

DIPNET 880 GEOMETRIC PROCESSING

WORKSTATION

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Abstract

Remote sensing cartography need a ortho-photomap as the base map, and the geocode is also based on rectified satellite image or rectified aerial remote sensing image. Because of the rapid developement of microcomputer, adopting the geometric processing workstation supported by super-microcomputer, to make orthophotomap or geocode using digital rectification methode will be applied to production more efficiently and practically.

This article introduce the software structure, program and some main algorithm developed in the geometric processing workstation of DIPNET-880 system. The experimental result, precision and efficiency for geometric correction of digitized aerial photos and SPOT image are presented.

## I. INTRODUCTION.

For establishment of image map base or overlapping remote sensing image with geographic single feature coverage so as to update the geographic information or topographic map, it is necessary that satellite image or aerial photos is rectified on the other hand, for increasing the resolution of multispectral image in terrain, people make the registration using multispectral image and panchromatic image with high resolution, and the relative rectification must be fulfilled for these two image. So that, the geometric processing function is an important part in an image processing system. So called geometric processing means geometric correction for a remote sensing image or a digitized coverage, also including a part of geometric graphic processing.

For realization of geometric function, a image processing system must possess a quantity of storage capability, high speed of operation and I/O device. In the traditional image processing system supported by minicomputer, the geometric processing spend a lot of computing time and computer resources. Because of the development of super microcomputer, now this important job can be carried on the workstation. In this paper, DIPNET geometric processing workstation, based on the Apollo CAD workstation, is introduced. Joining ingeniously graphic function with image processing function, and with the capability of colour display in high resolution and high

operation rate, the performance/price of DIPNET geometric processing workstation surpass the system supported by mini-computer.

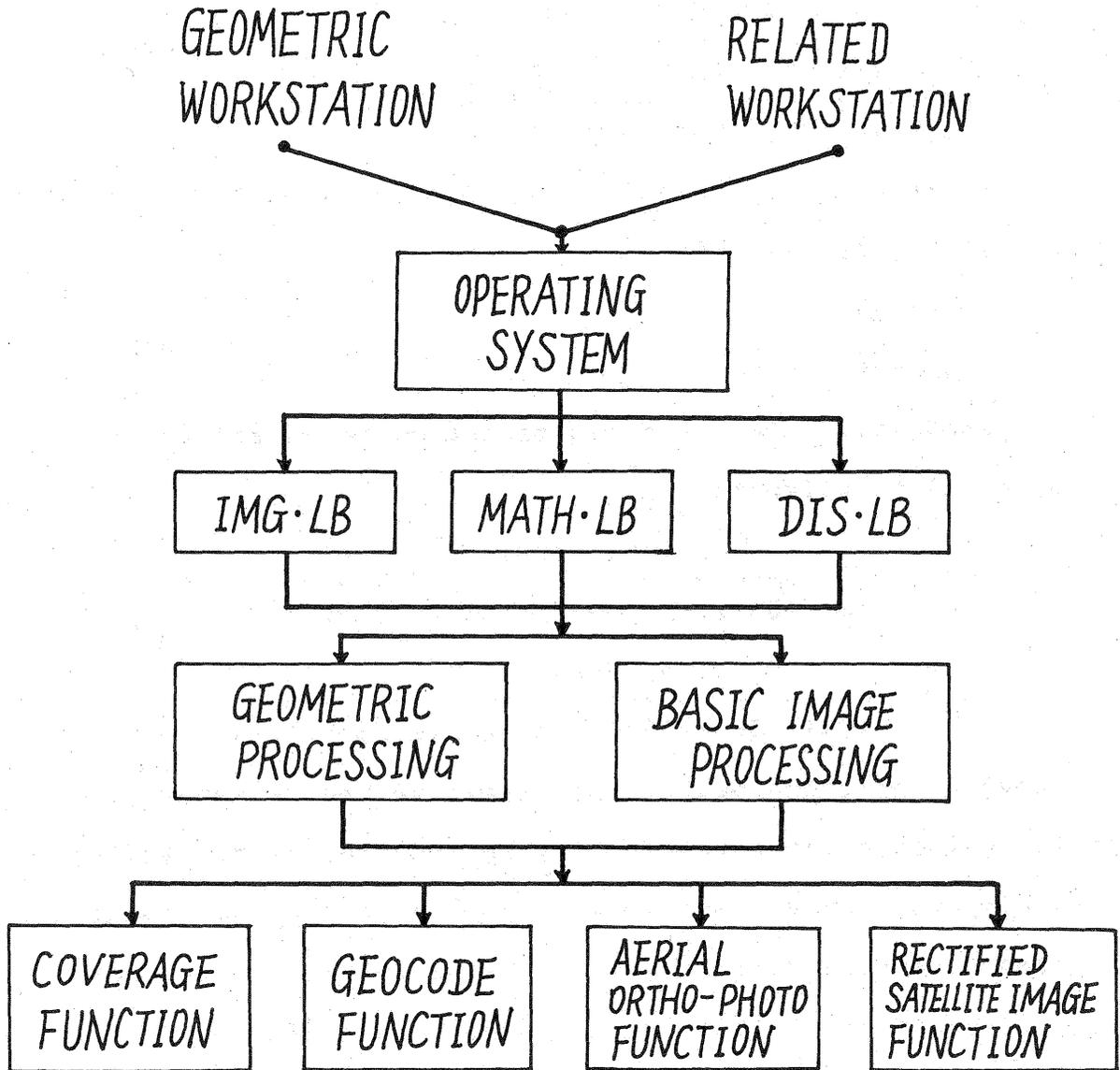
1984, in the paper "digital rectification of aerial photos in the system PIPS" [1], We have introduced the result of experiment using aerial photos. At that time, the experiment proceeded in PIPS system. Now, with the same quantity of image data, geometric correction is conducted in DIPNET workstation based on DN3000 and DN4000. The more fast operation rate is achieved, more over, the perfect graphic function of apollo workstation combine the image processing display function developed in DIPNET-880 SYSTEM, it shows the great deal advance than PIPS system, but the price is only 1/4 of that one.

DIPNET 880 geometric processing workstation can not only produce orthophotos and geocode in stand alone mode, but also it's rich software is the very important "interface" of cartography, GIS data acquirzation and processing workstation, as well as the future GIS global application in DIPNET micro-computer information processing workstation network.

## 2. The software structure and the main algorithm.

Geometric processing workstation can do geometric correction for aerial or space remote sensing image captured by different kind of sensor, some times, it is needed that neighbour rectified image can be done mosaic to a global sheet as the base of topographic or thematic map. At the same time, the related workstation such as image analysis, updating map, them-

tic cartography, and GIS data processing workstation also need geometric processing for different image and graphic file, in our distributed workstation network, the structure of geometric processing software express in diagram 1:



( diagram 1 )

The main algorithm of geometric processing as follow:

Geometric correction of digitized aerial photos adopted principle formula (1):

$$\begin{aligned}
 x &= -f \frac{A1(X-X_s) + B1(Y-Y_s) + C1(Z-Z_s)}{A3(X-X_s) + B3(Y-Y_s) + C3(Z-Z_s)} \\
 y &= -f \frac{A2(X-X_s) + B2(Y-Y_s) + C2(Z-Z_s)}{A3(X-X_s) + B3(Y-Y_s) + C3(Z-Z_s)}
 \end{aligned}
 \tag{1}$$

In the area having relief, an additional correction term is added in grey extraction.

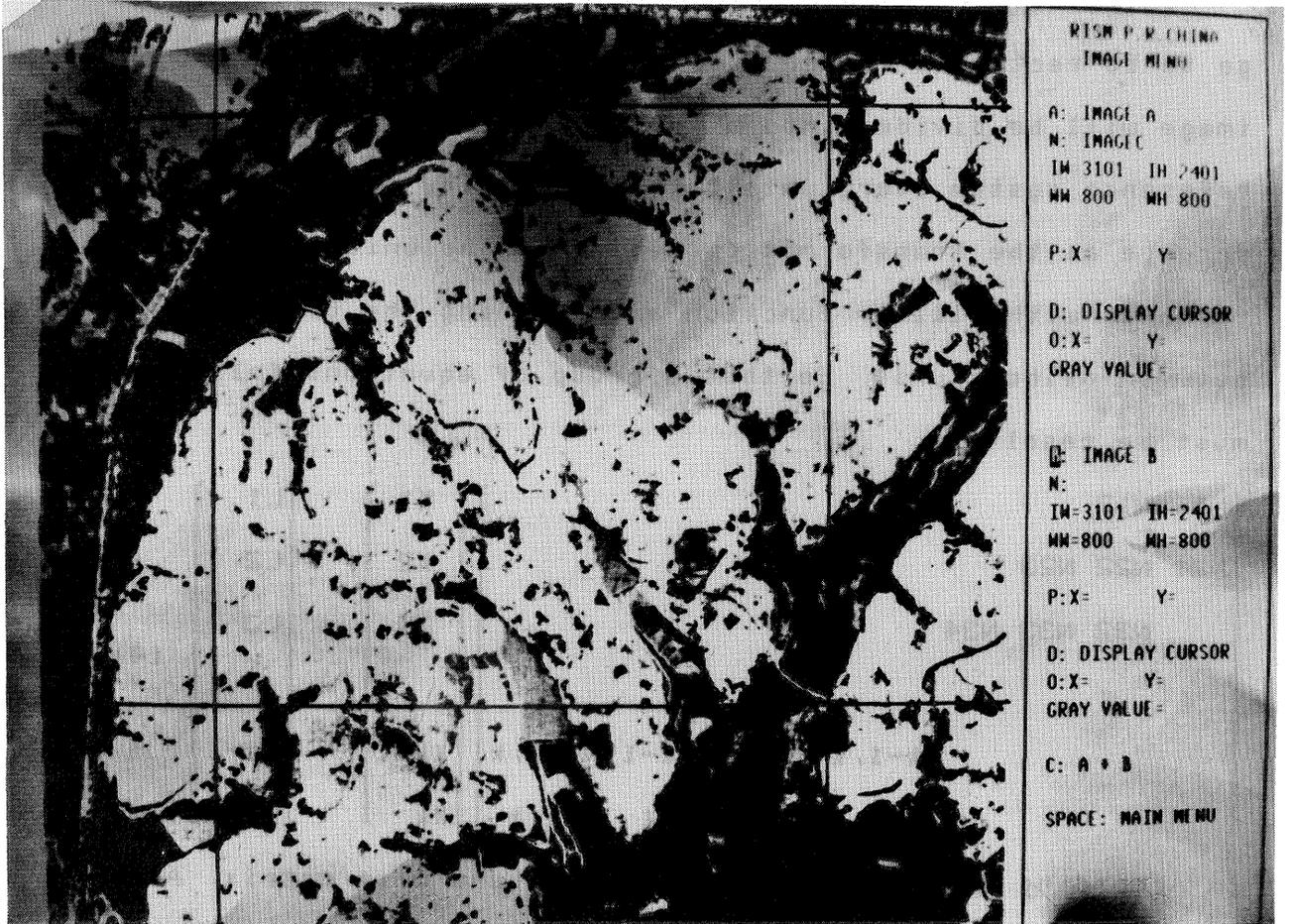
$$\begin{aligned}
 DX &= K_x * h \\
 Dy &= K_y * h
 \end{aligned}
 \tag{2}$$

The coefficients  $k_x, k_y$  can obtained by differentiating formula (1), relative to  $z$ :

$$\begin{aligned}
 K_x &= \frac{-(f * C1 + x * C3)}{A3 * X + B3 * Y + (C3(ZO - Z_s) - A3 * X_s - B3 * Y_s)} \\
 K_y &= \frac{-(f * C2 + y * C3)}{A3 * X + B3 * Y + (C3(ZO - Z_s) - A3 * X_s - B3 * Y_s)}
 \end{aligned}
 \tag{3}$$

Adopting polynome method, the satellite remote sensing image is synthetically corrected for systematic errors dealing with different errors source with good precision so the demand of remote sensing application can be satisfied. If the variation of orbit or attitude is not stable, the polynome approximation is still not a good mathematic model, so that, in geometric processing software a finite element method is developed





( figure 2 )



( figure 3 )

### 3. Experimental result and comparison:

As a test, the rectification for digitized aerial photos and SPOT image was conducted in NIPNET-880 workstation, the result shows that precision and velocity is satisfied.

With DN4000, for rectification of 2M image data of digitized aerial photos, 5 minutes is used for grey extraction, and 2 minutes are used for I/O. With DN3000, for the same quantity of image data, 10 minutes are used for grey extraction, 3 minutes are used for I/O. But in the PRIME 9650 mini-computer, the velocity of geometri correction is lower than DN3000 about 2 times.

The precision of rectification for digitized aerial photos has been introduced on paper [1]. Figure 2 is the rectified aerial photos displayed on DIPNIT workstation.

Using SPOT panchromatic SPOT image of YIYANG region of CHINA, the level 2 of geometric correction was conducted with control points mesured on the base map in scale 1:50000. After geometric correction with polynome method, the mean square errors  $M_s=20.4$  m according to 57 control points and with finite element method  $M_s=13.2$  m. According to tie condition, the mean square errors  $M_s=2.0$  m.

Figure 3 is the rectified satellite photomap in scale 1:50000.

With DN4000, 30 minutes was spent on geometric correction of 9M bytes SPOT image data. And with PRIME 9650 minicomputer 3 hours are needed. So that it is practical that workstation supported by super-microcomputer used to geometric processing.

DIPNET workstation can be used to do geometric correction and digital mosaic, add reference grid on the rectified image or overlay the coverage of geographic information on it . . . . so that geometric processing workstation can not only produce photomap and orthophotomap, also can support different application like image analysis and updating GIS data. . . . etc.

Because the performance/price of DIPNET geometric workstation is much more less than image processing system supported by minicomputer, and the production cost of orthophotomap has approximate one of digital orthoprojector controlled by microprocessor, so it will get more and more user.

reference:

[1] YANG MING HUI, REN WEI CHUN: "Digital rectification of aerial photos in the system PIPS" ISPRS 1984 COMMISSION III VOL. XXV A3a.

