The Screening Technique of Realizing High-Fidelity Color Printing

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Abstract

This paper brings forward a new screening method which differs from other traditional AM screening and FM screening methods, namely FCAM (frequency conversion amplitude modulation) screening. By applying FCAM screening, more than four-color printing can be realized and the evident Morie strip won't occur. Meanwhile, it shares the simple technology characteristics of AM screening and can achieve satisfactory practical result.

Preface

The screening technique of avoiding Morie strip is the core of realizing color image printing. Applying the AM screening and arranging the screening angles 0º, 15º ,45º and 75º can avoid Morie strip as much as possible and realize the traditional four-color printing. The AM screening is mature and the technical difficulty of plate-making and printing is relatively low. So, the AM screening is the main screening technique used in current color printing. But because of the restriction of screening angle, the AM screening can not be applied to more than four-color Hi-fi color printing. The Hi-fi color printing usually apply the FM screening, because the FM screening can't be restricted by the screening angles and, in FM screening, overlapping arbitrary screening angle can't produce Morie strip. FM Screening is superior in theory, but it is rigorous to plate-making and printing technology. So it is difficult to be applied in practice.

This paper brings a new method called FCAM screening based on AM screening. When the screens are overlapped, the Morie strip produced in this method are different from that in traditional screening. The screening angle which produces the weakest Morie strip is not near the angle 45º but between 20º and 30º. The combination of FCAM screening and the traditional screening can realize more than four-color printing without evident Morie strip and provides a new screening method to Hi-fi color printing. Its outstanding advantages are less difficult technology and easy realization. So, it takes a new look to the wide spread and application of HF printing.

Basic Thought of FCAM Screening

To every halftone image, it still applies the mature AM screening algorithm. Changing the screening line number (namely frequency of screening line) of different halftone image, FCAM screening can realize overlapping halftone images without producing Morie strip under the condition of same screening angle.

Theoretically, because it changes the frequency of dot of the different halftone image, the new method can avoid the Morie strip. But the new method does not use the stochastic screening technique. To every halftone image, it still applies the mature AM screening method. So there is not any practical difficulty in screening. Based on the AM screening, it changes the screening line number (namely, it changes the spatial distribution frequency of dot) of different halftone images, so we call the new method FCAM screening.

FCAM screening provides more technical selection for the process of halftone image and will promote the development of image process and color duplication technique to a certain extent.

Experimental Researches

Experiments

In order to observe the experimental result clearly, we discuss the Morie strip produced by overlapping two halftone images. Here, we temporarily take no account of the shape of Morie strip. We judge the intensity of the Morie strip by the distance between main Morie strips. Evidently, the larger the distance is, the more easily the Morie strip can be seen and the heavier the Morie strip affects the human eyes.

Experiment No.1: First we observe the Morie strips when two halftone images with same screen line number (175lpi) are overlapped in different angles. The curve between the intensity P of Mories strips and the screen angle α is as following curve O in figure 1.

Experiment No.2: One screen is 175LPI. Another is 150lpi. So the difference of screen line number is 25lpi. When they are overlapped in different angles, the intensity of Morie strip is curve A-1 in figure 1.

Experiment No.3: One screen is 175LPI. Another is 133lpi. So the difference of screen line number is 42lpi. When they are overlapped in different angles, the intensity of Morie strip is curve A-2 in figure 1.

Experiment No.4: one screen is 175lpi. Another is 120lpi. So the difference of screen line number is 55lpi. When they are overlapped in different angles, the intensity of Morie strip is curve A-3 in figure 1.

Experiment No.5: One screen is 175lpi. Another is 100lpi. So the difference of screen line number is 75lpi. When they are overlapped in different angles, the intensity of Morie strip is curve A-4 in figure 1.

Experiment No.6: One screen is 200lpi. Another is 133lpi. So the difference of screen line number is 67lpi. When they are overlapped in the angle range from 0º to 30º, the Morie strip is nearly invisible. When the angle becomes larger than 30º, the Morie strip gradually becomes visible, and it will be up to maximum at the angle 45º.

Experiment No.7: One scren is 200lpi. Another is 120lpi. So the difference of screen line number is 80lpi. When they are

overlapped in the angle range from 0º to 30º, the Morie strip is nearly invisible. When the angle becomes larger than 30º, the Morie strip gradually becomes visible, and it will be up to maximum at the angle 45 º.

Experiment No.8: One screen is 225LPI. Another is 133lpi. So the difference of screen line number is 92lpi. When they are overlapped in the angle range from 0º to 35º, the Morie strip is nearly invisible. When the angle becomes larger than 35º, the Morie strip gradually becomes visible, and it will be up to maximum at angle 45 º.

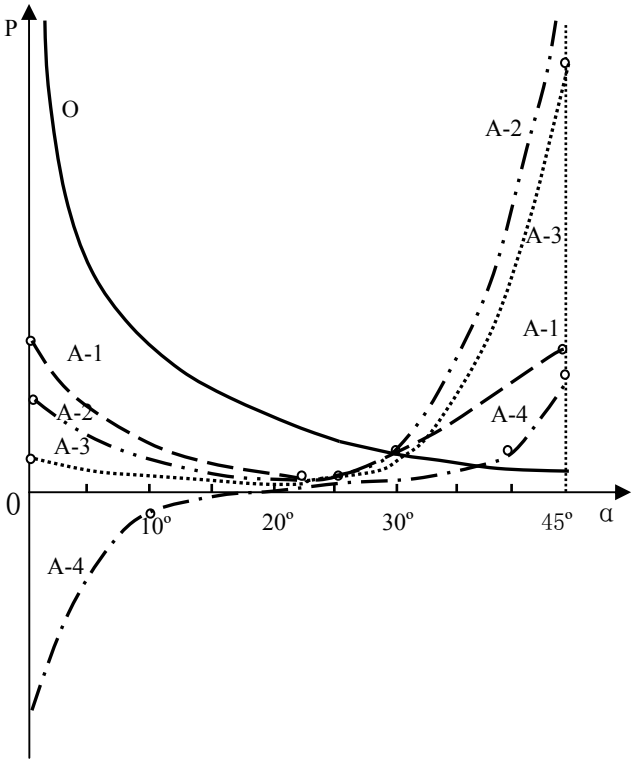

Figure 1: The trend of Morie strip

Analysis of experimental result

Applying FCAM screening technique, when two halftone images are overprinted, the rules of Morie strip can be summarized as following: (a) Applying FCAM screening technique, when the overlap angle of two screens approximates to angle 0º, the Morie strip is convergent. This is evidently different with the same screen line number screening. (b) When the screening frequency of one screen is fixed, within a certain range, the larger the difference between the fixed frequency and the variable frequency is, the smaller the Morie strip (here it is expressed by W0) is. When the difference of screen frequency is up to a certain value, the W0 is up to the minimum. Then the Morie strip is invisible, so it can be avoided. (c) The FCAM screening is different with the same line number AM screening. When the Morie strip is up to the minimum, the overlap angle is not 45º but between 20º and 30º.

Application of FCAM Screening in Hi-fi color printing

According to the experimental result, we can bring forward many implementary schemes of Hi-fi four colors plus spot color printing. In order to avoid Morie strip by applying FCAM screening, the basic precondition is to change the screening line number of one image. Necessarily, it should increase or decrease the screening line number of the image. In order to guarantee the image definition, the main colors (namely, standard four colors) should have as high as possible screening frequency and the spot color should have lower screening frequency. Increasing the screening frequency of the main color can make the screening frequency of spot color not to be too low.

Realization of five-color printing (four colors plus one spot color)

Based on the figuration of Y(0º)、C(15º)、M(75º)、Bk(45º) with the screen line number 200lpi, the screen line number of the spot color is 133lpi or 120lpi and its screening angle is 15º in it . The figuration is showed as figure 2. In this scheme, applying the corresponding frequency difference in experiment No.6 and experiment No.7, the Morie strip is not visible within the screening angle range from 0º to 30º. When the angle of spot color plate is 15º, the angle difference between magenta plate and spot color plate is 0º. The angle difference between yellow plate and spot color plate is 15º. The angle difference between black plate and spot color plate is 30 º. The angle difference between cyan plate and spot color plate is also 30 º. All the angle differences are within the range from 0 º to 30 º and keep away from the angle 45 º when the Morie strip is the most strong. Of course, when the screening angle of the spot color plate is 75 º, the result is same.

If the screen line number of the basic four colors is 225lpi and the screening line number of the spot color is 133lpi, the result of avoiding Morie strip will become better.

Realization of six-color printing (four colors plus two spot colors)

Based on the figuration of Y(0º)、C(15º)、M(75º)、Bk(45º) with screen line number 225lpi, he screen line number of the two spot colors is 133lpi.At the same time, the screening angle of one spot color is 15 ºand the screening angle of the other spot color is 75 º. It is showed as figure 2. In this scheme, applying the corresponding frequency difference in experiment No.8, the Morie strip is not visible within the screening angle range from 0º to 35º. When the angles of two spot color plates are 15º and 75º, All the angle differences between the two spot color plates and the main four color plates Y(0º)、C(15º)、M(75º)、Bk(45º)are within the range from 0 º to 30 º. So the Morie strip is avoided. The angle difference between the two spot colors is 60º which is equivalent to 30º, the Morie strip can not be produced. In addition, this scheme can also be applied in five-color printing.

Realization of seven-color printing (four colors plus three spot colors)

Based on the figuration of Y(0º)、C(15º)、M(75º)、Bk(45º) with screen line number 225lpi, the screen line number of the three

spot colors is 133lpi. At the same time, the screening angle of one spot color is 15º, the screening angle of the second spot color is

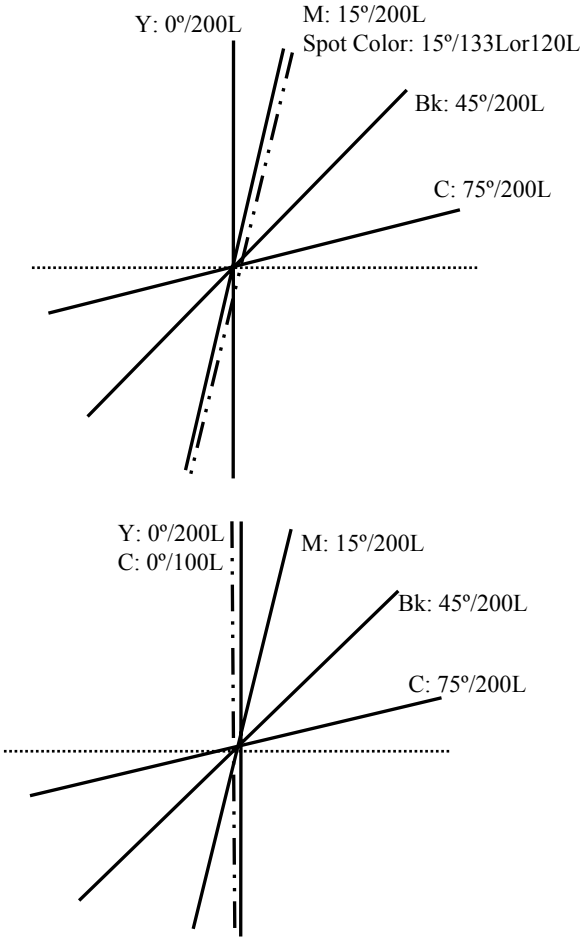

Figure 3: Figuration 2 of frequency and angle in five-color printing

45º and the screening angle of the third spot color is 75º. It is showed as figure 3.Compared with the second scheme; this scheme has additional spot color with the angle 45º. The angle difference between the spot color plate with the angle 45º and the black plate is 0º. The angle difference between magenta plate, cyan magenta and the spot color plate is 30º. So it guarantees not producing Morie strip. But the angle difference between the spot color plate and yellow plate is 45º. According to the data in experiment No.8, it produces weaker Morie strip with the frequency 36 lpi. Because the yellow plate has the characteristic of weak color, the Morie strip is not easy to be visible. Among the three spot color plates, the angle differences are 30º, 30º and 60º (it is equivalent to 30º), the Morie strip also can be avoided.

Although the figuration of six colors or seven colors has the coincidental element, such perfect and ingenuous composition is exciting.

Conclusions

The FCAM screening which this paper brings forward is a new screening method. It differs with the traditional AM screening, traditional FM screening and common mixed screening. It is a peculiar thought and expresses the special rule of itself. Applying

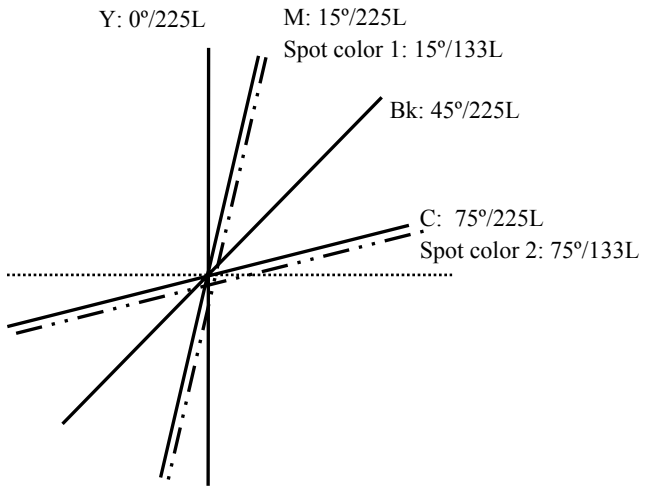

Figure 4: Figuration of frequency and angle in six-color

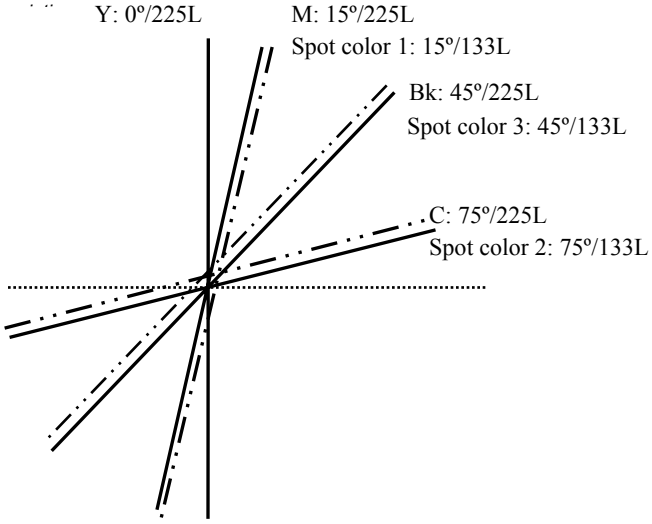

Figure 5: Figuration of frequency and angle in seven-color printing

the FCAM screening, the screen figuration scheme of realizing four colors plus spot color Hi-fi color printing proved to be successful by outputting film, proofing and attaining better color image duplication quality.

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