Digital Printing Quality Detection and Analysis Technology Based on CCD

Ming He, Liping Zheng
College of Mechanical and Electrical Engineering, Yunnan Open University;
College of Optoelectronic and Communication Engineering, Yunnan Open University, Kunming, Yunnan Province, 650500, China
E-mail:1240188382@qq.com

Abstract: With the help of CCD digital printing quality detection and analysis technology, it can carry out rapid evaluation and objective detection of printing quality, and can play a certain control effect on printing quality. It can be said CDD digital printing quality testing and analysis of the rational application of technology, its digital printing and printing materials for a variety of printing equipments to improve the quality of a very positive role. In this paper, we do an in-depth study and discussion based on the CCD digital print quality testing and analysis technology.

1. Introduction
In recent years, China's digital printing technology has got a certain degree of development, and in the printing industry it has been more widely used. Digital printing has fast printing technology, personalized printing, network printing and variable data printing and other advantages, in a number of printing areas have been widely used. However, at the present stage of digital print quality testing work, as well as the lack of a scientific and reasonable evaluation elements, leading to the specific print quality testing work difficult to obtain a good test results. Which also needs to build a good detection of digital printing quality testing technology, to promote China's digital printing technology and make it has been further developed.

2. the necessity for study the digital printing quality testing and analysis method
In the traditional print quality evaluation work, the detection methods it often used is the combination of subjective visual and objective measurement, and mostly by means of a density meter and spectrophotometer to do objective analysis on print quality and color information. In this detection mode, it is possible to reproduce the effect and accuracy of the original document to perform a good detection effect, but the shortcomings such as the clarity of the character and the outline of the line and the quality of the dot reproduction can only be given a qualitative description by means of visual inspection. Resulting in the lack of scientific and consistent evaluation results. As a kind of a visual product, the digital print can be carried out by means of a combination of subjective and objective in the process of quality inspection and analysis, and can be subjected to a color reproduction effect and a printing quality by a conventional print quality detection mode effective detection.

However, the current application of digital presses compared with the laser phototypesetter and...
direct plate making machine, there is a certain degree of gap in the output accuracy, and in the text printing process applied to most of the dry powder digital printer output resolution. The rate is relatively low, and will causing a certain degree of impact on printing the line and the clarity of the text [1]. In the digital printing process it is used in the inkjet printing equipment due to the printing material for the ink absorption, which led to the occurrence of edge diffusion and so on. In addition, because of the halftone dot structure and pigment particle size is too large and other factors, also led to the existence of dry powder digital printing equipment in the specific work process, its large filled area will appear obvious grain, and may lead to the occurrence of bar phenomenon because of mechanical failure.

Therefore, in the process of digital printing quality evaluation we must break the traditional binding of printing quality evaluation elements, combined with the characteristics of digital printing technology on the basis of a reasonable quality attribute requirements and the corresponding detection indicators, it is the only way to further improve the level of digital printing quality testing and analysis, and to promote China's digital printing technology has been continuously optimized and improved.

3. the brief introduction based on CCD printing quality evaluation and analysis methods

Digital cameras and scanners, CCD equipment as the main equipment to do digital printing for image captured, by means of these CCD devices it can accurate digitally the printed products, it will directly reflect the actual copy of the print results and quality of the image it obtained. It can be said that based on the CCD device it can be digital printing technology, print quality of its image clarity, color reproduction uniformity, network fidelity and bar defects and many other indicators to effectively detect and evaluate [2].

For large filling area quality, it can be quantitatively analyzed by means of large area darkness or chrominance information. The fidelity to the network can be compared and analyzed by means of the ratio of the diameter of the recording point and the degree of roundness of the points. Line and character print quality can be through the edge of the roughness, ambiguity and contrast and other indicators to conduct a reasonable quantitative analysis and evaluation. In the process of detecting and analyzing the digital printing quality of CCD, the smaller the edge roughness and the ambiguity value, the bigger the edge contrast value is, the better the line quality is.

The detection and analysis method based on CCD printing quality is mainly by scanning or carrying a magnifying glass digital camera to detect the printed matter to scan and shoot processing, and based on the digital image processing technology do the analysis of the relevant features of the region, and then by numerical means to give the corresponding quality attribute description. Under normal circumstances, CCD digital printing quality testing equipment is a light source, magnifying glass, high-precision CCD camera and the corresponding quality evaluation analysis software composed of several parts [3], the specific system structure is shown in Figure 1.

![Figure 1](image_url)
4. the case analysis
This paper gives the analysis and evaluation to digital printing quality testing mainly through the network quality, lines, text quality and large area filling quality and other four elements. And by means of digital printing quality inspection system for a number of print quality testing and comparative evaluation. In this paper, the CCD based digital print quality inspection system is equipped with a Sony CCD camera with a resolution of 1024 × 768 optical lens head, the ring light-emitting diode as a lighting power, and the CCD camera after the detection of the target image sent into the corresponding quality analysis and evaluation software [4].

4.1. network quality analysis Through the printing technology, it can be based on the network to achieve the replication of graphic information, the recording point used in the digital printing image structure of the smallest unit. The electrostatic photographic digital printing dot in the printing system is mainly composed of the charged toner particles adsorbed to the discharge area of the photoconductive material, and the ink jet printing is carried out by means of the direct ejecting of the ink droplets to obtain a certain printing effect. It can be said that the quality of the recording point will directly affect the quality of the entire network fidelity and network expansion and other quality attributes, the print image for the actual copy effect also has a very large impact. The comparative analysis of the same inkjet printer in two different printing materials on the output, the network distribution is shown in Figure 2.

![Printing material a and Printing material b](image)

**Figure 2** Quality analysis of inkjet printing points

It is found that the ideal diameter of each dot are about 300 μms, but the point of the printing material a is significantly smaller than the printing material b and is closer to the ideal circular shape than the printing material b. The diameter of the dot above the printing material a are about 311.6 μms, and the diameter of the dot on the above-mentioned printing material b is about 336.5 μms. In addition, both the printing material a and the printing material b the standard deviation values were 11.5 μms and 20.1 μms, respectively. In addition, there is a large difference in the degree of roundness between the printing material a and the point of the printing material b, which is 1.51 and 2.46, respectively. The results of these tests were analyzed and found that if there is no capillary phenomenon, infiltration phenomenon and feathering phenomenon on the printed paper, the roundness of the circular material on the printing material is ideal. According to the relevant data show that the substrate a above the capillary phenomenon and the emergence of the phenomenon are better than the substrate b, so have a good output. In addition, the analysis of the tone network, found in the substrate a printing process, it can achieve a more consistent dot effect, and can be close to the ideal size of the network of reasonable reproduction, so have a relatively high network fidelity, and can play a certain degree of control on the printing density of the digital printing.

4.2. Lines and text quality analysis
In digital printing technology, it is susceptible to the impact of capillary materials such as the role of printing and infiltration and other factors, coupled with the number of electrostatic photography due to the output of the digital resolution itself, led to the use of digital printing technology output lines and text edge quality. Compare with the traditional offset there is still a certain gap. Through the digital printing technology to print on two different printing materials, the specific output is shown in Figure 3.

Figure 3 Inkjet print proof of the line quality

Figure 3 on the line quality analysis, it can be clearly seen that the different printing materials for the printing quality also have a very significant impact. In Fig. 3, the print lines in the middle of the two graphs are compared and analyzed, and it is found that the capillary action of the ink on the printing material b is more obvious than that of the printing material a, which leads directly to the printing material b Lines of the line width is larger, the edge of the line quality is not as good as the printing material a. The data onto the printing materials are described by means of these quantitative analysis results, which can also to provide sufficient technical reference to the development of the relevant inkjet printing materials, inks and paper coating developers. In this study, the two kinds of printing materials, the quality of their lines as shown in Table 1.

| Table 1 Line quality analysis |
|-----------------------------|
| Printing material | μm Line width | Roughness | Ambiguity | Contrast |
| a               | 127.5          | 11.68     | 70.12     | 0.77     |
| b               | 178.9          | 20.98     | 79.65     | 0.65     |

Through the digital printing technology to carry out the printing of the text, and its digital quantitative analysis. It can also get the printed text edged roughness and edge ambiguity of the comparative analysis. In this paper, we selected three black and white laser printers of the same model to print the same text, and then compared the edge roughness, edge ambiguity and vertical line width of character B. The results are shown in Table 2 and Fig. 4 as shown.
Table 2 the same type of printer text quality comparison results

| Printer | μm Line width | Roughness | Ambiguity |
|---------|---------------|-----------|-----------|
| 1       | 195.74        | 5.16      | 51.66     |
| 2       | 233.14        | 15.46     | 63.15     |
| 3       | 215.36        | 10.15     | 66.02     |

It is found that the output effect of the printer 1 is the best, and the edge jagged phenomenon of the output character of the printer 2 and the printer 3 is more noticeable than that of the printer 1. In addition, the printing effect of the printer 3 is relatively poor, Toner is about to run out of effect. In the process of digital printing, the output characters if there is excessive stroke width and edge roughness, it is easy to lead to the output page of its reading performance to a greater degree of reduction, so in some small characters in the process of output, It is easy to lead to the output of the results difficult to read the normal situation. And by comparing the quality of the characters output by different printers, it is also possible to find and analyze the fundamental problems of finding out the quality of the output. Only in this way we can find out the various problems of the printing process and solve them in order to make the print output quality improve and optimize.

4.3. the quality of a large area of fill in the airspace

In the process of digital printing, if there are defects such as particles, spots and bars in the filling area, there are many problems such as insufficient reflection uniformity in the ink layer in the region. Taking the digital photoelectric printing quality as an example, the magenta color of 40% dot area is taken as the detection module by means of laser as the imaging light source and light emitting diode. In the specific detection and analysis of the two magenta are used to adjust the amplitude of the screen, and make its network characteristics to maintain a circular shape, to find a specific large area filling quality effect shown in Figure 4.

![Figure 4](image)

Figure 4 Contrastive analysis of large area filling quality for electrophotographic imaging

Analyze the Figure 4, found a map of the spot value nearly 1.65, the toner coverage of 55.15%, the specific percentage of the blank area was 44.85%. In Figure a, the average reflectance can reach 43.17 and its density is 0.35. Compared with a graph, the spot size of b is about 1.88, the toner coverage is 46.81%, and the percentage of the blank area is 53.19%. In b diagram, the average reflectance are about 50.16 and its density is 0.30. Through the analysis of these data found that through the electrostatic digital printing technology to magenta block print, with the output quality is equivalent, toner distribution is also more uniform, but the two magenta plate still exists a certain degree of
network. Expand the phenomenon, it also requires the relevant manufacturers and digital printing technology R & D personnel to give full attention to this problem and be resolved, so as to achieve a good digital printing effect.

5. Concluding remarks
In order to obtain a good digital print quality inspection analysis results, in addition to the spectrophotometer to the printing density and color information to be measured, but also need to take full account of its text, lines, outlets and large area filled area and many other elements that can make the copy quality of graphic image. With the help of CCD-based digital image processing technology and image captured technology, it can complete the reasonable detection and analysis of the whole digital printing quality, which is also very important to the further promotion of digital printing level. It can be said that in the digital printing quality testing and analysis of the application of CCD technology, which is the printing industry in the development process of an inevitable way.

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