely closed. Wicking of the border is changed to a higher value. The difference is not in the size of the wicks but in their frequency.

Quite the contrary can be observed with the EF prints. Comparing letters before and after ageing (Figures 9 and 10, samples (d) and (e)) shows how the surface coverage is decreasing. With the conventional use of fonts the coverage decrease can be seen spread evenly in random patches throughout the letter surface and with higher enlargements, it is obviously seen that the wicking is significantly enlarged. With the printed letters using Ecofont software, there are multiple changes. The surface coverage is generally decreased in the same way as with the conventional use of the fonts, as well as the wicking of the outer border is higher after ageing.

a) *b)* *c)* *d)* *e)*

Figure 9: First row: Arial, second row: Ecofont software-processed Arial; (a) computer modulated, (b) IJ printed, (c) IJ printed after ageing, (d) EF printed and (e) EF printed after ageing



a) *b)* *c)* *d)* *e)*

Figure 10: First row: Times New Roman, second row: Ecofont software-processed Times New Roman; (a) computer modulated, (b) IJ printed, (c) IJ printed after ageing, (d) EF printed and (e) EF printed after ageing

An interesting occurrence is seen with the generated gaps inside letters. Since it would have been expected for the gaps to widen and their wicking to enlarge, due to the ink coverage decrease in these cases, the opposite is observed. Generated gaps are more closed after ageing, while the wicking is hard to observe and determine the difference. This shows an interesting migration of EF toner while ageing with the selected method and its influence on the letter shapes.

In the previous observations, it has been described how the surface coverage of EF prints is also reduced in some cases. With this visual analysis, it can be seen that former negative quantitative results do not necessarily mean shrinking of the covered area in width and height, but it can be interpreted as decreasing the thickness level of the applied toner. When comparing (d) and (e) examples of Figures 9 and 10 it can be clearly seen that new blank surfaces are generated where the surface used to be covered before ageing. This can be observed with IJ and EF made prints. Still, these changes are not that significant and do not result in poor legibility.

3.4 Evaluation of legibility

Legibility tests were only performed using prints after accelerated ageing as test forms (presented as images on the screen), as has been stated in section 2.5. The legibility tests on aged prints give good results and correspond to previous quantitative findings. In Table 3, average values of answers from 42 observers are shown. The primary aim of collecting answers from observers with this kind of grading was to determine *PC*-index. If we followed the Equation [1] as it is, the result would be one value, which would describe how 42 observers perceive 48 different test forms, i.e. 96 texts. This description is too broad, therefore the original equation had to be altered. For each test form, the obtained answer values were summarized into one value, which became the numerator of the equation. In denominator *n* and *m* values had to be replaced with each other, since the 42 answers (from 42 observers) are in this case samples. If this would not be done, the denominator would result in zero-value and the equation could not be resolved with non-imaginary numbers. This modification is presented, for 42 observers, with Equation [2], where non-variables are inserted and v_i stands for the obtained answer (value 0, 1 or 2). In Table 3 average values of *PC*-indexes calculated for each legibility test form are presented.

$$PC\text{-index} = \frac{\sum_{i=1}^{42} v_i}{2 \cdot 1 \cdot (42 - 1)} \cdot 200 \qquad [2]$$

It has to be stressed that none of the average answer values is 0 or 2, which means that all observers never found one specific text better than the other. From results obtained it is obvious how the average answer values correspond with calculated *PC*-indexes. This was expected since there is no other variable taken into the account when calculating *PC*-index for a specific test form. It also confirms the accuracy of used Equation [2]. Since both comparisons give the same results, the first comparison is commented, due to an easier interpretation of results.

If v_i value 1.0 is treated as the orientation point, since answer value 1 means equally good legibility of texts, it can be seen that text with used Ecofont software has

Table 3: Average values of answers obtained in legibility test and average PC-index values for different fonts, font sizes and printing technologies for each legibility test form

Font	Printing technology	Font size	Average answer value	Average *PC*-index value
Arial	Inkjet	8 pt	1.3	132
		10 pt	1.1	109
		12 pt	1.4	143
		14 pt	1.3	133
	Electrophotography	8 pt	0.8	86
		10 pt	0.7	76
		12 pt	0.8	85
		14 pt	0.9	94
Times New Roman	Inkjet	8 pt	1.1	115
		10 pt	0.9	94
		12 pt	1.1	117
		14 pt	1.1	110
	Electrophotography	8 pt	0.4	40
		10 pt	0.5	48
		12 pt	0.3	31
		14 pt	0.6	57

better legibility than normal text when printed with IJ printer regardless of used font, although Arial has higher average answer values. Printer EF gave results with a lower value, which means that text without the use of Ecofont software has better legibility than with since answer values are below 1.0. Here the difference between used font is more obvious. It is visible that Times New Roman has much lower legibility in comparison with used Ecofont software when printed with EF.

Times New Roman printed with EF has very low legibility answer values. These low values lead us to the statement that the use of Ecofont software is not suitable for prints using this font and EF printer. Considering the results for Arial, we can furthermore conclude that Ecofont software is not suitable for EF printing technology either.

In combinations Arial IJ, Arial EF and Times New Roman IJ a trend can be seen when comparing answer values for 8 and 10 pt sizes. Legibility rating decreases when the font size is changed from 8 pt to 10 pt. This happens due to more applied ink, which results in more wicking, which does not only close the gaps in the printed letter, which would normally result in better legibility, but also the whitespace in the kerning of the words, which leads to worse legibility. Interesting to see, when enlarging the font size to 12 pt, the opposite happens. Answer values for texts in this size are higher, which means the legibility of Ecofont software-processed texts is better. Prints made with IJ have again better legibility when increasing the type size for another 2 pt, i.e. to 14 pt.

The same trend of increasing or decreasing legibility is seen in these three cases, except in combination of Arial EF size 14 pt. This type combination has already proven to be isolated from other measurements in the previous section 3.3 where the surface coverage has been questioned. In Figure 10 it can be seen how accelerated ageing drastically changed the surface coverage of prints for combination Arial, Ecofont software processing, and EF. Therefore, this can again be treated as a print feature, since this finding is completely isolated from the others and does not correspond to any of them. This leads us to a general assumption that the legibility when using Ecofont software is better using certain type sizes, in this case, 8 pt and 12 pt has been proven to be more legible than sizes 10 pt and 14 pt.

In general, it can be seen from Table 2 that the best legibility score and consequently the best case to use Ecofont software is in Arial font and IJ printing technology. In this case, sizes 8 pt, 10 pt, 12 pt and 14 pt are suitable, with size 12 pt being the most visually pleasing.

4. Conclusion

The results of the research have shown that digitally printed text on permanent paper could be used for long-lasting correspondence, where information permanence needs to be ensured for a longer time. The highest ink coverage was obtained for IJ prints and font Arial. Results gained in legibility tests also state that combination of IJ, font Arial, Ecofont software processing, and font size 12 pt is the most visually pleasing when comparing it to other tested combinations. Because of higher precision of EF, the use of Ecofont software resulted in higher ink reduction at EF prints compared to IJ prints. The dry toner used in EF printing was seen to be less stable after accelerated ageing at dry heat, while prints made with IJ ink either maintained surface coverage or it has been even enlarged. The combination of Ecofont software and EF printing results in lower durability than Ecofont software-processed text printed with IJ.

Ecofont software is suitable for printing documents with demanded longer stability and permanence, but with its use, it is important to take into the account other factors, such as printing technique, font type, and font size.

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HIV/AIDS communication through televised public service announcement in the Tamil language

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Abstract

In HIV/AIDS communication, gender defines how programmes respond to the needs of both men and women. Supportive environments should be created to have enough means of protection against the disease, besides care, when infected. The research methods adopted for this study is discourse analysis of 'Pulli Raja', televised public service announcement (PSA) on HIV/AIDS. The study has taken a televised PSA in the Tamil language, adapted from the Hindi language. In HIV/AIDS communication, televised PSA is an important tool in educating and creating awareness among women. The research is based on 'Pulli Raja' PSA, brought forth on HIV/AIDS in the last two decades. Discourse analysis helps to understand the media text, context, gender, character portrayal, location and the target audience. Health belief model is adopted to understand the psychological health behaviour change.

Keywords: Pulli Raja, gender, discourse analysis, communication, message, sex worker

1. Introduction

Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) is a great threat to humanity. The HIV is a type of retrovirus that destroys the immune system of a human. Women in the lower socio-economic status are more exposed to HIV. The HIV has spread across the world since the early 1980s to pandemic levels (IFSW, 2012). Women are more likely to be exposed to HIV. Gender inequities in socio-economic status and patriarchal ideology around sexual practices have to be looked into (Chong and Kvasny, 2007). Gender inequities in abstinence, monogamy, and condom use are important factors in the feminisation of HIV/AIDS that are often overlooked (Ojikutu and Stone, 2005). The social ideology surrounding gender and power relationships is inevitably reflected and constructed in HIV/AIDS discourses (Cukier, Bauer and Middleton, 2004).

The first AIDS patient in India was diagnosed by Dr. Suniti Solomon, a microbiology professor at the Madras Medical College, in Chennai in 1986 (Pal, 2016). In India, heterosexual mode of HIV transmission accounts for 88.2 per cent of HIV positive cases detected, mother-to-child transmission accounts for 5 per cent, infected syringe and needle 1.7 per cent, homosexual 1.5 per cent, contaminated blood and blood products account for 1 per cent, and other causes of HIV infections detected during 2011–12 (NACO, 2012).

2. Need for study

Many HIV prevention programmes have been carried out with a gender approach. Still, women do not have equal opportunities to benefit from the programmes. Mendoza (1997, cited in Satpathy, 2003) argues that these programmes are related to gender roles in a society and include sexual norms that limit women's access to information by implying that they are ignorant about sexual matters. Women's economic dependence on men, violence against women and widespread acceptance of male promiscuity has worked against women's chances of protection against the disease. Women are at greater risk of HIV infection from unprotected sex than men as they are often not in a position to negotiate with their partners because of the deep entrenched patriarchy particularly in Tamil Nadu, the southern state in India inhabited by the people mostly speaking the Tamil language. The major thrust of early programmes was promoting ABC – Abstinence, Be faithful to partner, and Condom use. Still CNN – which means Condom use, safe Needles, and Negotiating with partner – is yet to be adopted in

India, which includes the state of Tamil Nadu. In spite of the tradition and moral values one may proclaim, A and B sometimes fail. Giving importance to family relationship and keeping away from premarital and extramarital sex are welcome but not a must when it comes to HIV/AIDS prevention and thinking of the larger social good. Further, CNN goes beyond condom use, and emphasises on safe needles and negotiating with partner as well.

In this context, the media can play a role in creating awareness and thus contributing towards a change in behaviour. This study analyses the influence of 'Pulli Raja' Public Service Announcements (PSAs) broadcast on television in creating HIV/AIDS awareness. One of the most effective means to create social awareness and bring about a change in behaviour is PSA. The HIV/AIDS PSAs are intended to change the public interest, by raising awareness by informing people about HIV/AIDS, on safer sex (condom usage), give up stigma and discrimination, and the importance of testing and counselling. Giving importance to family relationship and keeping off sex workers too are suggested but are not considered a must. The PSAs, particularly on television, are expected to have direct or subtle influence among people and bring down the HIV/AIDS prevalence. A PSA is a public interest message disseminated by the media without any fee, with the aim of raising awareness, changing public attitudes and behaviour towards a social issue. It is a non-profit message distributed voluntarily through the media.

Changing the strategy of AIDS awareness campaign prevalent in 2003, the Population Services International (PSI) embarked on 'Pulli Raja' campaign focused on using a condom every time Pulli Raja decided to have extra-marital sex particularly under intoxication, but the follow-up campaign focuses on how a unfaithful husband could be the single largest donor of the AIDS/HIV virus to wife, unborn children and lover. The PSI is an Non-Governmental Organization (NGO) and it addresses health problems of the low income group and the populations lacking access to resources in developing countries.

Men in the lower economic strata were the target group of the entire programme, Tamil Nadu being identified as one of the six high HIV prevalence states of India. Out of the total 111 608 AIDS cases detected in the country till 2005, Tamil Nadu has a vast share of 52 036 cases, accounting for nearly 46.62 percent (NCAER, 2005). The idea of the PSI was to reach men and target them as in the power equation they had the say over use of condoms or when to have sex. The PSAs tried to break the myth that if a person was healthy he/she could not contract HIV/AIDS. The PSAs created openness in discussing issues related to AIDS in public.

Sex workers catering to the mobile population are normally either from the neighbouring villages coming to the halt point during the day time or local tribe women, slum dwellers from the industrial towns located nearby, migrants or daily wage labourers from the construction sites, vegetable or fruit vendors at the halt points, etc. (NACO, 2006). Of late, sex workers are more aware of HIV/AIDS and they necessarily use condoms with their clients. Key populations with higher risk for HIV include overcrowded low-income areas such as slums and labour classes. Hence, there is a need to study the influence of HIV/AIDS PSAs used as part of major campaigns on television in Tamil Nadu where even sex education in schools is till date a taboo. The study has taken a televised PSA in the Tamil language, adapted from the Hindi language.

The objective of the study was to analyze the content of 'Pulli Raja' televised PSA on HIV/AIDS in the Tamil language in terms of its potential effectiveness and biases to promote HIV/AIDS awareness among the intended population, including men and women in low-income categories using discourse analysis methodology.

3. Review of literature

The review of literature revealed that innovative approaches have to be tried out to trigger behavioural change. The use of mass media as a tool to promote HIV/AIDS awareness has been used extensively (Noar, et al., 2009). Although practitioners are now more realistic about the outcome of media use, it remains attractive to health practitioners due to its wide reach, appeal and powerful nature alongside its cost effectiveness (Randolph and Viswanath, 2004). Myhre and Flora (2000) confirm that the use of television in HIV and AIDS campaigns often resulted in higher message exposure in developed countries, whereas the developing countries have often used a mix of low cost media such as radio and print materials. According to Singhal and Rogers (2003), communication strategies represent a key 'social vaccine' against HIV. Communication is a necessary, but not a sufficient condition for preventing HIV/AIDS, and for augmenting care and support programmes. Dillard, et al. (1996) found that fear appeals such as those used in HIV/AIDS campaigns do much more than scare people; they evoke a variety of affective responses that have separate and unique effects on persuasion. To construct effective public health messages, campaign designers must begin to give explicit attention to the affective outcome of their persuasive appeals. Approaches that effectively combine both behavioural and message design theories are more likely to be successful than those that use one without the other (Noar, et al., 2009). Go, et al. (2003) on a study about HIV prevention messages and gender

norms in slums of Chennai found that there is a direct linkage between marital violence and women's ability to protect themselves from HIV/AIDS.

4. Theoretical framework

The HIV/AIDS PSAs come in various forms to cater to the needs of various audiences. This study tries to find out if the new trends in PSAs should replace older strategies, by examining the 'Pulli Raja' PSA text. The study uses Health Belief Model (HBM). The HBM is a psychological model developed in the U.S. in the 1950s that explains and predicts health behaviours by focusing on the attitudes and beliefs of individuals. The key variables of the HBM are presented in Figure 1 (Rosenstock, Strecher and Becker, 1994).

5. Methodology

The research methodology followed is discourse analysis. The researchers carried out the analysis keeping in mind the mental outlook of the targeted population. In discourse analysis, interpretation arises from an act of reading or analysis which makes meaning of a text. Interpretations are based on contextualizing the text to social and historical realities. According to Fairclough (1995), interpretation focuses on three dimensions of discursive practice: (i) its manifestation in linguistic form (in the form of 'texts'); (ii) its instantiation of a social practice (political, ideological and so on); and (iii) a third dimension which focuses on socially constructed process of production, distribution and consumption which determine how texts are made, circulated and used. This study examined the message factors such as theme, appeal, PSA characters, target audience, target message, female characterisation, social reality and gender. Rogers (2003) and subsequent 'diffusion' studies concluded that the media was very important for increasing awareness but that interpersonal communication and personal sources were crucial in making decisions to adopt innovations (Waisbord, 2001).

6. Analysis and interpretation

For the purpose of this paper, one of the HIV/AIDS PSAs, 'Pulli Raja' has been analysed in depth. 'Pulli Raja' is one of the most popular PSAs brought forth on HIV/AIDS in the last two decades. The PSA had extensive reach as it was first to shake the cultural taboo of not talking about sex in the Tamil society. More so, it became popular as it was in public arena for a longer period of time, and in multiple media including large hoardings.

Background: 'Pulli' usually refers to an important person. But it could be anybody who is as small as a dot (ordinary person in the society). 'Pulli' in the Tamil language is also a full stop or an end for something. The message is that anyone could be infected by HIV. Pulli Raja is a representative of normal men, but also an important person with bad habits like consuming alcohol and visiting brothels. 'Raja', meaning King in the Tamil language and in other Indian languages as well, is also a common name in all strata of society. To start with, Pulli Raja's identity was not revealed. The name

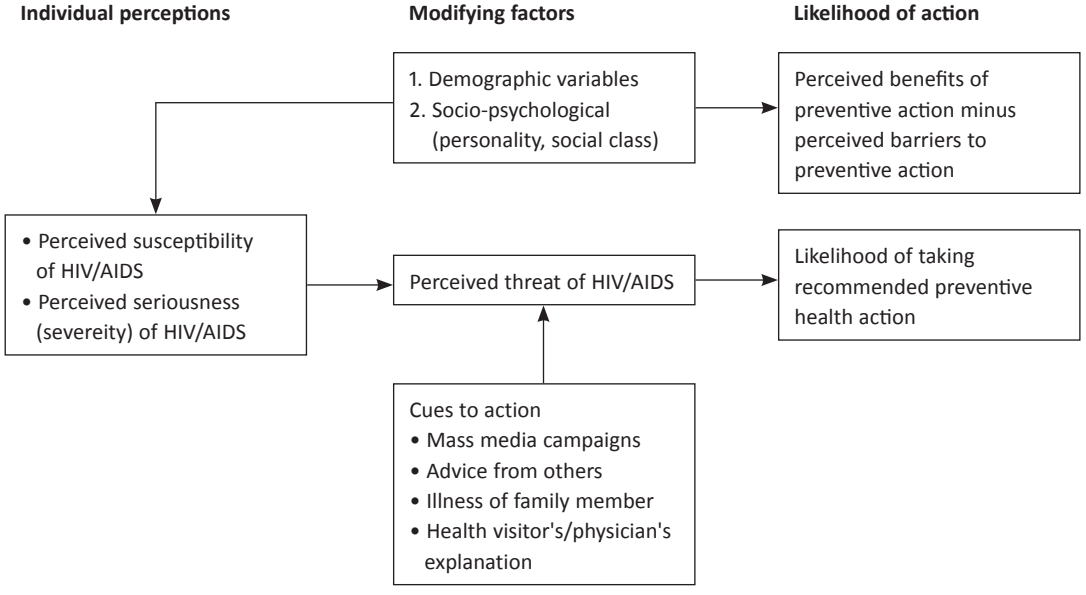

Figure 1: Theoretical Propositions of HBM (adapted from Rosenstock, Strecher and Becker, 1994)

itself suggests that he is a mischievous character. But such mischievous characters may look normal to the outside world. So first the question, "Will Pulli Raja get infected with AIDS [meaning HIV]?" followed by visuals of people from different walks of life under the same caption. Depicting people of different walks of life in the 'Pulli Raja' campaign implies that if you indulge in unsafe sex you will also contract HIV. Different people who repeat the same question in the PSA include common men from all walks of life. It serves as the reflection point for each man drawn from the different strata of society that everyone is susceptible to this deadly infection if he is not careful about his moral behaviour, especially if he is a habitual drunkard and has unsafe sex with the sex workers. It is also implied that no individual should think that HIV infection would not affect him but only others. This 'you' appeal is to dispel the feeling even among the so-called respected people that they are immune to HIV infection.

6.1 Text of the televised PSA

Location: Local bar

Opening shot: Two men sitting across a table facing each other. They consume alcohol and are laughing. A message is given by a man who drinks in the bar. He is portrayed as a participant, not as an observer or an outsider. A waiter places water on their table.

Man 1: *Will Pulli Raja get infected by AIDS?*

Who is Pulli Raja? Is he a friend, an acquaintance?

Man 2: [Looks at him] *If he is like you, he will get infected.*

The person he is addressing is careless, easily gets drunk and visits brothels.

Man 1: [Moves to the edge of the seat in eagerness] *Uh! How do you say?*

He is nervous and tense; he is uninformed but concerned.

Man 2: *If he gets totally drunk like you and goes after a woman, being too drunk to forget wearing a condom even once, he might get infected by AIDS.*

[Fear appeal]

It implies that this character does it often. It also implies that persons like him will also have the same feeling.

Man 1: (A close-up shot of a shocked and guilty face)

Guilty face denotes that he himself has indulged in such activities.

Man 2: *What? Did you understand?* [In a scolding and advising manner]

This is the manner adopted by film heroes too. In Tamil films, heroes are idolized. Their advice and their style of advice are taken seriously. The voiceover uses an interrogative. A voiceover is usually a voice of conscience. A third person is used for the voiceover. The viewers are asked to question themselves.

Voiceover: *Does Pulli Raja wear a condom each time?*

The message is not to avoid wrong relationships completely but to be safer and protected in such relationships. The message is incomplete and makes the target audience to find an answer and decide. Will Pulli Raja get inflected by AIDS?

6.2 Discourse analysis

In the 'Pulli Raja' PSA, viewers learned about the need for using condoms while going for sex.

Theme: Warning for drunkards, who would look for sex with sex workers!

Appeal: Emotional appeal of fear

PSA characters: Proximal characters

Target audience: Drunkards and sex workers

Target message: If you forget to use condom when you are drunk and have sex with sex workers, you may get AIDS [HIV]. If your drunkard behaviour has led you into unprotected sex with a sex worker or an unknown woman, then there is every possibility that you may get AIDS [HIV].

Female characterization: No woman is visually portrayed in this PSA, but it warns the drunkards verbally that if you go after unknown women, you may get infected with HIV. The PSA is trying to reaffirm the Tamil societal value system that it is always the woman about whom a man should exercise caution in spite of the fact that he himself is drunk and morally wrong. Here a stereotypical gender divide is constructed, which is pro-man. Discourse can be conventional and reproductive, accustoming people to accept it as common sense or fact; or creative and transformative, awakening people to realize alternative truths.

Social reality: The reason to portray a local wine shop could be that the men may not be conscious of their

behaviour when they are drunk, and to emphasize the probability that men meet each other there and socialize over a drink. It is like giving them a warning about their probable undesirable actions when drunk.

Gender: Sex workers are indirectly referred to as various women. Gender balance is like men are portrayed as drunkard and women as sex workers. According to Chong and Kvasny (2007), empowering HIV/AIDS prevention messages would, therefore, start from women's daily life experiences, lead women to question their original understandings about their own identities, and leverage the authoritativeness of the discourse providers to challenge ideologies that may heighten women's risk for contracting HIV.

6.3 Health Belief Model

The following analysis is based on the HBM.

Perceived susceptibility: In a conversation in 'Pulli Raja', the drunkard assumes his chances of getting infected and asks indirectly, "will 'Pulli Raja' get infected by HIV"?

Perceived severity: The other person says that if he is like you, he will get infected by HIV. He moves to the edge of the seat (exhibiting the anxiety of probably getting infected with HIV) and asks "How do you say?" (Consequences).

Perceived benefits: Even if they are not able to avoid having sex with sex workers, if they use condoms they can avoid getting infected by HIV.

Perceived barriers: The close-up shot of shocking and guilty face shows the psychological barrier whether he will be able to stop the drinking habit, or he will be able to use condom, if he is drunk and unconscious.

Cues to action: After talking about the use of condom the other person will ask in a screaming, advising manner, "Did you understand?" This is a reminder for others to follow.

Self-efficacy: The final voiceover asks, whether Pulli Raja always uses condom? This builds confidence in one's ability to use condom to avoid getting infected by HIV.

Consequence: There was a sudden spurt in condom sales and use due to (at least partially) the high-recall of the 'Pulli Raja' campaign which screamed from billboards, bus panels, television screens and cinema halls. The campaign had by then started moving into the villages as well.

The campaign, which was undertaken by the government in association with the PSI, did come in for criticism from some quarters. A few women's organisations had objected to 'Pulli Raja' advertisements saying that the PSAs were in bad taste and depicted women as immoral. But the PSAs were in response to the sexual habits of men and women in south India.

The PSI based its concepts on studies which revealed that one in every three men in the HIV/AIDS vulnerable group had more than one sexual partner. In an attempt to stem risky behaviour, it warned of the risks of having sex with sex workers if you are not protective and advised not to have sex with sex workers without using condom. It promoted condom use rather than abstinence or being faithful to the partner. But then, it is not talking about morals when the society has gone a particular way and there is a need for action as a matter of emergency. The need to behave as a responsible human being or citizen is more compelling than being a morally good person. Sometimes, people who hold so-called high moral values slip from their moral standing by oversight. It can lead to disastrous consequences particularly in the context of sexual morality and HIV infection. This is because if self-righteousness is so high among people, they do not think of using condom when they have pre-marital sex or extra-marital sex. Hence, the direct condom promotion in PSA campaigns is much needed to break adverse mind-set against the use of condoms. 'Pulli Raja' remains faceless throughout the campaign. He is every man, his conscience. He is an idea. This abstractness makes it easier for those in the target group to identify themselves with him. Showing the character's face will lead people to develop associations and reject bad similarities with him.

7. Conclusion

The PSA characters make the viewers identify with the characters. If the identification is stronger and messages clear enough, intended communication happens. Poor women are doubly discriminated – they are 'the other of the other'. They are neglected and disempowered first since they are poor, and second because they are women. Women who are victims of sexual violence are at a higher risk of being exposed to HIV. The lack of condom use means that women are immediately more likely to be exposed to HIV infection. Abused wives face increased HIV risk based both on the greater likelihood of HIV infection among abusive husbands and elevated HIV transmission within abusive relationships.

The PSA challenges the thought that men indulging in occasional sex outside marriage may not be at risk of being infected by HIV. Particularly in a Tamil society which sets a supposedly high moral standard, men having sex outside marriage normally do not have condom readily available for use. The PSA insists on not for-

getting condom use even if a man gets drunk and goes after a stranger for sex. The final voiceover asks, "Does Pulli Raja always uses condom?" This rhetoric instils on a man to have self-efficacy to use condom to avoid getting infected by HIV.

The study undertook a discourse analysis of the media text supplemented with HBM with the perception of the people in the state of Tamil Nadu in mind on the issue of HIV/AIDS communication, but it did not go to the intended population to know the impact of the PSAs.

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TOPICALITIES

Edited by Markéta Držková

CONTENTS

News & more

The year 2017 in Paperbase

paperbase INTERNATIONAL

Paperbase is a database for the field of pulp, paper and related products, collected since 1975. In 2016, its new version was launched – see the News & more section in 5(2016)3. During the course of 2017, the number of referenced sources has grown again, by seven thousand entries. The classification table below shows that traditional areas, as well as the latest research in materials and technology advances, are covered, together with the news from companies.

Subject Area	Abstracts Added
Company Information – Commercial Aspects	858
Company Information – Technical Aspects	1 110
Wood Fibrous Raw Material	556
Wood	527
Wood Chemistry	1 413
Wood Working, Wood Yard, Saw Mill	537
Non-Wood Fibrous Raw Material	1 190
Chemicals, Organic and Inorganic Compounds	659
Synthetic and Inorganic Fibres	597
Superabsorbents	542
Pulping (Including Washing)	599
Mechanical Pulping	575
Semichemical and Chemimechanical Pulping	550
Chemical Pulping, Organosolv Pulping and Biopulping	608
Production and Recovery of Cooking Chemicals, Pulp Industry By-Products and Biorefining	1 057
Bleaching	589
Stock Preparation	626
Paper, Board and Nonwovens Making – Wet-Laid Processes and Equipment	721
Finishing	589
Coating and Other Treatments	724
Instrumentation and Control	748
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Properties and Testing of Finished Paper and Board	957
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Composites	1 463
Fibreboard, Particleboard	556
Converting and Converted Products	745
Paper, Board and Nonwoven Packaging	900
Non-Conventional Printing	527
Paper, Board, and Nonwoven Printing Technology	752
Synthetic Paper and Nonwoven Products	544
Water, Effluent, Effluent Treatment and Air	826
Recycling and Waste Paper	751
Energy	682
Biotechnology	702
Nanocellulose	1 229
Regenerated Cellulose, Cellulose Derivatives	850
Engineering	1 229

Intergraf Economic Report on the European graphic industry

INTERGRAF AISBL
European Federation for Print and Digital Communication

Since late spring, the annual economic report from Intergraf is available. The evolution of the graphic industry in Europe is reviewed based on the OECD (Organisation for Economic Co-operation and Development), the European Commission, the statistical office of the European Union Eurostat, and relevant trade associations data. The country reports include also the data provided by some (but not all) of the Intergraf Member Federations, and one chapter is contributed by Smithers Pira.

The overview of the general economic situation in the first chapter builds on 2017 data and shows a positive outlook. The data on various aspects of the European graphic industry mostly show decreasing trends as detailed in the second chapter, with the industry profile and labour costs based on 2015, the production value on 2016 and trade figures on 2017 data. It is followed by the European print market review from Smithers Pira. The fourth chapter then presents the reports for ink, paper, publishing, book and press markets, together with the situation at energy and postal markets and the overview of value-added tax (VAT) rates. The fifth chapter includes country reports from Austria, Belgium, Bulgaria, Denmark, Estonia, France, Germany, Italy, Luxembourg, the Netherlands, Norway, Portugal, and the United Kingdom. These are based also on qualitative data and thus provide information beyond statistics, such as the influence of minimum wages, environmental legislation, attitudes towards print and digital, or support from European funds, as well as country-specific issues, e.g. the impact of Brexit on printing industry in the UK. Finally, the supporting data are provided as annexes.

Fifth drupa Global Trends report

Unlike the Intergraf report presented on the previous page, this report reflects the state of the industry as seen by the companies participating in the global survey. Its fifth edition released in April 2018 analyses the survey conducted last November in which 708 printers and 234 suppliers took part, with about two-thirds coming from Europe and the rest from the other regions.

Similarly to the 4th one, the 5th drupa Global Trends report shows the economic confidence of European printers as the most realistic, whereas the gap between the expected and actual economic situation is the biggest for printers based in Africa, Middle East, Asia and North America; however, the North American printers still rate the current economic situation more positively than the printers in Europe. When comparing the positive and negative answers, the net balance for both regions is about 40 %. In the case of suppliers, the forecasted and actual numbers are close across all regions and range roughly between 40 and 70 %. Overall, the report was summarised as "a clear recovery" and reflects the successful implementation of modern technologies, including the integration of digital communications. With respect to the investment plans, sheetfed offset was reported among the top two print technologies for publishing, commercial and packaging print, complemented by electrophotography for the first two and flexography for the third sector. For functional print, the plans are dominated by the inkjet technology.

PIA iLearning offer

Printing Industries of America runs the online education platform that is free for its members and paid for the others. Recently, the Preparing Files for Digital Enhancement course was added, focused on the digital application of effects such as spot inks, dimensional varnish, foil, etc.

Among the terms searched in Paperbase during 2017, the most frequent are – not surprisingly – the general ones like lignin, paper and pulp, with different types and aspects of cellulose at the top of the list. The interest in micro- and nanofibres is balanced. A large number of searches is connected to various material properties, treatments and modifications, including different chemical treatments and compounds, catalytic effects, etc. The users were also interested in substances used as absorbents, adsorbents and fillers. One of the often searched prefixes was bio-, including biofuels and the employment of hydrothermal processes. Among enzymes, e.g. laccase was searched. Tens of queries were related to print, packaging and other applications.

Some Paperbase users were also looking for information on companies, industry associations, such as TAPPI, conferences and symposia, as well as on proceedings, journals and also particular researchers. When following the activity during the year, the busiest are the winter months, while the number of searches in the third quarter is significantly lower due to the summer holiday period. The interest in many subjects was more or less stable. At the end of 2017, conversion, degradation and pyrolysis gained interest.

We thank Camilla Burman, RISE Research Institutes of Sweden, for providing the Paperbase data.

Gate to available grants – Mendeley Funding

Many researchers know and maybe use Mendeley as a reference manager and academic social network, some for over ten years already. It was founded in 2007 and later, in 2013, purchased by Elsevier. Since 2015, Mendeley offers also a cloud-based repository for storing and sharing datasets, Mendeley Data. In 2016, Mendeley Careers was launched, assisting its users in search of science and technology jobs. Another year later Mendeley Funding was started as one of the tools which the research community and other involved parties can use to find relevant funding opportunities. It links to many thousands of open calls, covering various types of funding and funding organisations. Although the latter two services are rather new, their appreciable improvement has been announced a few weeks ago. Same as Mendeley Careers, newly suggesting job positions, Mendeley Funding now makes use of machine learning to provide researchers with the most relevant funding opportunities according to their interests and expertise. Users interested in this feature can receive email notifications with suggestions of the latest funding possibilities, based on their Mendeley profile.

When searching using the keyword 'printing', the portal offers more than 150 funding opportunities across different research areas from social sciences to materials science and engineering, with funding for fellowships, projects, conferences, and more. Users can also learn about related prizes, for example, about The Royal Photographic Society award for photographic publishing, which was introduced in 2016. The search can be also refined based on the amount, application deadline, funder, country of citizenship, and applicant type. The last one includes options ranging from undergraduate students to experienced researchers, from academic institutions over local or state governments to small and medium businesses, and specific applicant types, such as persons with disabilities. Naturally, not everything is perfect; e.g. when searching for a higher amount, it is better to sort the results because the filter returns also all items without the specified amount.

Bookshelf

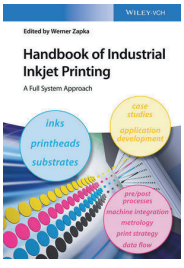
Handbook of Industrial Inkjet Printing: A Full System Approach

This two-volume handbook should provide sufficient background to facilitate implementation of inkjet applications in industry. It covers industrial inkjet printing in a wider sense, that is, all inkjet applications except home and office printing. Although it is contributed by the authors from industry companies, it aims to concentrate on technical details, avoiding simple marketing terms and messages.

The content covering individual relevant areas is organised into eleven parts. The first one compares the advantages and disadvantages of inkjet printing and screen printing because the latter is seen as another printing technique being the most suitable for industrial applications. The next three parts overview various aspects of key technology elements – inks, printheads, and substrates. Ten chapters on inks, their components and curing systems cover various types of inks, including UV, aqueous, sublimation, ceramic, and silver nanoparticle ones. The part on inkjet printhead technology presents the most common among the best available printhead types for industrial inkjet printing, with diverse types of piezoelectric ones and also those based on the bubble jet technology and on the continuous jet of ink with nano-sized pigment particles. Among the substrates required in industrial inkjet applications, paper and paper-based substrates, polymeric nonabsorbing substrates and glass substrates are described with respect to their characteristics and surface properties.

The following four parts deal with the metrology, presenting modern control methods necessary for high and long-term reliability, the importance of efficient data flow, give advice on a system approach to machine integration and various related aspects, and explain processes used for substrate and print treatments applied prior to and after printing, namely plasma surface pretreatment for wettability adjustment, UV LED ink curing, electron-beam curing, photonic curing for high-speed sintering of metal inkjet inks, and oven drying. The last three parts present strategies to turn industrial application requirements into real printing solutions, application development in cases of printed electronics, metal lines and sensors printed on 2D and 3D plastic substrates, hybrid processing utilising inkjet and laser, and additive manufacturing, including bioprinting, and finally the details of successful implementations and case studies.

The related terminology is summarised in the glossary – from general physics terms, such as evaporation, viscosity and surface tension, over common words with specific meaning in inkjet technology (for example swathe, i.e. the width of print that is produced by one pass, or priming, i.e. introducing ink to an inkjet printhead and forcing ink out of the orifices to expel air prior to printing) up to inkjet-specific terms, such as coanda catcher, drop-on-demand and satellite droplets.

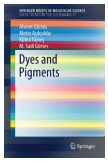


Editor: Werner Zapka

Publisher: Wiley
1st ed., January 2018
ISBN: 978-3-527-33832-0
984 pages
Hardcover
Available also as an eBook

Dyes and Pigments

Authors: Ahmet Gürses, Metin Açıkyıldız, Kübra Güneş, M. Sadi Gürses

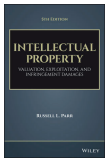


Publisher: Springer
1st ed., May 2016
ISBN: 978-3319338903
83 pages, 23 images
Softcover
Also as an eBook

In five chapters, the authors go through historical development of colorants, describe the structure of dyes and pigments along with their properties and perceived colour given by the interaction with light, provide the classification of dyes and pigments, followed by an overview of dyeing and painting, and then discuss the health considerations and environmental aspects of colorants, including waste dye treatment. Among others, the book gives examples of common chromophoric groups and types of transition, shows the relationship between colour and absorbed light wavelengths, presents the theoretical approaches to a colour–structure relationship, and reviews the use and consumption of the common colorants.

Intellectual Property: Valuation, Infringement, and Joint Venture Strategies

Author: Russell L. Parr

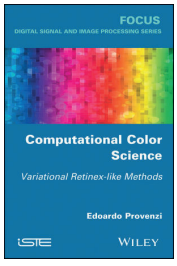


Publisher: Wiley
5th ed., April 2018
ISBN: 978-1119356219
672 pages
Hardcover
Also as an eBook

This classic and informative book is now available in its 5th edition. The author elucidates the valuation approaches for different purposes, including licensing agreements and the setting of reasonable royalty rates, as well as the determination of infringement damages. Discussion of valuation errors, early-stage technology valuation and other special situations, university licencing, evolving patent damages, copyright

Computational Color Science: Variational Retinex-like Methods

This concise book starts with the background on the human visual system that processes visual signals by the retina and brain, introducing some important concepts and formulae built upon further, especially in the last chapter. The computational part presents first the colour constancy algorithms, describing the dichromatic and Lambertian image formation models and discussing classical hypotheses for illuminant and reflectance estimation. Then, a mathematical description of the original ratio-threshold-reset Retinex (Retina plus Cortex) algorithm is given, along with its analysis and other Retinex-like algorithms for colour image processing. It is stressed that the central concept in the Retinex theory is the spatial locality of colour perception and that the theory aimed to quantify how is the colour perception of a given spot modified by its surrounding. The next chapter deals with the variational formulation of histogram equalisation and application of such techniques to colour images. Finally, the perceptually-inspired variational models for colour enhancement in the RGB space are developed in the fifth chapter. Here, the scaling mechanism is introduced in addition to the threshold and reset mechanisms considered in the third chapter.



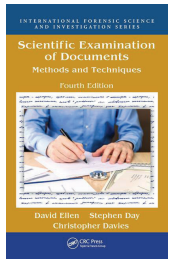
Author: Edoardo Provenzi

Publisher: Wiley
1st ed., May 2017
ISBN: 978-1-786-30159-8
142 pages
Hardcover
Available also as an eBook

Scientific Examination of Documents: Methods and Techniques

The book intended for all who deal with questioned documents summarises current knowledge on handwriting with respect to variations between normal writings, accidental and deliberate modification of handwriting, the purposes and principles of its scientific examination and the importance of the proper collection of samples. Further, typewriting, typescripts and the materials of handwritten documents are covered. The chapter on the examination of printed and photocopied documents was completely updated to reflect both the advances in respective materials and technologies, including inkjet printing, and developments of relevant analytical methods. The role of biological and fingerprint evidence collected from documents is also discussed, as well as various imaging techniques available. The last chapter then presents the document examination in court.

Authors: Stephen P. Day, David Ellen, Christopher Davies

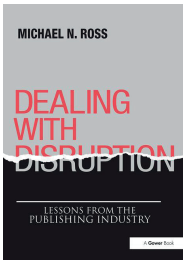


Publisher: CRC Press
4th ed., May 2018
ISBN: 978-1-4987-6803-0
248 pages, 30 images
Hardcover
Available also as an eBook

Dealing with Disruption:
Lessons from the Publishing Industry

Building on his first-hand experience, Michael Ross in this book provides a valuable insight into the topic which is crucial for the future of all publishers around the world. He describes how the publishing industry has been and still is struggling with the digital threat but he also presents the digital technology as an opportunity to provide the content in an appealing and efficient way. As ever, also this challenge should be seen as the one bringing innovation and opening new perspectives in today's publishing.

Being aware that consumers generally have become more comfortable with using digital products but still their appetite for physical books remains strong, the book discusses business models and other key aspects for the success in both local and global markets, showing how to employ current technology at individual stages of the publishing process. While presenting the new tools and current media landscape, the stress is put also on one thing which did not change – the need for quality and trust. All that is complemented by practical examples. The overview of international book fairs, links to information on publishing and licensing and the sample licensing agreement are provided as appendices. The paperback edition of this well-accepted book is available since January 2018.



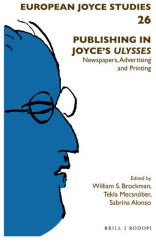
Author: Michael N. Ross

Publisher: Routledge
1st ed., March 2016
ISBN: 978-1-4724-5687-8
216 pages
Hardcover
Available also as an eBook

Publishing in Joyce's Ulysses:
Newspapers, Advertising and Printing

The essays written by twelve contributors explore the printing and publishing industries as known by James Joyce and reflected in his Ulysses. The Joyce scholars analyse the references to the late Victorian weekly journals, especially George Newnes's Tit-Bits, but also Photo Bits and others, big news events in 1904, steganographic aspects of Joyce's writing and messages concealed within common texts, the classified advertising treatment, the advertising language and female consumers depiction, as well as the other prominent instances of advertisements present in the book, followed by various aspects of the newspaper-office episode, the role of newspaper clippings, and finally the shift in typography of Ulysses editions until 1940.

Editors: William S. Brockman, Tekla Mecsnóber, Sabrina Alonso



Publisher: Brill Rodopi
1st ed., January 2018
ISBN: 978-90-04-35904-8
232 pages, 60 images
Softcover
Available also as an eBook

damages, controversy about so-called patent aggregators, and many more are covered. All terms are clearly explained and the concepts are illustrated by real-world examples of valuation methods, exploitation strategies and court cases.

Digital Type Design for Branding:
Designing Letters from Their Source

Author: Stephen Boss

Publisher: CRC Press
1st ed., February 2018
ISBN: 978-0815365532
224 pages, 225 images
Hardcover
Also as an eBook

This reference is primarily aimed at situations when there is the need to design a set of particular characters, not to develop a complete alphabet. After overviewing the history and providing the timeline with main milestones, the chapters go through the 26 English characters, presenting the origins of individual letters and how-to illustrations highlighting the process of building letterforms. The next part deals with letter frequency and numerals, followed by projects at Design School Kolding and interviews.

Typographorum Emblemata:
The Printer's Mark in the Context of Early Modern Culture

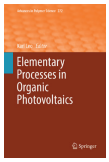
Editors: Anja Wolkenhauer, Bernhard F. Scholz

Publisher: De Gruyter Saur
1st ed., February 2018
ISBN: 978-3110439199
429 pages, 188 images
Hardcover
Also as an eBook

This collection of 17 articles explores in-depth the European printer's mark. It is organised into three main parts that present printer's marks origin and relationship with emblems, their development in selected regions and places, and some related historical and systematic concepts.

Elementary Processes in Organic Photovoltaics

Editor: Karl Leo

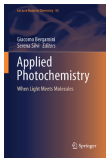


Publisher: Springer
1st ed., December 2016
ISBN: 978-3319283364
421 pages, 244 images
Hardcover
Also as an eBook

The potential seen in organic photovoltaics is reflected in numerous recent research activities. This book is based on a large collaborative research of several groups, financed within the "Organic Photovoltaics" German priority programme during the years 2008–2015, and presents a number of improvements achieved within the projects – from the theoretical design of new molecules, over the practical organic chemistry and synthesis of the materials, their characterisation and description of device principles, to the engineering aspects of device design and module integration. The emphasis put on the interdisciplinarity of research groups was a key to gain a better understanding of the working principles, necessary for the further development of organic photovoltaics technology and its applications.

Applied Photochemistry: When Light Meets Molecules

Editors: Giacomo Bergamini, Serena Silvi



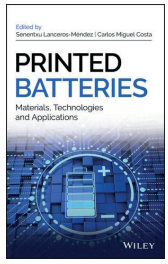
Publisher: Springer
1st ed., July 2016
ISBN: 978-3319316697
533 pages, 485 images
Hardcover
Also as an eBook

Dealing with photochemistry topics relevant for various areas, this volume explains, among others, solar energy conversion in photoelectrochemical systems, working principles and device technology of organic light-emitting diodes, light-emitting electrochemical cells, and industrial photochromic dyes. The utilisation of photochemical reactions in biology, medicine, environmental sciences and art is also covered.

Printed Batteries: Materials, Technologies and Applications

The first chapter of this book provides an introductory overview of types and design of printed batteries together with their main advantages, disadvantages and application areas. It also briefly mentions printed commercial batteries. The second chapter is dedicated to printing techniques for batteries. After a short overview of materials and substrates, it presents both flatbed and rotary screen printing along with screen mesh and squeegee, stencil printing, letterpress and flexographic printing, gravure printing, offset lithography, coating, and inkjet printing, including its advanced applications. Drying, process chain and printing of layers are discussed as well. The next two chapters deal with the influence of slurry rheological characteristics on lithium-ion electrode processing and with the polymer electrolytes for printed batteries prepared by different techniques. The fifth chapter presents the approaches to the design of printed batteries, considering also their aesthetic versatility. The following chapter is focused on applications, namely on microbatteries, primary batteries, rechargeable batteries, high-performance structured batteries, power electronics and energy harvesting, while the next one provides the industrial perspective on printed batteries, again presenting printing technologies for functional printing and then giving more detail on screen-printed thin film batteries, their applications and combination with other flexible electronic devices, as well as comparison with conventional ones. The concluding chapter sums up the open questions, challenges and outlook for the future research.

Editors: Senentxu Lanceros-Méndez, Carlos M. Costa

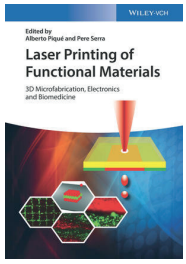


Publisher: Wiley
1st ed., April 2018
ISBN: 978-1-119-28742-1
264 pages
Hardcover
Available also as an eBook

Laser Printing of Functional Materials: 3D Microfabrication, Electronics and Biomedicine

This comprehensive book is organised into three parts that cover the fundamentals of laser-induced transfer processes and their modifications, the use of this technology for different types of materials, and its applications in various areas – printing of electronic materials, chemical and biological sensors, proteins and biomaterials, cells for tissue engineering, 3D metal structures, entire intact structures and components for embedded electronics, including the analysis on the industrial perspectives of laser printing.

Editors: Alberto Pique, Pere Serra



Publisher: Wiley
1st ed., May 2018
ISBN: 978-3-527-34212-9
480 pages
Hardcover
Available also as an eBook

Bookshelf

Academic dissertations

Investigation on the Mechanical Behavior of Paper and Paper Stacks in the Out-Of-Plane Direction

Doctoral thesis – Summary

Author:
Jian Chen

Speciality field:
Paper Science

Supervisors:
Edgar Dörsam
Samuel Schabel

Defended:
1 November 2016, Technical University of Darmstadt, Department of Mechanical Engineering, Institute of Printing Science and Technology Darmstadt, Germany

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With clearly defined focus on mechanical behaviour of paper materials in the out-of-plane direction, the main concern of this dissertation was the compressive behaviour of a single sheet and of multiple sheets, extending the knowledge beyond the existing, mostly constitutive models for only one sheet. After providing the brief literature overview and setting the research goals, the experimental setup is presented and basic characteristics of the force–deformation curve of paper and its elastic–plastic behaviour are given. Throughout the work, normal copy paper (80 g/m^2) was taken as a representative example, with the applied force ranging up to 100 N for the most of experiments. All experiments were done under standardised climatic conditions. In the third chapter, the influence of surface roughness on mechanical behaviour of paper is considered. The actual contact areas were made visible using carbon paper and then the image processing was applied. The next two chapters describe models for paper and paper stacks. In the theoretical modelling, paper is regarded as an elastic material with two rough surfaces and one internal structure, described using pyramid and tubular elements, respectively. Two different calculation methods based on the literature are presented and compared for one sheet and then the model is extended and applied for the force–deformation relationship calculation of multiple sheets. In all cases, the match of calculated and experimental results is discussed. The deviation markedly increased above 130 sheets. With the second approach, the paper structure is not considered and the J-shaped stress–strain relations are approximated using suitable equations. The descriptive model based on the literature is again presented for one sheet and then extended for paper stack, with comparison of the calculated and experimental results. Finally, the utilisation of gasket model in finite element method (FEM) software for compressive simulation of paper materials is shown and verified by comparison with the experimental results.

Improving Image Quality in Multi-Channel Printing – Multilevel Halftoning, Color Separation and Graininess Characterization

Doctoral thesis – Summary

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This dissertation aimed to provide the solutions ensuring an improvement of perceived image quality, which is the core reason why multi-channel printing employing additional inks is used, while at the same time increasing the efficiency of the process. Common issues connected to multi-channel printing comprise the rise in computational time due to the one-to-many mapping problem when the same colour can be reproduced by several ink combinations and, in respect to the ink placement, the risk of over-inking and graininess. The first chapters introduce the topic and bring the background on colour theory and reproduction with related metrics, halftoning algorithms, colour reproduction models and halftone quality evaluation methods. Based on the experimental verification, the graininess index (GI) was selected as the most suitable metric for the research on developing or adapting halftoning algorithms and colour separation models carried out within the thesis, presented in the second part. First, a multilevel halftoning algorithm suitable for multichannel printing purposes is implemented and

analysed for the combination of primary CMYK inks and their light counterparts, forming corresponding subsets varying in lightness. The challenges resulting from the combination of several inks in one channel consisted in finding the appropriate ink limits and compensating the dot gain. These aspects are related, as the thresholds between the inks are highly dependent on the paper grade due to the dot gain effect. With this approach, the inks are printed dot-off-dot and only four channels are kept in the colour separation, so the characterisation complexity is not increased. The resulting images showed smooth tonal transitions and decreased graininess, with a somewhat reduced colour gamut. Second, correct colour separation based on both colorimetric and spectral data is addressed, also enabling to overcome chromatic discrepancies of the inks within a channel, and the accuracy of print characterisation employing multilevel halftoning is evaluated by comparing the predicted spectral data to the measurement of 50 randomly chosen patches. Finally, a colour separation approach applicable when additional RGB colorants are used in the print setup is proposed, taking into account the reproduction quality in terms of graininess and colour accuracy; the procedure included the graininess prediction using the developed method. It was shown that the image quality can be improved by choosing the ink combinations which reduce graininess while closely resembling a colorimetric input, without the perceivable loss of colour accuracy and mostly with the only slight increase in ink consumption.

Doctoral thesis – Summary

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A Quantitative Study of Spelling Variation in William Caxton's Printed Texts

With an approach utilising current data-processing capabilities and digitalised content, this dissertation presents the study of books published by William Caxton in the 15th century based on the simultaneous analysis of all the spellings contained in Caxton's texts. The bottom-up quantitative approach in combination with existing bibliographical knowledge enabled in-depth exploration of editorial and printing processes used in Caxton's printing house, comparing the spellings of the individuals involved, i.e. the compositors and the scribes. The opening part of the dissertation introduces the research questions and context. An important point is that the layers of spellings were introduced into Caxton's printed texts in the successive processes of copying and further that the discrete sections of different spellings were introduced in cases when more people worked on a text at the same time. The background on fifteenth-century printing history, spelling and the process of type justification is given. Through quantitative analysis, it is shown that the printing process has little influence over the orthography of the printed text. The main part first describes the design of data-driven quantitative methods enabling detection and analysis of the orthographic idiolects present in printed texts, along with their testing and optimisation. These methods are based on cluster analysis and similarity measurements. Then, the application of these methods to a selection of Caxton's texts is presented (2.2 million words in total). Spelling data are used to locate individuals and examine similar spellings; then the data are assessed with respect to an evidence of Caxton's influence, showing his practices as an editor and translator. It was proved that Caxton's texts are not made up of the spellings of just one person, but contain spellings from a number of involved people like in case of manuscripts. Based on the findings, the author argues that all spellings are of equal importance when establishing whether a change in idiolect takes place within a text. The presented innovative approach provides a means to gain further insight into the historical spelling variation and the history of early printed books in general.

Events

NANOTEXNOLOGY 2018

Thessaloniki, Greece
30 June to 7 July 2018

Traditionally, this large event features numerous contributions that employ the advanced applications of printing technologies, among others. The plenary session for this year offers talks on 'Plastic nanoelectronics for the Internet of Things (IoT)' by Thomas D. Anthopoulos, 'Bio-responsive hybrid materials for regenerative medicine and biosensing' by Molly M. Stevens and 'Nanotechnology, 3D printing and organic electronics in automotive applications' by Ashutosh Tomar. One of the keynotes of the 15th International Conference on Nanosciences and Nanotechnologies deals with 3D bioprinting of responsive hydrogels and ionogels, while invited talks include, e.g., the commercialisation of fully roll-to-roll printed organic photovoltaics. The 11th International Symposium on Flexible Organic Electronics offers a keynote on printed hybrid electronic, optoelectronic and photovoltaic devices, invited talks covering the multi-scale high-resolution mapping of printed photovoltaics, volume plasma functionalisation of graphene nanoplatelets and its impact on conductive inks performance, state-of-the-art printed batteries, defect control in laser-printed and solution-processed organic field-effect transistors, printing of flexible wearable stretchable electronics, and other contributions with variety of topics, from screen-printing ink for all-solid-state flexible supercapacitors over the use of spectroscopic ellipsometry for in-line, real-time quality control of roll-to-roll printed perovskite films to the overview of printed electronics activities in China.

The sessions of the International Workshop on 3D Printing, 3D Bioprinting, Digital & Additive Manufacturing are dedicated to a plenty of applications of inkjet and other 3D printing techniques. The programme also includes the presentations mapping the progress of twenty EU funded R&D projects in nanotechnologies and organic electronics, for example, the InSCOPE – Open-access pilot line to accelerate industrial uptake of hybrid printed electronics. These three events are accompanied by the 8th edition of NANOTEXNOLOGY Expo and fill the whole working week, which is framed by three weekend days of 12th International Summer Schools on Nanosciences & Nanotechnologies, Organic Electronics and Nanomedicine.

Printing for Functional Applications
Summer School

Swansea, UK
9–13 July 2018

The courses of this summer school hosted by the Welsh Centre for Printing and Coating (WCPC) again offer the proven content that embraces design and applications, printing processes, inks, substrates, curing and characterisation, as well as practical sessions. The school takes place at the new Swansea University Bay Campus, where also the 5th Advanced Screen Printing Workshop of Asada Mesh is organised two months later (10–11 September).

Serigrafia SIGN FutureTEXTIL 2018

São Paulo, Brazil
25–28 July 2018

The 28th edition of this Latin American exhibition for the printing and visual communication markets provides its visitors with an opportunity to see practical demonstrations of screen printing applied, e.g., in casual fashion and sports, promotional souvenirs, footwear and textile printing, as well as the possibilities of printed interior decoration, this year applied in a commercial environment. The Forum space is reserved for lectures, debates and practical cases.

PackPlus 2018

New Delhi, India
25–28 July 2018

PackPlus and the co-located shows serve for the whole packaging, processing and supply chain in India and neighbouring countries, presenting live demonstrations and new product launches. The main topic of the annual International Packaging Conclave on 27 July is the forthcoming regulation for safe packaging.

CGDIP 2018
2nd International Conference on Computer Graphics and Digital Image Processing

Bangkok, Thailand
27–29 July 2018

The conference organised by the Asia Pacific Institute of Science and Engineering is focused on computer graphics, image processing, computer vision, modelling and animation, visualisation, means of interaction and related foundations. For its second year, Shahram Latifi, David Zhang and Sasan Mahmoodi are announced as keynote speakers.

I3S 2018
6th International Symposium on Sensor Science

Kenting, Taiwan
6–8 August 2018

This year, the meeting held by the Sensors journal is taking place in Asia for the first time. The co-located event, 4th SPINTECH Technology Thesis Awards, is organised to support the cooperation between industry and academia, with prizes and monetary awards for both the advisors of theses and students.

CIE Expert Tutorial and Workshop on Research Methods for Human Factors in Lighting

Copenhagen, Denmark
13–14 August 2018

For this event, the invited presentations combined with workshops cover the key elements of best practices in lighting research, namely the theoretical perspectives and hypothesis generation, critical analysis, research preparation with consideration of ethic issues, risk assessment, etc., photometric measurements, determination of dependent variables, such as behaviour and health, recent innovations, e.g., 'big data', research design for laboratory as well as field investigations, including the internal and external validity, causal inference, statistics and data interpretation, and finally the advice on appropriate reporting of the results.

WAN-IFRA Events

Besides several educational events organised during the summer weeks, the WAN-IFRA offer for the forthcoming months includes the eRev Exec Programme taking place in Washington, DC, USA and the WAN-IFRA India Conference held in Hyderabad, which are both scheduled to 25–27 September 2018.

IGAS 2018
International Graphic Arts Show

Tokyo, Japan
26–31 July 2018

After three years since the last edition, this Japanese trade and educational event is jointly organised by the Japan Printing Machinery Association and the Japan Association of Pre-Press & Digital Printing Systems Suppliers. The show this year features four theme zones – the Research and Education Zone presenting next-generation printing technologies from university laboratories, and zones dedicated to flexography, small and medium enterprise support, and the Japan Color Certification System. Further, the Small Start Zone is reserved for the unique technologies and products with the high added value produced in small series, intended primarily for small and medium-sized printers. Inspiration can be gained also at the Japan Printing Exhibition showcasing a variety of prize-winning printed products from various competitions.

The seminar programme on 26 July includes the keynote by Thayer Long, reviewing the global trends and innovations in the printing industry, and the panel discussion on digital printing and the printing industry outlook and challenges specific to principal member countries of the Forum of Asia Pacific Graphic Arts (FAPGA). On the next five days, a number of panel discussions focused on various themes are planned, held from the brand owner's perspective. The topics include new media approaches including cross-media, digital printing and aqueous flexographic printing in soft and label packaging, hybrid printing combining offset and digital, high-speed web-fed inkjet digital printing, technology changes in the field of publishing, extended gamut and ganging on flexographic printing, and the Japan Color digital print certification.

High-Performance Graphics 2018

Vancouver, Canada
10–12 August 2018

This event is organised by the representatives of major manufacturers and research institutes active in the field of performance-oriented graphics systems and in 2018 it celebrates its 10th year under this name, as it was first held in 2009 as a successor of the former Graphics Hardware and Interactive Ray Tracing conferences. The presentations from the previous editions are available online in the web archive for the High-Performance Graphics conference series.

The keynote for 2018 announced to date is 'Game ray tracing: state-of-the-art and open problems' presented by Colin Barré-Brisebois. The programme consists of regular sessions focused on the efficient rendering enabled by real-time adaptive temporal filtering, importance sampling of many lights and optimised scene simplification, the methods for fast vertex processing, the approaches to noise generation, and on the ray tracers. Short papers sessions are reserved for presentations dealing with anti-aliasing, ray traversal, transparency, and GPU (Graphics Processing Unit) computing. The Hot3D Session scheduled on the last day features the talks by industry experts. The conference wraps up with the Wolfgang Straßer Best Paper Award for the authors of the most outstanding paper presented at the event.

SIGGRAPH 2018

Vancouver, Canada
12–16 August 2018

The theme of the 45th SIGGRAPH Conference on Computer Graphics and Interactive Techniques is "Generations" and points to all who took part in this event through the years and inspired the next generations. One of them, Rob Bredow, was asked to give the keynote for this year's conference.

The 2018 programme is prepared for five interest areas. The main items are the Technical Papers conference for Research & Education, the SIGGRAPH Computer Animation Festival for Production & Animation, and the Art Papers and Art Gallery programmes for Arts & Design. All participants, including those interested in Gaming & Interactive and New Technologies, can learn about the latest advances in the Talks Forum, Panels sessions and Courses. As a new feature, the Thesis Fast Forward live event has been announced. Doctoral students finishing their studies or PhD degree holders within a year of graduation can submit an abstract and a three-minute video presentation explaining the central theme of their thesis. Up to twelve candidates then will be asked to participate in a special SIGGRAPH session.

SPIE Optics & Photonics 2018

San Diego, California, USA
19–23 August 2018

The cutting-edge printing applications are again represented in many conferences across the programme of this large multidisciplinary optical sciences event, such as in all papers within the session focused on Printed Sensors and Integrated Devices. These include the invited papers dealing with 3D-printed electrochemical sensor circuits, an augmented book platform, and examination of hybrid memory devices by means of nanoscale spectroscopy and microscopy methods. Further, the session on Organic and Hybrid Sensors and Bioelectronics features the invited paper 'From printed organic photodiodes to printed image sensors' and presentations of a microfluidic platform for gas and fluid sensors produced roll-to-roll and functionalised by means of digital printing technologies, fully printed light-emitting bioelectrochemical cells and 3D-printed photonic components. As another example, inkjet-printed vertical-stack thin-film transistors can be mentioned.

IC-MAST 2018
7th International Conference on Materials and Applications for Sensors and Transducers

Bratislava, Slovakia
24–27 September 2018

This year's IC-MAST conference is co-organized by the Institute of Physics, Slovak Academy of Sciences. The programme contains, among others, the presentations of neat poly(vinylidene fluoride) in the piezoelectric β-phase produced directly from the melt in a 3D-shape that can be printable, and the Fe_2O_3 and ZnO/Fe_2O_3 screen-printed sensors used to detect the breath of three persons with combinations of diabetes and smoking.

XIV Conferenza del Colore 2018

Florence, Italy
11–12 September 2018

This conference deals with colour and light from a professional and scientific point of view. The programme starts with a series of tutorials on different colour-related topics and continues with the presentations of submitted works (in Italian or English).

FESPA Events

Two of the regional exhibitions held worldwide by the FESPA organisation are scheduled for the late summer weeks. The first one, FESPA Africa taking place in Johannesburg, South Africa (12–14 September), is again co-located with Sign Africa and Africa Print shows. As the second one, FESPA Mexico is held in Mexico City, Mexico (20–22 September).

OLEDs World Summit

San Francisco, California, USA
18–20 September 2018

The annual OLEDs World Summit, organised by Smithers Apex for the global lighting and display industry to track the development of organic light-emitting diodes, celebrates in 2018 the 20th anniversary. The sessions are designed to compare the present state of quantum dots and OLED technologies, review current advances in materials and manufacturing along with achieved performance and efficiency of OLEDs, including those employing the TADF (Thermally Activated Delayed Fluorescence) emitter materials, and discuss challenges and innovations in the most common OLED applications, as well as the needs of end-users.

FachPack 2018

Nürnberg, Germany
25–27 September 2018

FachPack 2018

This trade fair for packaging covers all related industry solutions, with the PackBox Forum specialised on packaging, packaging printing and processing topics, while the TechBox Forum is focused on packaging technology and logistics.

The special shows at FachPack this year include two new ones. Besides the special space reserved for premium packaging, the Marketplace "Sustainability and plastics – no contradiction" is introduced to give an insight into the resource and energy requirements of plastic production.

Labelexpo Americas 2018

Rosemont, Illinois, USA
25–27 September 2018

25 - 27 September · Chicago
LABELEXPO AMERICAS 2018
www.labelexpo-americas.com

This large show for label and packaging printing presents the latest presses, finishing units, inks and substrates, including their live demonstrations, this year with special focus on automation, including management information systems and workflow automation, more environmentally conscious production, inks, coatings, primers and varnishes for modern narrow-web converting operations, and shrink-sleeve technology.

5th International Digital Textile Printing Congress 2018

Ghent, Belgium
27–28 September 2018

5th International Digital Textile Congress 2018

This event is organised to bring forward the research and development in digital technologies for textile printing, including hardware, software, inks, substrates and applications.

ICFPE 2018
9th International Conference on Flexible and Printed Electronics

2018 ICFPE

Changzhou, China
25–28 September 2018

This Asia-based technical conference is held annually (except the year 2011), rotating between Korea, Japan, Taiwan and Mainland China. In 2018, the event is co-located with the 8th Chinese National Symposium on Flexible and Printed Electronics, Flexible Electronics Summit 2018 and Flex China 2018. A special feature for this year is the flexible printed electronics business competition held on 25 September and entitled FlexFuture – Global Demo Competition & Awards, providing startups with the opportunity to present their business cases based on the innovative technologies to investors from China invited to sit in the panel together with international experts and decide about the awards.

Among plenary speakers, Harri Kopola is about to give a talk on 'Printed intelligence routes to industrialization and new applications', presenting the PrintoCent innovation centre that provides companies with easy access to new business development and pilot manufacturing resources. The lecture focus is on the novel applications developed in the 2016–2018 period. The topic of a keynote given by Je Ping Hu is closely related, with a presentation of the flexible electronics pilot laboratory that was established in Taiwan in 2007, as the first one in Asia. The three core areas that are in focus are connected with the roll-to-roll production, development of organic light-emitting diodes for lighting with sun-like colour, and bio-sensor platform. The other four plenary speakers announced are Yunqi Liu, Klaus Hecker, Yibing Cheng, and Jeremy Burroughes. Five parallel sessions are scheduled in the afternoon of each conference day, dedicated to materials and technologies, manufacturing processes, sensors, semiconductors, displays and lighting, energy, and new technologies and applications. In addition, two sessions are reserved for the Flexible Electronics Summit 2018 programme.

PRINT 18

PRINT 18
September 30 - October 2, 2018
McCormick Place | Chicago, IL USA
PRINTevent.com

Chicago, Illinois, USA
30 September to 2 October 2018

To help the participants to easily reach the innovative products shown at the 2018 PRINT event, this year the Association for Print Technologies (APTech, formerly NPES), is rolling out the RED HOT Technology Recognition Program, showcasing the technology or equipment that has come to market within the past 12 months. These technologies for the graphic communications industry are also the candidates to win one of the RED HOT Disrupter Awards.

Several tens of education sessions available during the event include the keynote of Seth Godin on 'Thriving in the connection economy' looking back on a century of marketing, industrialism and print. The topics of regular sessions range from various means and strategies to grow printing businesses over the current progress in industrial inkjet and augmented reality to best practices for colour management and measurement. The Computer Lab courses can be attended to learn, for example, how to design for digital print or how to research vertical markets and understand the needs of the customer and consumers.

Journal of Print and Media Technology Research
A PEER-REVIEWED QUARTERLY

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B – Structure of the manuscript

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List of authors: I.e. all persons who contributed substantially to study planning, experimental work, data collection or interpretation of results and wrote or critically revised the manuscript and approved its final version. Enter full names (first and last), followed by the present address, as well as the E-mail addresses. Separately enter complete details of the corresponding author – full mailing address, telephone number, and E-mail. Editors will communicate only with the corresponding author.

Abstract: Should not exceed 500 words. Briefly explain why you conducted the research (background), what question(s) you answer (objectives), how you performed the research (methods), what you found (results: major data, relationships), and your interpretation and main consequences of your findings (discussion, conclusions). The abstract must reflect the content of the article, including all keywords, as for most readers it will be the major source of information about your research. Make sure that all the information given in the abstract also appears in the main body of the article.

Keywords: Include three to five relevant scientific terms that are not mentioned in the title. Keep the keywords specific. Avoid more general and/or descriptive terms, unless your research has strong interdisciplinary significance.

Scientific content

Introduction and background: Explain why it was necessary to carry out the research and the specific research question(s) you will answer. Start from more general issues and gradually focus on your research question(s). Describe relevant earlier research in the area and how your work is related to this.

Methods: Describe in detail how the research was carried out (e.g. study area, data collection, criteria, origin of analyzed material, sample size, number of measurements, equipment, data analysis, statistical methods and software used). All factors that could have affected the results need to be considered. Make sure that you comply with the ethical standards, with respect to the environmental protection, other authors and their published works, etc.

Results: Present the new results of your research (previously published data should not be included in this section). All tables and figures must be mentioned in the main body of the article, in the order in which they appear. Make sure that the statistical analysis is appropriate. Do not fabricate or distort any data, and do not exclude any important data; similarly, do not manipulate images to make a false impression on readers.

Discussion: Answer your research questions (stated at the end of the introduction) and compare your new results with published data, as objectively as possible. Discuss their limitations and highlight your main findings. At the end of Discussion or in a separate section, emphasize your major conclusions, pointing out scientific contribution and the practical significance of your study.

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Note: Some papers might require different structure of the scientific content. In such cases, however, it is necessary to clearly name and mark the appropriate sections, or to consult the editors. Sections from Introduction until the end of Conclusions must be numbered. Number the section titles consecutively as 1., 2., 3., ... while subsections should be hierarchically numbered as 2.1, 2.3, 3.4 etc. Only Arabic numerals will be accepted.

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