Research on the method of acquiring ink zone control Tiff images

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Abstract

Currently ink presetting is one of the most popular topics in printing application research field. Based on the analysis of international and domestic common printing ink zone control methods ,this paper put forward a way which hold tiff images after rip as basic source images , then obtain the data of controlling ink zone through compression and conversion process. The ink zone control software system can be built on this method. By verified and simulated ,it is provided that： 1 the ink zone data of this system is from tiff source image with dot compensation ,so the data is accurate and reliable 2.the Mathematical Model which built by system about data from source images to ink zone is convenient in account and have good precision. If this result applies to printing production, it can provide theoretical support for total-digital printing workflow and improve printing quality.

1. The situation and trend of ink zone control at Home and Abroad

With digital, network, and the advance of automation technology, printing technology has made rapid development. At the same time, people have more and more demands on the effectiveness of the printing, accuracy and maximize profits. Ink presetting technology as one of the control modules plays a significant role. According to prepress data, it can automatically adjust ink key to reduce the number of test printed, save paper and ink consumption, and then publish ahead of time.

Currently the domestic exist two methods of ink presetting

First: Manual adjusting. The traditional process of the ink presetting is a method which adjust printing unit by the operator directly on the ink fountain, but the adjustment process will be very time consumed, and very imprecise, because such operation mainly depends on the operator's experience to forecast the need of ink and the width of ink key.

Second: Use plate image reader. Using specialized CCD imaging shooting devices of the plate image reader scans the plate, analyzes the image and calculates the dot percentage of the ink coverage area after shooting, , then on the basis of this data measured, using corresponding software presets the width of the ink key.

Such a preset system comes out as early as 1980s (such as Dainippon printing company ， DEMIA system, etc.). But since the plate image reader was published, it has been the following shortcomings. First, the dot of the high-quality color printing is very small and based on the size of the finished product the breadth of the plate image reader must be larger, high-resolution also essential, therefore it is impossible to increase the speed of scanning. Second, because different companies have different plates which have kinds of the photosensitive components , the data of the dot may differ by calculation, therefore the method ,using plate image reader to achieve ink presetting in actual production process be eliminated [1] .

With computer technologies comprehensive applying in the prepress field; it is possible that using the information of prepress extract the ink presetting data. A large number of foreign companies such as Heidelberg, Man Roland, KBA and KOMORI and other well-known manufacturers of devices are equipped with such software and ink presetting interface which can directly receive the document of the ink zone and directly preset the ink key opening. But the ink presetting technology with intellectual property of the domestic enterprises has not developed while the price of the corresponding equipment is very expensive, and technical aspects for us are also completely confidential.

With the development of modern printing technology, especially CTP technology comes out, it is much more important to develop the technology of ink presetting which have independent copyright.

2. The acquisition of TIFF image of ink zone control

2.1. Data source and acquisition of TIFF image

Because of the digital operation of prepress, using its storage of information that can be extracted ink presetting data has become possible. But how to obtain data from the process to preset ink zone is the primary problem we have to solve. Figure 1 shows the data flow in the prepress process: From Figure 1 of the analysis available: If we selected "a single page" as data sources, the drawbacks are following: First of all, to different companies, the storage formats of single page are disunity, It is possible to take place unpredictable wrong when equipment reading data. In addition, because of the independence between pages, there is great inconvenience to data's statistic and calculation, so we consider the second data – the imposed PDF, as its characteristics of cross-platform and small amount of data, using the imposed PDF as data source may be a good method, but in the latter process of generating plate, the imposed PDF document looks powerless in how to make compensation to the change of dot. Considering the status in domestic, in terms of most enterprises which purposes are to export the finished products, because they do not have corresponding flow software, although three file formats in RIP have the potentiality to meet the requirements, the process data can not be easily obtained by the majority of enterprises, thus they can access to the final data in RIP lightly, so we choose the ultimate data in RIP that are provided by Third-party--- One-bit Tiff and made the following analysis: First of all, as data of digital flow, One bit Tiff file is generated by the RIP, but also recorded various screen information, including screen angle, screen lines and so on, graphics, images, text, and other information which formed in prepress are fixed with high resolution, dot lattice information and will be no longer impacted. Therefore, take One bit Tiff as data source is safe and reliable. Secondly, because we have to rasterize PS or PDF files before imposition, if we used the One bit Tiff data file in the process of RIP, we can find existing problems in documents timely, thus ensuring the correctness of the imposition;

and then we can make dot compensation on the digital pages which can promote print products closer to the original manuscript. As the above analysis, we have chosen the One bit Tiff image data as ink presetting data source [2].

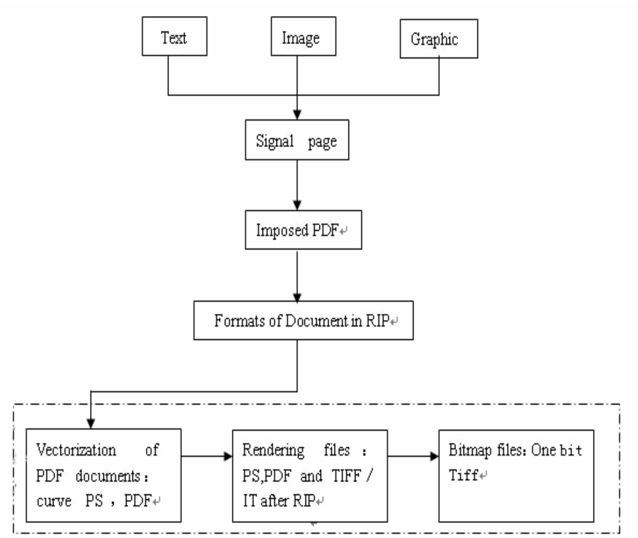

Figure1

After obtaining the suitable data, we have designed experimental program with the following three steps:

Firstly: read the data. As the data of the separation document is very large after RIP (usually up to several G). It is inconvenience to read the original data, so we need to divide the data of the One bit Tiff image into several blocks ,then read into memory to evaluate the speed of the calculation.

Secondly: data processing. According to the definition of the CIP3 (Print Production Format), we have to compress the source image document after RIP to generate the low-resolution "continuous tone image" and then implement dot compensation.

Thirdly: Tiff image's generation and statistics. The program generates the tiff image that can be preset the ink key directly, then analyzes and counts the image to obtain the histogram or ink interface documents.

This paper mainly discusses on the second part, and then draws histogram of the ink zone through experiment.

First of all: For the One bit Tiff binary image data, we get the resolution through program and set to α. Since it needs to do dot compensation subsequently, we will change the binary image into "continuous tone image".

Next: In order to achieve the standards of CIP3 (for 50.8 dpi gray scale image), we need to take β pixels of the image individually in the horizontal and vertical direction to make a new pixel in 50.8 dpi gray scale image, that is α/50.8 = β. As figure 2 shows, every new pixel "G_{new}" that comes from β× β pixels has as much as β^2 +1 gray scales after compression.

Finally: As different documents have different output purposes, leading to different β because of different α value, it requires a normalization processing to generate continuous gray image, switching the 0 ~β^2 gray scales to the 0 ~ 255 gray scales. Here we process it with Lagrange interpolation algorithm.

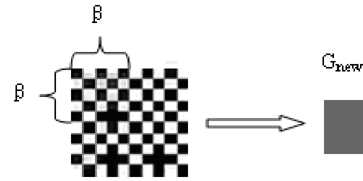

Figure 2

We set $[x_{k-1} \quad x_{k+1}]$ as an interval and get x_{k-1} , x_k , x_{k+1} as interpolation nodes, then find two times interpolation polynomial which should satisfy:

$$L_2(x_i) = Y_j \qquad j = (k-1,\ k,\ k+1)$$

$L_2(x)$ is a parabola which gets through the three points. The expression can be given by geometry meaning directly

$$L_2(x) = \frac{(x-x_k)(x-x_{k+1})}{(x_{k-1}-x_k)(x_{k-1}-x_{k+1})} y_{k-1} + \frac{(x-x_{k-1})(x-x_{k+1})}{(x_k-x_{k-1})(x_k-x_{k+1})} y_k + \frac{(x-x_{k-1})(x-x_k)}{(x_{k+1}-x_{k-1})(x_{k+1}-x_k)} y_{k+1} \qquad (1.1)$$

From the formula (1.1) we can see， $L_2(x)$ is made up of three linear fundament functions as shown in formula (1.2) which coefficients are y_{k-1} y_k and y_{k+1}

$$l_{k-1}(x) = \frac{(x-x_k)(x-x_{k+1})}{(x_{k-1}-x_k)(x_{k-1}-x_{k+1})}$$
$$l_k(x) = \frac{(x-x_{k-1})(x-x_{k+1})}{(x_k-x_{k-1})(x_k-x_{k+1})}$$
$$l_{k+1}(x) = \frac{(x-x_{k-1})(x-x_k)}{(x_{k+1}-x_{k-1})(x_{k+1}-x_k)} \qquad (1.2)$$

Because the parabola gets through the following three points:

$$(x_{k-1} = 0 \quad y_{k-1} = 0)$$
$$\left(x_k = \frac{\beta^2+1}{2} \quad y_k = 128\right)$$
$$(x_{k+1} = \beta^2 + 1 \quad y_{k+1} = 256)$$

We can easily get the Function Curve as shown in formula (1.3).

$$L_2(x) = \frac{x\left(x - \beta^2 + 1\right)}{\frac{\beta^2+1}{2}\left(\frac{\beta^2+1}{2} - \beta^2 + 1\right)} 128 + \frac{x\left(x - \frac{\beta^2+1}{2}\right)}{\left(\beta^2+1\right)\left(\beta^2 + 1 - \frac{\beta^2+1}{2}\right)} 256 \qquad (1.3)$$

Different gray scales of $0 \sim \beta^2$ range can be accurately converted to 0~255 range of gray scales by formula 1.3, obtaining unification "continuous tone image" to prepare for the following dot compensation.

As ink zone data use to initialize ink key directly, striding the process of the film's and the plate's generation in prepress, however the eventual ink zone control data is on the basis of dot coverage area of the printing, so we need to generate the low-resolution image depending on the process flow (CTF and CTP) with dot compensation, simulating graphics-attribute data of printing, so as to increase the accurate data of the preset ink keys. Therefore firstly we must find the relationship between the dot rate of the One bit Tiff image files after RIP and dot rate of the printing[3].

In the CTF process, image gets "dot gain" compensation after separation process. After the compensation, it is the dot percentage F (Film) that is recorded on the film.

That is: F (Film) = F (printing) – ΔF (dot gain), because the laser exposing film also leads to a slight dot expansion, it is usual to have the recording equipment linearized in RIP. Then we obtain the dot percentage of the binary image after RIP, called F (RIP)

So: F (RIP) = F (Film) –ΔF (exposure enlarged) = F (printing) – ΔF (dot gain) –ΔF (exposure enlarged)

To gain dot percentage of the printing --F (printing), we need curve of "Copy to Film". Based on this curve, we can get it by calculation.

We can know the ΔF (dot gain) by analyzing the curve, then get the F (printing) –Δ F (exposure enlarged) from the F (RIP)+ ΔF(dot gain) ,as Δ F (exposure enlarged) is usually very small, F (RIP) + ΔF(dot gain) ≈ F(printing).

After the analysis, we find out the relationship between the tiff image files after RIP and the printing. According to curve compensation, ultimately we know: the actual dot percentage of printing--- F (printing), then calculate ink coverage according to the "Copy to Film" curve as shown in figure 3. For example: gray value of a certain pixel in the low-resolution "continuous tone image" is 179, corresponding to the dot area rate 70%, it would be converted to 80% dot percentage.

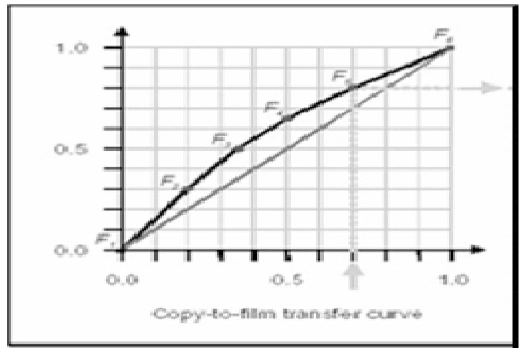

Figure3 *Dot transmission curve in output process*

As CTF process includes two transmission, one is that dot coming from the film transfers to the plate, the other is that dot in plate transfers to the printing, so the curve of Figure 3 is actually made up of two non-linear curves; For the CTP process, the transfer process just consider the dot gain which dot of plate is converted to printing, the compensation process is mostly similar to CTF process [4].

2.2 Analysis and statistics of experimental results

In order to visually show the ink zone information of image after compensation, the tiff image after RIP will be treated by program, so that we can obtain relatively accurate data of ink zone. Preliminary preparation work will be realized in PHOTOSHOP, simulating the screening process of the digital manuscript, then get the "One bit Tiff image file."

First, we select digital image which have a relatively good color, tone, level and the definition as Figure 5 below; then separate and compress the image in PHOTOSHOP, obtaining low-resolution "continuous tone image" as shown in figure 6 . For example, we chose cyan plate and store the ink zone data with compensation, as well as without compensation. So that ink data can be counted by the program. Figures 7 - Figure 8 are the histograms of the cyan plate with compensation and without compensation after analysis.

Figure 5 *Color Digital Original*

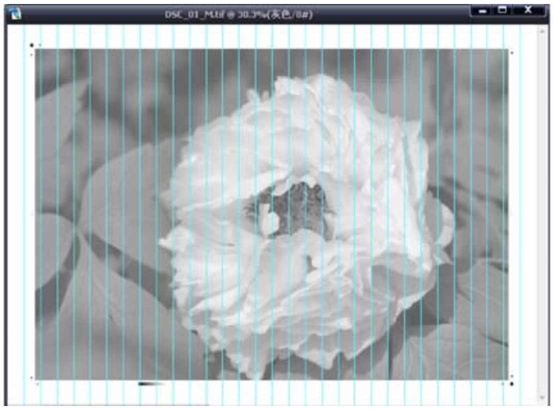

Figure 6 *low-resolution continuous tone image*

Figure 7 *statistical graphic of cyan plate without compensation*

Figure8 *statistical graphic of cyan plate with compensation*

Contrast with the original manuscript ,We can easily see that: 1. Because the yellow flowers are existed in center, the ink sharply decreased in the corresponding area of cyan plate while the ink of both sides are basically the same volume in histogram according to the digital image 2. From the statistics of the cyan plate's ink data with compensation and without compensation in the histogram, we can see that the former data have obviously changed compared to the latter and using the data after compensation as basis of ink presetting data is more precise than the former. In addition, not only can the simulation program draw the histogram based on data of the image; but also can record the coverage area of ink zone, which don't list exhaustively here.

3. The conclusion

The paper start with experiment and data source, theoretically proved: it is feasible to use One bit tiff image file as data source of the ink zone control, and the tiff image after interpolation algorithm and dot compensation has the characteristics of small amount of data, high precision, which can improve the rationality and veracity of the ink distribution. If the result applied to the printing production, not only can it improve the quality of the printing and provide theoretical support for digital printing processes, but also will promote the long-term development of the printing industry.

References

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