Research Article

SCREEN ANGLE COMBINATIONS AND DESCREENING
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ABSTRACT
This paper deals with study of color deviation caused due to changing screen angle combinations in process color lithographic offset printing. The printing test chart comprises of conventional and customized angles for process colors.

KEYWORDS
Halftone, Screen angle, Moire, Process Color

INTRODUCTION
Most of the available printing technologies cannot produce continuous tones. Instead the images printed with these devices contain a series of dots arranged in specific patterns to simulate different shades of gray. The process of converting a continuous tone image into a binary image that can be rendered using a bi-level printing device is called halftoning. Conventional halftoning methods involve either changing the size of printed dots, called Amplitude Modulation (AM), or changing the relative density of dots on the page, called Frequency Modulation (FM). The most common method for performing AM halftoning is clustered dot screening while commonly used FM halftoning algorithms are dispersed dot screening and error diffusion. AM halftoning methods offer the advantage of stable dot formation and, therefore, they are widely used in commercial offset printers where a single isolated dot may not develop and be stable. Essentially all printed material in the form of books, newspapers and magazines employs clustered dot halftoning. However, there is one serious drawback to using AM methods. The regular placement of dots in clustered dot halftoning can lead to Moiré patterns when it is used for reprinting images scanned from printed originals. The term Moiré, in general, is used to describe interference patterns that arise due to frequency difference or misalignment of two similar overlapping periodic structures. In a scan-to-print process, the halftone screens in the printed original and target printer are the two overlapping frequencies that could interfere and render the resulting print useless due to severe Moiré artifacts. In general, FM halftoning methods do not cause severe Moiré; however, the tiny isolated dots produced by these methods cannot be stably printed by electrophotographic printers. Thus, FM halftoning is mostly limited to ink jet printers. Many print materials, such as newspapers, magazines and books, use a clustered-dot halftoning method to print out continuous tone images that have a limited number of color inks. Halftoning quantizes continuous tone image by replacing them with sequences of dots, whose size varies according to the continuous tone image intensities. This process, however, introduces quantization error referred to as halftone noise. Halftone noise may be less significant if looked at from certain distances because human eyes cannot perceive high frequencies, so halftone dots are not recognized individually. On the other hand, when the halftone material is scanned, halftone noise becomes a problem since scanners read the halftone dots individually. Moreover, depending on where the halftone dots on the scanning material are placed on the scanner aperture, the scanning process can produce undesired artifacts, such as the Moiré effect. The changes in the size of the halftone dot alter the halftone frequency, which causes frequencies to interfere with each other, creating the Moiré effect. The Moiré effect is critical in halftone images since it boosts the halftone noise by creating noticeable patterns with halftone dots. If the scanned halftone image is reduced in size to fit the desirable size for a display purpose on a computer monitor or a mobile phone, the Moiré effect becomes severe and is likely to be visualized by most display devices. Re-printing the scanned halftone image can also increase the Moiré effect because halftone frequency already exists in the material can interfere with the printing frequency. In order to preserve the image quality, a descreening process, which removes halftone noise, is important as a post processing step of the scan. The simple way to remove halftone noise is to detect halftone frequency and remove it by performing a low pass filter on it. However, since the halftone noise is mixed in the frequency domain with the high frequency image components such as edges, it is hard to distinguish between these two.

IMPORTANCE OF SCREEN ANGLES
A human eye experiences moiré pattern maximum at 90° and minimum at 45°; hence lightest possible i.e. yellow
color is kept at 90° and darkest color is maintained at 45°. The conventional screen angles for four process colors are yellow – 90, magenta – 75, black – 45 and cyan at 15. The difference between 2 dark colors is kept at 30° to avoid moiré pattern. In process color prepress and printing, the angle at which the rows of halftone dots run in relation to the horizontal. In order to eliminate undesirable moiré patterns when the four color separation halftones are overprinted in multi-color printing, each screen needs to be placed at a different angle, as the dots of one color interfere with those of another color, creating the distinct moiré patterns.

Screen angles are offset so that the moiré pattern can be avoided; however, when you combine the four-color separations, the slightest misalignment of the separations can lead to moiré. This can also result in color shifting because misalignment of the halftone dots can result in a change of dot density. To correct this problem, the screen frequency or angle must be modified. Because each halftone screen consists of a regular pattern of shapes, it creates a pattern on the printed image. When the separations are combined, the patterns created by each separate halftone screen interact. This interaction can create an undesirable effect called a moiré pattern that can be eliminated by changing the screen angle of each color separation.

<table>
<thead>
<tr>
<th>Table 1: Screen angle combinations to be used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
</tr>
<tr>
<td>Comb1</td>
</tr>
<tr>
<td>Comb2</td>
</tr>
</tbody>
</table>

When printing using same angles i.e. Combination 2; following conditions may take place –

When dots print on top of dots we get wet ink sticking to wet ink and white spaces between the dots. When dots print beside dots you have wet ink sticking to dry paper with less white space between the dots. We can observe and deduce that the dot on dot color looks darker and less vibrant than the dot off dot. The result is that the final blue hue, in this example, of dot on dot will also be different than the dot off dot blue because wet trapping inks reduces the ink’s efficiency at filtering light. The white paper surrounding the dots also contaminates the perceived color by adding a graying effect and therefore the dot on dot printing will have less chroma (vibrancy) than the dot off dot. When there is slight misregistration on press the screen will shift from dot on dot to dot off dot which may result into shift of color. The number of dots within the cell determines the cell’s tonal level. The continuous tone amplitude modulation is converted to various distances, or frequencies, between the dots. The mode distance between the dots of the cell is the principal frequency. The distance between dots determines the
phase of the array resolution and the maximum diameter of the dots. The frequencies lower than the mode frequency is referred to as noise. It is generated due to misregistration. The higher the mode frequency then the less noticeable is the noise. Noise is described as a color. There are three colors currently used to describe a kind of noise: white, blue and green.

Descreening using scanner[4]

The array of dots used in the preprinted halftone printing process is called a screen, and the software filter to remove moiré is called a Descreen filter. The Descreen filters have selectable parameters to match the screen frequency of the original image halftone (like newspaper or magazine). The additional Descreen processing does lengthen the scan time. It also greatly increases memory requirements for the processing the images.

EXPERIMENT OVERVIEW

Problem statement

To check visual appearance of printing and evaluate the gamut for different angle combinations.

Experimental set up

Table 2. Set up

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine</td>
<td>HP Indigo 3050</td>
</tr>
<tr>
<td>Printing Seq.</td>
<td>K C M Y</td>
</tr>
<tr>
<td>Paper</td>
<td>130 gsm coated</td>
</tr>
<tr>
<td>Scanner</td>
<td>Hell drum type</td>
</tr>
<tr>
<td>Dot shape</td>
<td>Round</td>
</tr>
<tr>
<td>Screen ruling</td>
<td>150 lpi</td>
</tr>
<tr>
<td>Screen angles</td>
<td>Ref. table 1 i.e. 2 combinations</td>
</tr>
<tr>
<td>Ink</td>
<td>HP</td>
</tr>
<tr>
<td>Software</td>
<td>CorelDraw, Photoshop</td>
</tr>
<tr>
<td>Instruments</td>
<td>Xrite online spectrodensitometer</td>
</tr>
</tbody>
</table>

A test chart consisting of print quality assurance standards is printed using angle combinations in table 1. Thus 2 prints A & B were obtained. The 2 prints obtained were scanned at 1200 dpi on drum scanner and without descreening; again 2 prints were taken, A1 & B1. The scanned results of first two prints (A & B) were descreened and 2 prints were taken, A2 & B2. The results were analyzed.

ANALYSIS

When using different combinations of screen angles; visually it is possible to judge the difference between two prints. The process (CMYK) color work in the artwork will not always have all the colors at all possible places, i.e. the printing work will not be continuously overlapped with all CMYK colors because it will result into black color only. It means that number of times, say while printing skin tones, we will have yellow and magenta as dominant colors and they will not be overlapped all the time otherwise according to Subtractive color theory, the combination of yellow and magenta will result into red color everywhere but we get different shades of skin tones. By using this example we can show that even though we keep the screen angle of yellow and magenta same we will get printing result with different skin tones. The experiments show that when screen frequency is less than 60 lines per inch the moiré pattern is very much discernible although the conventional screen angles are used. The printed result also shows that there is no moiré pattern observed although the screen angles are the same.

The A2 & B2 images appeared flat and showed discernible moiré pattern. The prints A1, B, B1 having same screen angles did not show any pattern.

CONCLUSION

- Angle combination does not have significant effect on colour gamut.
- Colour variation is observed when angle combination is changed.
- Angle combination (used here) does not show discernible moiré.
• When using preprinted job as original we have to carry out descreening in order to avoid cashes of screen pattern of the original and result required after printing.

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