Concentric Screening in the Spotlight

Barbara Detavernier

Screening technologies are applied for the reproduction of halftones. Aiming at the highest possible quality, Esko-Artwork offers a new technology: concentric screening. This was the subject of my paper with which I graduated. In my article I provide a summary of my conclusions and take a close look at this technology.

In the graphic industry, screening technologies are applied for the reproduction of halftones. Aiming at the highest possible quality to improve the visual results, Esko-Artwork now offers its customers a new technology: concentric screening. This is said to be a major halftone screening technology innovation and was the subject of Barbara Detavernier's final paper with which she graduated at the Arteveldehogeschool. She won the golden Joris Lannooprijs and the silver Febelgraprijs 2007. In this article she provides a summary of the project's conclusions and takes a close look at this technology.

Concentric Screening

The aim for photographic quality in printed matter is a perpetual search for new answers. An improvement of the screening is one of these answers. Nowadays this gets a lot of attention in several studies. Esko-Artwork takes part in the battle and developed concentric screening. Concentric screening is based on the conventional AM screen, but another dot is used. (see image 1) The AM dot is divided into thin concentric rings. We continue using a screen with an uniform pattern. The thickness of the ring and the size of the space between the rings may vary. These are average values, for example the thickness of the ring is 1.2 pixels. A test case with colour bars, screened in different rings and spaces between the rings, is used to determine the optimal parameters for the customer. (similar to the pre-test case of this study) The parameters with the best results are applied to subsequent productions.

A screen dot is built-up within a specific area, the screening cell. This involves that it is limited in size. If you use a higher screen ruling, 1 inch contains more screening cells. This implies that the surface of one cell gets smaller. Thin rings give a high quality. They make sure that a high screen ruling can be used and that the image contains a lot of detail. We can't use too thin rings, because this could result in problems during the exposure. It's possible that the rings aren't closed anymore.

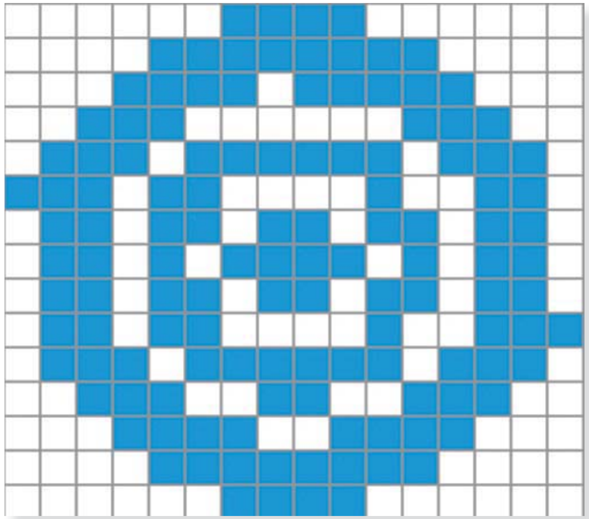

Image 1

The study

In cooperation with Esko-Artwork, a study was started at Cartonnage Soenen to test the different possibilities of this new screening technology. Three test cases were printed. We started with the 'pre-test case'. (see image 2) This test case consists of colour bars, screened in different rulings with different rings and spaces between the rings. The test was printed in black, cyan, magenta and yellow separately. In addition to concentric screening, we also find the AM-screening in the same screen ruling. Linear plates were used in this first phase. This means that 50% input corresponds to 50% on the plate. The realization of this test was done on several cardboards having a different quality.

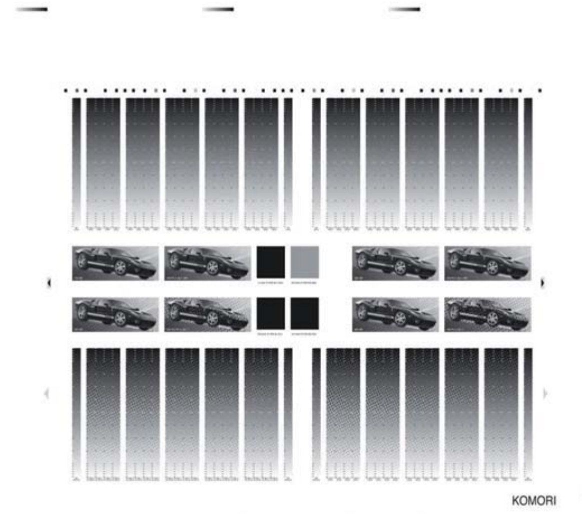

Image 2

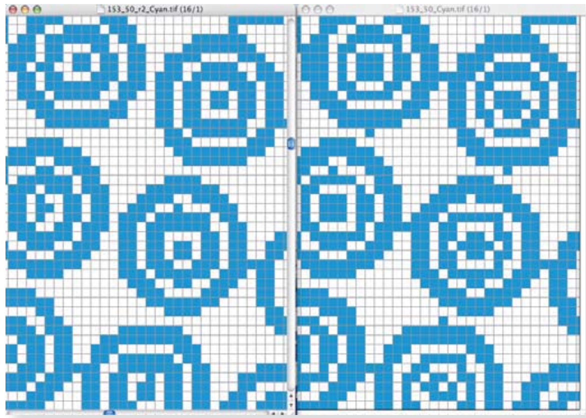

Image 3

Test case 1

This first test resulted in the analysis of the different characteristics of concentric screening and the influence of the different parameters. The results prove that a thicker ring ends in a lower dot gain. If the space between the rings is larger, we get a higher dot gain. The explanation for this relates to the outline of the dot. When we use a thicker ring, the dot is built up by fewer rings than when we use thin rings. This means that the total outline of the screen dot is lower and that the dot gain will be lower too. Higher percentages have another effect. The outer ring is thicker independent from the thickness of the ring that's used.(see image 3) The reason is that thin rings may give problems after exposure.

A larger space between the rings results in the opposite. More space between the rings leads to a larger diameter of the dot, which results in a larger total contour. The influence of the space between the rings is very small.

Another conclusion is the influence of the screen ruling on the dot gain. An AM screen has a larger dot gain when using a higher screen ruling. This study proved that this is not the case with concentric screening. The dot gain is equal for the different screen rulings.

The final remarkable conclusion, maybe the most important one, is the colour saturation: concentric dot's saturation is much higher than the saturation of an AM dot. For the explanation of this phenomenon we need to take a closer look at the profile of the ink. Concentric rings make sure that the ink film thickness is limited. AM dots accept a lot of ink. We get a thick ink film.

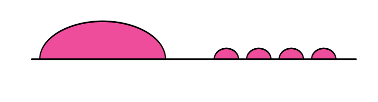

Image 4: Left: ink profile AM screen
Right: ink profile Concentric Screening

We can show that this brings certain ink pollution along and leads to a lower saturation than concentric screening. After measuring the chroma of both concentric screening and AM screening, we conclude that the chroma of concentric screening is remarkably higher. This screening technology uses a thin ink film; this means that the ink is spread better. The full AM dot accepts a large amount of ink; the ink film is much larger. This results in a polluted colour reproduction.

The size of the difference in chroma depends on the quality of the printed matter. A type of cardboard with a high quality will reproduce a big difference in chroma. The chroma of concentric screening will be much higher than the chroma of AM screening. Visually the colours will be more beautiful. The amount of process colours affects the chroma too. The study reveals that magenta leads to a smaller difference in chroma. The composition of a lot of ink will also result into a smaller difference in chroma.

This first test al ready proved different advantages of concentric screening, advantages that AM lacks. After the realization of this test case we focussed on one specific ring and space between the rings. These parameters were used for subsequent tests.

Calibration curves

Each printing press has its own specific output property. This curve is adjusted to the desired norm ISO 12647-2 to be able to work according to the standards. The first test was printed with linear plates. The dot gain was measured to be able to draw up the calibration curves. The Litho-Sync curves were used for the AM screening. (see image 5) They are created with Symphony, software of Esko-Artwork. The software calculates the curve when you give 3 percentages (25, 50 and 75%). You observe in the image that the curve is bending. At first these same curves were used for concentric screening as well. Concentric screening uses a thin ink film and a high screen ruling; this resulted in missing dots in the highlights. As a solution to this problem Esko-Artwork developed adapted curves, the HD curves. (see image 6) They bend less in the low screening percentages.

Test case 2

This test case contains 2 types of elements: photographical images and measurement fields. (see image 7) The photographical images are used for the visual judgement, the measurement fields are used for the evaluation of the test. Each element is found twice on the test case: on the right concentric screening 340 lpi ring 1.4 pixels and space 1.0 pixel is used. On the left we find the same element screened in a n AM screen 200 lpi. This test case was printed on different types of cardboard too. The calibration curves were applied by Nexus on the digital files.

After printing and measuring this test, we came to the conclusion that concentric screening is as easy to calibrate as an AM screen. This applies to both high quality cardboards and low quality cardboards.

The chroma of several areas was measured again. These fields now contain a composition of different inks. The difference in chroma between concentric screening and AM is lower when the total percentage of ink (the sum of the amounts cyan, magenta and yellow) is high. When the amount of magenta increases, the difference in chroma is less. A clear answer to this phenomenon is subject of further study and testing.

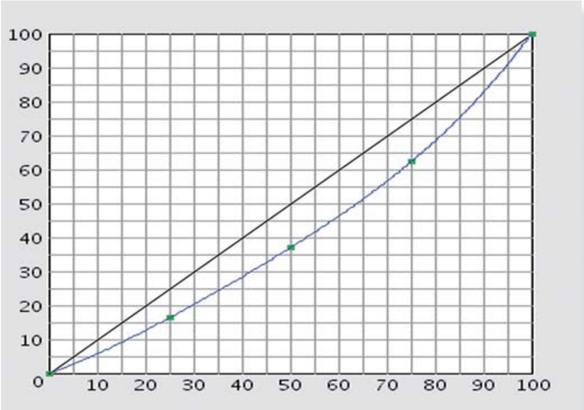

Image 5

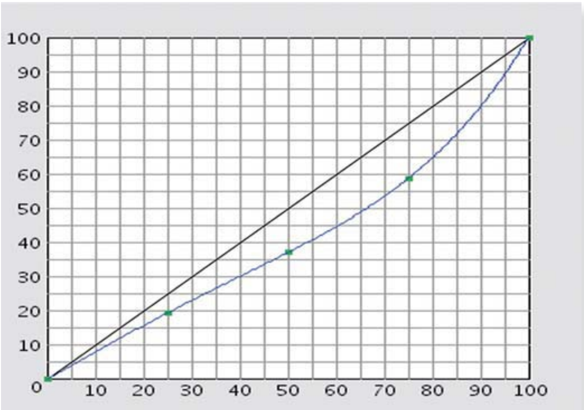

Image 6

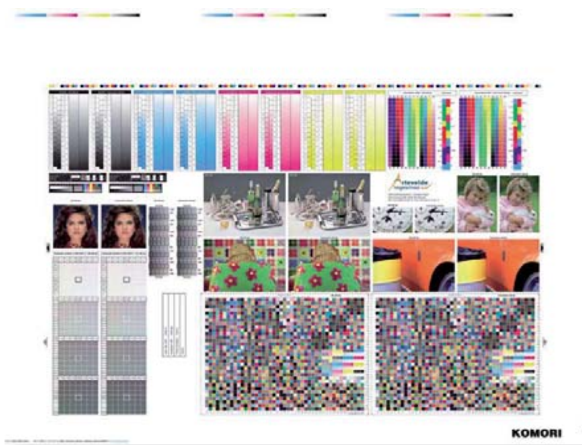

Image 7

Adapted profile

The next step was measuring the ECI-chart with the aid of the Eye-one of Gretag MacBeth. The measured values were compared to the standard values in order to create the new profile. ProfileMaker 5 was used for this creation. A profile changes when another type of screening technology, type of support, type of ink, etc. is used. That's why we created for each type of cardboard and screening technology another profile. The conversion of the photographic images from RGB to CMYK was done using these profiles.

Of one specific type of cardboard a lot of samples were printed. These sheets were measured to be able to determine the latitude on the press during one edition. Both AM screening and concentric screening proved to be stable. But this is concentric screening's advantage because 340 lpi was used. The AM screen was printed in 200 lpi. This test proved though that we already control the AM screening when we print in 200 lpi.

Observations and measurements have shown that the chroma of concentric screening is generally higher than the chroma of AM-screening. An explanation for this might be found in the profile of the ink. The ink profile of concentric dot is less high than the profile of the AM dot. The pollution gets fewer chances, certainly when we work with composed ink layers. This leads to a higher chroma. Further tests with calibrated press and the use of adapted profiles end in equal results. But these values aren't that easy to interpret. Apparently there are other parameters that are object of profiling and that have an influence on the chroma. Further study is needed to explain all these questions.

As a conclusion

This paper investigated the use of concentric screening and the statements of the producer who talks about an improvement of quality. This paper scrutinised these statements, took a closer look at this new screening technology and tested its potential extensively in a business context. The results of the study confirm these statements and clarify the principles which they are based on.

In closing, this study proved the importance of an intense cooperation between the graphic business community and higher education for applied scientific research. I am very thankful to be part of this process and to have contributed in a modest way to enhancing this cooperation.

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