The Research and Application of RIP Technology In Map Publishing System

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Abstract   In this paper, the structure of map publishing system, the PostScript page description language and the RIP technology used in map publishing system have been discussed, and the definition of the RIP has been given. Then the procedure of digital screening and text processing, the principle based on RIP technology and its application in map publishing have been discussed particularly. Finally, the design of specific RIP used in map publishing has been brought forth and implemented step by step through our research.

Key words   Map publishing   RIP technology   PostScript language   Digital Screening   PS font.

The RIP（Raster Image Processor）is one of the kernel technology in electronic publishing system. Its main task is converting vector data and screening data into grid data for image output. In fact，the RIP technology includes many complex contents, for example PS language explanation, color screen separation, fonts replacing, image preview, image processing, output control and so on. Meanwhile it also can be thought as a tool that can translate PostScript information into high-resolution image products by some software. After being processed, images can be output onto paper or film by some output equipment like laser printer or imagesetter. Thus the RIP technology is the only bridge to convert publishing data into high-precision image output and becomes the ultimate signal of advanced degree of publishing system. Whether the RIP is good or not partly determines the open degree of the system, output quality and print speed.

The map publishing possesses all the important factors of image and text publishing, so in the map publishing, all functions in RIP technology can be used effectively. But it is essential that the cartography software must be adaptive to the most advanced RIP technology. Meanwhile, because the characteristic of map publishing is different with that of common image and text publishing, the cartographer must search and apply the RIP technology associating with the characteristic of map publishing to serve map publishing better. And it is very conducive to heighten the quality and the efficiency of map publishing.

1   the relations among map publishing ,RIP technology and PS language

1.1 PS language

The PostScript language developed by American Adobe System Corp. is an explanation language with powerful ability to process image and graph. It is not only a common program design language, but also an international standard page description language. Being a program language, its characteristic is very clear, for examples complex page description for output, powerful ability to process image, independence of equipment, and being understood easily. It becomes the international leader to high-precision image publishing system for three following reasons besides above merit:

① abundant high-precision outline description fonts;
② PostScript description program structure with open stack;
③ compatible Display PostScript system (PostScript RIP is it's kernel).

In 1990,the Adobe System Corp. brought forth the PostScript Level 2 based on the PostScript Level 1. Because it describes pages in high level and is independent of equipment totally, it became a universal page description language since 1990. In the later of 90s, the PostScript Level 3 comes out, and some new attribute and characteristic were added, for instance the support of built-in RIP white leak fill, the improvement on low efficiency in the PostScript flow through adopting PDF (Portable Document Format) which is independent of page. Unlike PS file, "dialect" does not exist in PDF file, and the PDF can process pages independently and record contents with the page as unit. After the PostScript Level 3 is integrated with PDF, a new digital file is created for the transmission and print, and the technology can be used as a digital standard to maintain the integration of file.

1.2 RIP technology

As mentioned above, the RIP is the only bridge to convert the page information into image or text output in the publishing system. Its basic function is explaining page description language. One of its key operations is the conversion from vector data and information on screen separation to grid data, the other is controlling exposure of imagesetter to record line image, text and dot image on film. Because the PS language is very advanced, systematic and standard, it has become a universal international standard in fact. At present, the basic signal to estimate the advancement and openness of RIP technology is whether it can receive PS format data which come from front end or not. Now famous domestic and abroad developers all research RIP technology based on the PostScript. In this sense, the RIP in publishing system is actually an explaining implement, and its basic operation is explaining PS language. In other words, the basic function of the RIP is translating the pages described by PS language into grid image data for output equipment, driving and controlling the real output of equipment.

In the past, the functions of RIP are limited to three aspects: ①explaining page description language which is generally PS language which comes from application program.②creating a object list files for display on the page. ③rastering data, it means converting data into dots, building raster map in which some information is set for dots, and implementing screening when data being output through output equipment. Along with the further development of RIP technology, the RIP will be able to complete all works related with image, for instance magnification, reduction, crop, separation, white leak fill and so on. In the present updated publishing system under such a new mechanism, all software just put some orders of technology disposal into data flow and in later phases this orders are carry out by the RIP.

Through using PDF file format which is independent of the page, the PostScript Level 3 improves the RIP technology very strongly and makes the process much more efficient, foreseeable and fluent. Now designers for RIP are exploiting some new products compatible with the PostScript Level 3, and many RIP products which can receive and process PDF file format have come out.

1.3   the relations among map publishing, RIP technology and PS language

The advanced RIP technology can effectively guarantee high quality for map publishing. Whether the RIP can accept and explain PS language efficiently and correctly or not determines the output mistake ratio, the advancement and openness of publishing system. The font library and screening technology in RIP determines the precision of output image and text, the effect of color recovery, and the explaining speed, meanwhile network support in RIP determines the efficiency of map publishing.

Because of the powerful functions of PS language, it is the key to ensure map publishing system to work efficiently and standard. Moreover, the use of PostScript RIP requires uniform PS data format at front end to avoid other problems produced by different data formats. A new

request is put forward that all data of cartography and publishing must be converted into EPS、PS、PDF formats for store and process.

Now some simple introduction will describe the conversion from map data to EPS format. The EPS data structure includes three parts: file head、PostScript description、file trail.

The file head is made up of DSC (Document Structure Convention) notation followed by some procedures and it's description in PostScript language.

The PostScript description, main part of data, includes many orders, for example moveto, lineto, curveto, fill, stroke, width and so on. They can be showed simply as u, U, O, R, k, K, T, Z, e, t and so on.

A solid circle filled by color [C M Y K]=[0 0.80 0 0] can be expressed through curveto:

```
0 0.80 0 0 k 0 0.80 0 0 K
1202.82 552.251 m
1202.82 553.48 1203.81 554.463 1205.04 554.463 C
1206.26 554.463 1207.25 553.48 1207.25 552.251 C
1207.25 551.022 1206.26 550.039 1205.04 550.039 C
1203.81 550.039 1202.82 551.022 1202.82 552.251 C
f
```

The chinese characters must includes some attributes on font, color, transfiguration and size:

```
0 0 0 0.95 k 0 0 0 0.95 K          //color define
/_HYg1gj 2.94927 0 0 0 z           //fonts choice
[1 0 0 1.4 1169.13 1131.95]e       //transfiguration define
30(地图制图)t                       //character size and content
```

Finally the file trail tells the end of file. According to this approach, the EPS file can be accepted by Adobe PhotoShop 5.0、Illustrator 5.0、Freehand 5.0C、CorelDraw 8.0 and the data can be used widely.

The relations among map publishing, RIP technology and PS language description are showed as the following figure 1:
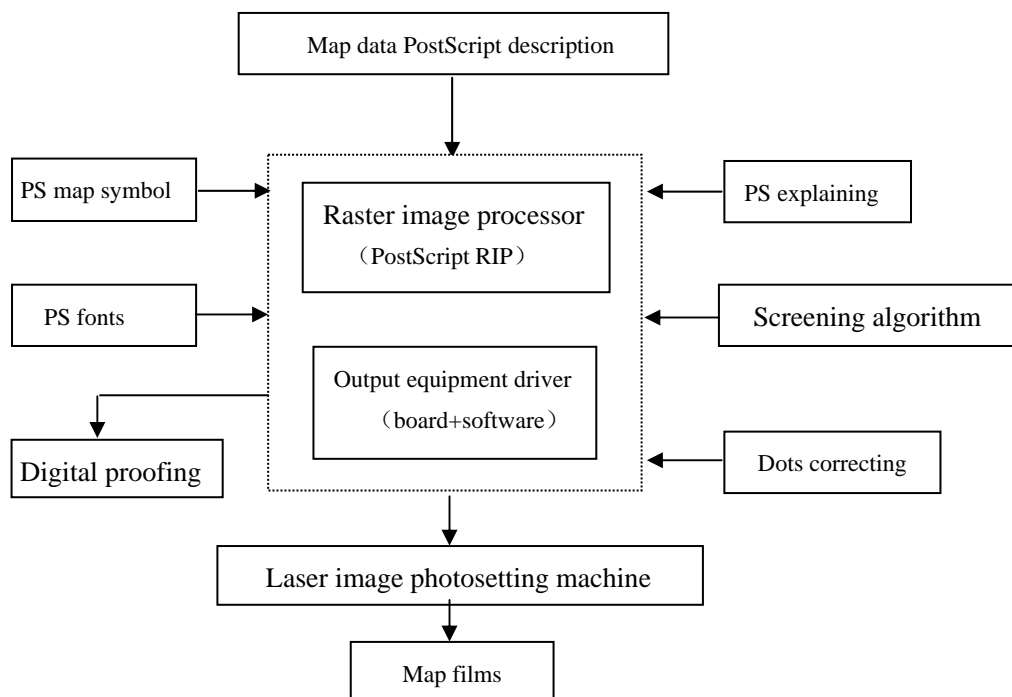

Figure 1: relations among map publishing, RIP technology and PS description

The application of PostScript RIP makes the map publishing system open and advanced,

and enables the system to accept and process standard data. So it can undertake all kinds of output business from other map and image manufacture center. Meanwhile map data descriptions in PS language ensure the precision of publishing data and uniform data format. So the standard data can be output at any image output center. Through adopting this technology, the map publishing is taken in international and standard technology flow based on PS technology. It ensures the map publishing technology to step into the path of international universal publishing.

2　The application of RIP digital screening and text process technology in map publishing

2.1　digital screening technology

Screening is an important function of the RIP. Any excellent RIP must own the scientific and reasonable algorithm in order to output product in high quality. The screening algorithm decides whether the Moire and Rosette can be reduced to the minimum or not. It heavily influences the recovery of the original color.

It's the dot technology that implements the solid color of the line map, the geomorphological dashing and the image map in printing. The screening technology directly influences the accuracy of duplicating the designed color in the map, and it further influences the process of delivering message, the level, and the beauty of the map.

There are two kinds of screening method presently, namely conventional screening and stochastic screening .The conventional screening (which is also called AM) is that the dot has the fixed position and frequency. We can change the size of dots to adjust the level of the image. The stochastic screening (Which is also called FM) means the screening dots that occur randomly have the fixed size, but the dot distance varies with different dots. The level of image can be adjusted through changing the mount of dots.

At present conventional screening is the main method .It includes the rational tangential screening, the super cell structure, the irrational screening and so on. Because the imagesetter expose and form image in grid ways, and the ratio of opposing side and adjacent side is the rational, the screening angle must be rational tangential angle if without special processing. Thus the simple algorithm, the small amount of data and the fast processing speed are all the advantages of the rational tangential screening. Through regular screening , 0°,15°,45°,75° can not be achieved accurately. But, with the technology of approximating the screening angle and slightly adjusting the frequency of the line, it reduces the Moire to the minimum, and can basically satisfy the color printing.

Whereas the above conventional rational screening method can reduce the frequency of the line in order to approximating 15° and 75°. We can adopt the following way to solve the problem between the screen angle and the frequency of the line: first, a huge dot cell (called super cell) is formed, then it is divided into many sub-cells. A super cell has 300-3000 sub-cells. This super cell has many dot arrangement ways called super cell dot structure technology. Applying this technology the optimum approximation of the regular screening angle（15°/75°）can be guaranteed, and the frequency of the line in four separations of the image can be achieved ,so the problem between the resolution and the approximation of angle 15° is solved. Based on this technology, some new screening methods are brought forth. It is typical of the Linotype-Hell HQS, Adobe Accurate screening and Agfa Balanced screening.

The super cell dot structure belongs to the rational tangential screening, whereas irrational screening has no cell or super cell. Every cell is calculated individually, so massive calculation must be accomplished momentarily. As the coordinate of the record header changes, it is converted into the screening coordinate in the pre-settled screening angle system, and can form the dotted image in random angle.

There are many problems which exist in the conventional screening technology:

① It produces Morie inevitably.

② The resolution and level of the image will be lost in it ,and especially the leap of level will easily occur in the highlight and shadow area.

③ The combination of the optional line frequency and angle is limited ,so it is difficult to realize the overlap over four color separations.

If the stochastic screening technology is adopted, above problems can be overcome easily, in the future, the stochastic screening will be the main screening technology in printing The stochastic dot has many advantages:

① It has high definition but no Morie or Rosette, and can recover the level of image completely.

② The screen angle is no limited, and the scale of color recovery is very wide. It can produce special result that the conventional separation can not do.

③ It can using the lower line frequency in scan model and the imagesetter with lower resolution.

It is a very notable problem how to put the different advanced screening technology into the RIP in publishing system. In the research of RIP, it has applied screening technology with peculiar high quality and high level to form dots, and has put peculiar stochastic screening algorithm to use in the map electronic publishing system.

2.2　text process technology

The PS text processing and explanation is one of the important functions of the RIP. Its main flow is:

Firstly the RIP accepts the chinese character code and the information of the matrix, then finds out the corresponding chinese character from the PS fonts library installed, at last converts the image and text to the grid.

There are two ways to process the text in the map publishing system:

①When we convert the common format file to the PS format file ,the chinese character code and attribute are converted into the corresponding curve outline which also called path according to the description information of the chinese character. As the RIP processes the chinese character, it is identified with the conventional line without the attribute of chinese character. In this method, not only the amount of the data is enlarged, but also the characters look unpretty and aliased when they are zoomed.

②During the course of map editing, the conventional TrueType font library is used. But it is the PS font library that is installed in the RIP. When the RIP converts the edited data file into PS format file, only the attribute information on font, color, and deformation are provided, and the chinese characters have to be loaded, replaced by the corresponding curve outline description in the PS font library, and then converted into matrix information further. Because the amount of the PS file data is reduced, the processing speed is heightened through this method. What is more important is that it can guarantee to output the chinese character accurately in high quality and anti-aliased texts which were zoomed randomly. The latter method should be used in the conventional map publishing system.

In order to understand the RIP processing text well, The concept and character of the curve outline font library is highlighted as follows:

In the curve outline font library, it applies quadratic curve or cubic curve to describe the font outline and looks as the most perfect font technology present. It can retain original whole information of text through fitting the font outline with Bezier curve or spline curve. With new interpolation function family and sampling algorithm, it can avoid complex calculation and guarantee the accurate through describing curves by four control points, so it is a well-known best method to describe text. The curve outline font library has many characters. Firstly, it can be zoomed and rotated randomly with invariable occupation. Secondly, after magnified, it has no alias. Thirdly, after reduced, it still has high definition.

The curve outline font includes PS font and TrueType font. Both of them are described by above method, but they are different in concrete creation, use and character. The PS font is one of curve outline fonts described by PS language. After the PostScript level 2 is put forward, because all the graphics are described by cubic curve, the PS font is much more accurate. The PS font is designed for printing and output of imagesetter, and it only can be used by laser printer or output system equipped with the PostScript RIP. Though the PS technology font is printed accurately, fast with smaller occupation, but the PostScript printer is very expensive to the customer. In order to reduce the calculation during the course of font recovery, in Truetype font library the advantage of cubic curve fitting is gave up, so the precision is lower than that of PS fonts. Because the Truetype font places the intelligent process on the description of font outline, it can be used as display font on screen with the support of the Microsoft's software. Meanwhile after transferred, the Truetype font can be output with acceptable result by conventional laser printer (Which is not PS printer). In the DTP system equipped with common printer(s), when the layout information described by PS language is not necessary, it is enough to use a set of Truetype font library. But because the TrueType font library is installed in the computer (namely the PS font library is installed the hard disk of printer or RIP) directly, its occupation will be larger and the printing process time will be longer than that of PS font library.

In the conventional map cartography and electronic publishing system, the ink-jet plotter is used for checking plotting basically. But in the accurate digital proofing, it applies ink-jet, thermal sublimation and electrostatic method, whereas it must apply precise laser photosetting system during output. In the system with these equipments, in order to guarantee the quality of font display and printing, increase the efficiency, and guarantee the openness and convenience for data exchange, the curve outline font library should be used uniformly. In the cartography and publishing system, it is necessary only to install TrueType font library cheaply and conveniently in high printing quality and display quality (the resolution can reach beyond 600dpi). When the PS printer, digital proof machine and imagesetter are equipped in the system, besides that the TrueType font library is installed in the workstation for map editing, the PS font library should also be installed into the memory, the hard disk or the RIP. In order to guarantee to output lettering in high quality and precision, it is a fundamental requirement of using PS font library. Though its price is higher(a set of PS fonts is about worth ￥70000～80000) , it should be installed in all the conventional map publishing system.

3　the design of the specific RIP of map publishing

Using existing universal or special RIP in publish system domestically or abroad, map

making and publishing can be fulfilled. Due to some peculiar characters of map, for examples map symbol library, special color and cartographical representation, it is necessary to design a special RIP for the map publishing. This kind of RIP not only can satisfy general color publish but also can be added into several special functions associating with the character of map publishing in order to simple the map editing, accelerate the data processing and improve the quality of product.

(1) As a PostScript explanation implement, in order to ensure openness and advancement of map publishing system, it's very important for the special RIP to accept PS or PDF file format. Only in this way, the map publishing system can develop along with PostScript page description language and related technology to follow international advanced technology and ensure its advancement.

(2) Advanced dots processing (screening) technology. The screening technology and its screening effect influence the recovery of color and level directly. Hence some new effects about dots process domestically or abroad should be used in special map publish RIP research, for examples the stochastic screening, the rational tangential screening, the super cell structure, and the irrational screening

(3) Building the special map PostScript symbol library. In the library some map symbols in common use are stored and connected with RIP after being vector tracked and coded according to PS format. So in front-end map editing it only requires to transfer symbols in according with code, and other such works as symbol inquiring, data format conversion and output are left to be completed by the RIP. This project has little data quantity and ensures rapid speed and beautiful map symbols. Moreover, It is very necessary to select highly quality PS fonts connected with the RIP for ensuring the quality of map lettering.

(4) Building tools for special screen line and texture. Ordinarily in color publishing system, there are only dot screening and not line screening in the RIP. But in the map making, especially in thematic map making, it is common to use line and texture to represent thematic element. Whereas in some thematic map such as geologic map、land use map、vegetation map, there are still some representations in which lines are used to present color layers(even to form middle tone through overprinting) and textures are used to present distribution area. This technology is peculiar to map printing. If the RIP can not form screen line and texture, the only approach is to draw them combining software with handwork in map editing. In this method, it has large quantity of data, runs slowly and inconveniently. So in the design of special RIP, the screen line and texture formation function should be added. Then, in the former map editing, the RIP can complete the formation of screen line and texture according to their parameter, for examples line width, line frequency, line angle and texture type.

4 conclusions

The RIP technology not only is the kernel in conventional color electronic publishing but also is very important in map publishing system. Only the map cartograhic soft developers are familiar with RIP technology, they can develop advanced software which goes with RIP technology. Meanwhile, because the map publishing is different with common text and image publishing, The cartographer should search and apply RIP technology to server map publishing well and raise the quality and efficiency associating with the character of map publishing.

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