COMPARATIVE ANALYSIS OF DOT GAIN OF HYBRID MODULATED (XM) & DIGITALLY MODULATED (DM) SCREENING ON DIFFERENT GRADES OF PAPER

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Abstract

Screening is used to convert continuous tones images in printing dots. Printing is done by transferring these dots to the desired substrate under defined printing conditions. The aim of this research is to identify the significant dot gain differences of Hybrid Modulated (XM) & Digitally Modulated (DM) Screening on different grades of paper printed by offset printing process. The experiment is conducted using FOGRA 39/ PSO standard. This research work is based on an experiment. To conduct this research work, the master of 44.5×29.5 cm output is prepared by incorporating quality measuring parameters and printed in KCMY colour sequence on different grades of paper on RYOBI 524HX (Sheet fed Offset) by using XM and DM screening technologies. During printing, around 150 sheets are printed to achieve target Solid Ink Density value (± 0.05). After the density values are attained in accordance with standard SID values, another 50 sheets are printed for spectrophotometer analysis. Solid Ink Density patches are not compared here because both screening technologies are likely to produce identical results.

Key Words: Hybrid Modulated Screening (XMS), Digitally Modulated Screening (DMS), Dot Gain, Trapping, Print Contrast

Introduction

XM Screening is also known as cross modulated screening. It places the FM microdots on AM grid which is spaced uniformly [1]. XM screening is primarily AM screening, Although FM screening is used at tint values below 5 % and above 95 % (Figure 3.3). This allows smooth transition and imaging in highlight and shadow areas [2]. XM technology is the result of developing a modern algorithm of conventional screening, which allows higher line screen printing than Amplitude Modulated Screening, and significant reduction in the process control that was associated with stochastic screening [3]. XM screening designed to compensate for the deficiencies of each method by combining the best features of AM and FM screening technologies [2]. These screens are also known as "transitional" screens. By adopting hybrid screening, printers can raise line screens higher than usual halftone line screens without any rigorous process control and easier to print [1].

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DM Screening is the advanced stochastic screening since it not only provides ultra-smooth flat tints that are as smooth as AM conventional screening, but also achieves the high level of image detail long associated with FM stochastic screening. In DM screening, each and every pixel is modulated and controlled digitally considering the laser optics, plate technology, ink flow and press behaviour so that dot gain is eliminated, resulting in removal of artifacts and graininess completely [4,5]. DMS is also defined as "intelligent screening". DM screening decodes an image digitally during rasterization process and then analyses it intelligently to determine the position of dots precisely on the plate with their proper sizes and shapes. The DMS halftone dots display two crucial qualities, first they output images with dots that are small enough to produce print that is nearly photographic in quality and second, they are sturdy enough to be stable in a real-world production environment [6].

Research Objective

The research objective of this experiment is to compare the dot gain at 50% patch printed by offset printing process using Hybrid Modulated Screening and Digital Modulated Screening techniques. An experimental approach is adopted for collecting data of cyan, magenta, yellow & black ink at 50 % patch printed on different grades of paper to identify the significant difference between them.

Material and Methodology

Printing substrates are selected according to the paper types defined by ISO 12647-2 for Offset Printing [7]. GSM Margin of $\pm$ 5 is considered as per the availability of paper stock in the market. Below are the different paper grades used for research work for offset printing:

Paper Grades Company	GSM	l	a	b
Paper type 1 (PT1) SAPPI	120 g/m^2 glossy coated	95.24	0.44	-3.18
Paper type 2 (PT2) HANSOL	120 g/m^2 matte coated	96.04	0.02	-1.5
Paper type 3 (PT3) CENTURY	65 g/m^2 LWC web offset	94.61	1.02	-0.06
Paper type 4 (PT4) ITC	120 g/m^2 uncoated white offset	93.89	2.09	-5.72
Paper type 5 (PT5) 8.32 RUCHIKA	120 g/m^2 uncoated yellowish offset	93.61		-0.73

Data Analysis

To evaluate the quality of printed sheets, a series of test elements is printed along with the image, and each element is designed to highlight a particular aspect of the printing quality parameter. Some of these test targets are evaluated by measuring instrument and others are evaluated visually.

Master used for research work

Dot Gain:

Dot gain depends on number of factors and this can be minimised by understanding and controlling all the variables. In other words, it can be defined as an increase in the diameter of printing dots. Each stage of printing process contributes to dot gain. As the number of dots increases, dot gain will increase. But all the dots do not act in the same manner. Mid tone range shows the maximum dot gain. Above this range, dots progressively touch each other and do not provide proper space for dot gain and hence diminish. But under controlled pre-press and press setting, dot gain should be consistent and is possible to predict and control the dot gain during press run [8].

For this research work, Dot Gain is measured at 50 % patch of cyan, magenta, yellow and black ink by using XMS and DMS with the help of Spectrophotometer-X-Rite eXact™.

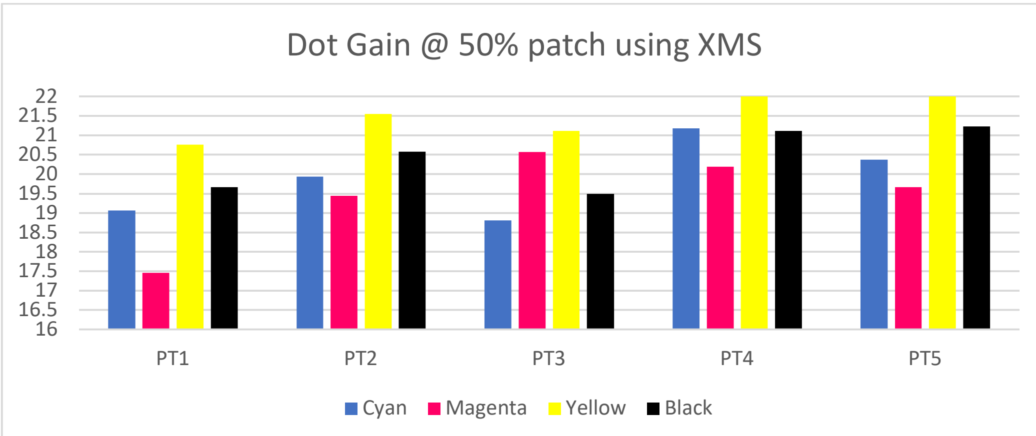
XMS	PT1	PT2	PT3	PT4	PT5
Cyan	19.06	19.94	18.81	21.18	20.37
Magenta	17.46	19.44	20.57	20.19	19.67
Yellow	20.76	21.55	21.11	22.3	22.19
Black	19.67	20.58	19.5	21.11	21.23

Table 1: Average value of Dot Gain @ 50 % patch of C, M, Y & K ink by using XMS

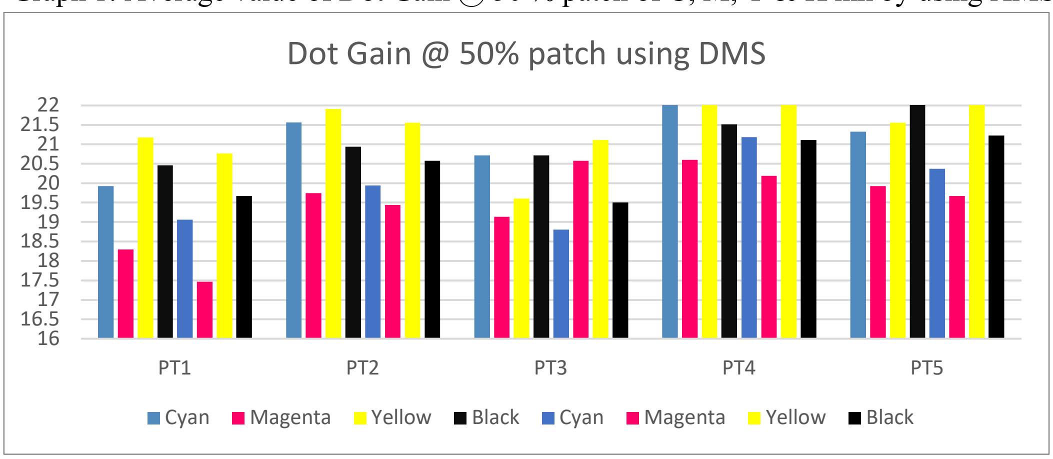
DMS	PT1	PT2	PT3	PT4	PT5

Cyan	19.92	21.56	20.72	22.13	21.32
Magenta	18.3	19.74	19.13	20.6	19.93
Yellow	21.17	21.91	19.6	22.47	21.55
Black	20.46	20.93	20.72	21.51	22.44

Table 2: Average value of Dot Gain @ 50 % patch of C, M, Y & K ink by using DMS



Graph 1: Average value of Dot Gain @ 50 % patch of C, M, Y & K ink by using XMS



Graph 2: Average value of Dot Gain @ 50 % patch of C, M, Y & K ink by using DMS

Result & Discussion

It is observed that Digitally Modulated Screening showed slightly higher dot gain than Hybrid Modulated Screening on all paper types. Digitally Modulated Screening showed dot gain in range of 19-23.5%, 17-21%, 18.5-24% and 19-23.5% for cyan, magenta, yellow and black ink at 50% patch respectively.

Hybrid Modulated Screening showed dot gain in range of 18-22.5%, 16.5-22%, 19-23% and 18.5-22.5% for cyan, magenta, yellow and black ink at 50% patch respectively. It is observed that dot gain measured in both XMS and DMS is with in tolerance limit.

It is also observed that highlight and very fine details are printed better by DMS. Pictures are printed sharper and smoother by DMS. Gradients are printed well by DMS. However better picture depth and contrast is observed in XMS. Shadow tones are printed clear by DMS. Uncoated substrates showed more dot gain as compared to coated substrates.

Conclusion

Dot Gain achieved by XM screen is close to standard values while DM screens showed little higher values. It is also observed that dot gain is more on uncoated substrates. Highlight details/very fine lines/ Face tones and shadow tones are better visible in DM screens and pictures are printed sharper and having better details. Gradients are also printed well in DM prints It is observed that contrast and depth is better in XM prints.

Considering the above parametric conclusion, DM Screen is most suitable and showing excellent results in most of the print parameters and also suitable with all paper types.

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