Generation of GCP Chip in Landsat-7 ETM+

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Abstract

In order to utilize remote sensed images widely, it is necessary to correct geometrically. Traditional approaches to geometric correction require substantial human operations. Such substantial human operations make geometric correction a laborious and tedious process. In this paper, We introduce concept of GCP(Ground Control Point) Chip and generate a GCP Chip for automatic geometric correction. GCP Chip is small image patch which has a GCP in reference coordinate image. GCP Chip will be used to match new images in geometric correction. We generated GCP chip using Landsat-7 ETM+ panchromatic band image in this study. Henceforth this result will support automatic process in geometric correction.

Keywords : Automatic geometric correction, GCP chip, Landsat-7 ETM+

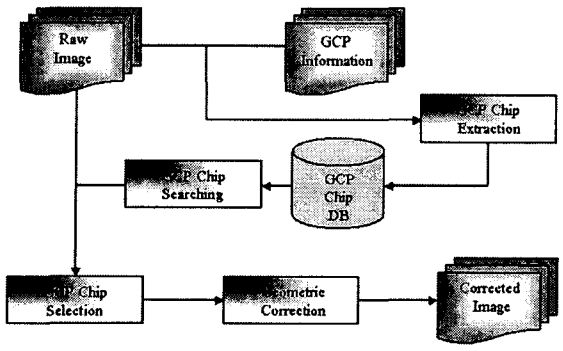
1. Introduction

It is increased to utilize satellite image and get information little by little in nowadays. Moreover, the development of remote sensing platforms and sensors has noticeably increased the availability of both hyperspectral and high-resolution imagery. So, usefulness of satellite image will grow in the future. In order to utilize remote sensed images effectively, it is necessary to correct geometric distortion precisely. In order to accurately correct geometric distortion, for example, GPS (Global Positioning System) surveying, digital map , topographic map and reference images are required. For image-to-image registration, tie points

between two images are required. But, traditional approaches to geometric correction require substantial human operations. Such substantial human operations make geometric correction a time-consuming, laborious and tedious process. The specially, as many satellite image are processing, thus operations will be troublesome more and more. In this paper, we introduce concept and generation of GCP (Ground Control Point) Chip for automatic geometric correction to save time and work. GCP Chip is small image patch which has a GCP in reference coordinate image. The output set of GCP Chip is stored in the database. This study is developed by Visual C++ in Window2000 PC and experimented by MS-ACCESS and ODBC (Object Database Connectivity) as database. We think that GCP Chip DB help to make a geometric correction process automatically in the future. A few previous publications dealt with an automatic geometric correction using GCP Chip. There is GCP Chip applied to KITSAT-3 (Lee *et al.*, 1998), SPOT (Kim *et al.*, 2002), RADARSAT (Adair, 1996) in previous study.

2. Concept of GCP Chip

Because the geometric correction using a GCP depend on skillful degree of the person who selects a GCP, it is possible to change result in the individual case. If observation date is changed (i.e., data is changed), we must process a geometric correction from the beginning to the end. Therefore, to save time and work, automatic selection and registration of satellite image as control points have been studied a lot (Dai and Khorram, 1997; Eric *et al.*, 1991; Ton and Jain, 1989; Zhang *et al.*, 2000). Among the automatic image registration, GCP Chip can be used for geometric correction. GCP Chip is small image which has reference coordinates and invariant feature distinctly according to temporal changes in position and brightness. GCP Chip has advantage as follows. First, there is no troublesome process, that is, extraction GCPs from digital map, paper map and satellite image. Second, because GCP Chip is not vector composed of lines and points but data type of new(no geocoding) satellite image, it makes GCP extraction more accurate and fast (Lee *et al.*, 1998). Finally, when GCP information is constructed as database in data archiving center (i.e., a lots of data), it presents convenient environment to users in reducing repetitive process. Figure 1 shows flowchart of automatic geometric correction method using GCP Chip.

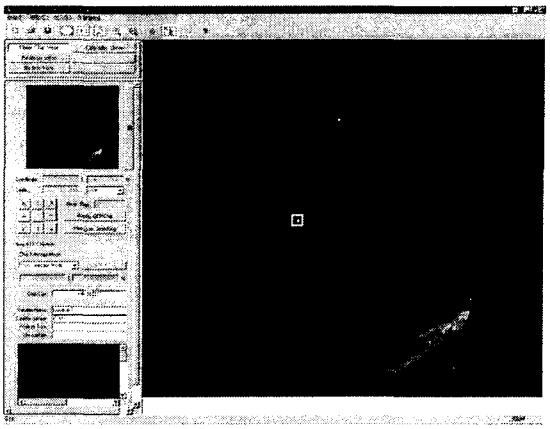


[Figure 1] flowchart of GCP chip method

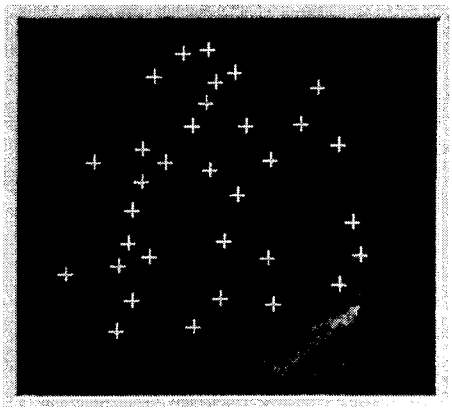
In the figure 1, GCP Chip is extracted from GPS surveying, digital map , topographic map and reference image and so forth. And generated GCP Chip is archived as database. As new image is correct geometrically, GCP Chip DB makes automatic correction through GCP Chip searching. Automatic geometric correction provides users to save time and work. GCP Chip method is not only convenient but also accurate process. The RMS error of accuracy is lower than one pixel in case of SPOT (Kim *et al.*, 2002).

3. Generation of GCP Chip

GCP DB is constructing using 1:25,000 topographic maps over the Korean peninsula in our projects. We think that GCP DB plays an important role in constructing GCP Chip DB which automatic geometric correction needs. When data archiving center presents GCP Chip DB through web-service in the future, people will have convenient operation environments in geometric correction. In this paper, we carried out experiments with Landsat-7 ETM+ panchromatic band image which is 15m spatial resolution. We aimed that GCP information is extracted and a GCP Chip is generated from reference images in this study. Figure 2 shows a main window of GCP Chip generation using a reference image. Small rectangular box in the main window image is GCP Chip area.



[Figure 2] Main window of GCP chip generation



[Figure 3] Position of GCP chip generation

The process of GCP chip generation can be divided into three methods. First, as user selects rectangular area using dragging a mouse from reference image, GCP Chip (centered on the GCP with its reference coordinates) is generated. Second, user selects GCP point from reference image and fills in width and height of chip. Finally, user can also generate a GCP Chip through filling out GCP coordinates and row/column of pixel manually. Third method will help to construct GCP Chip DB using GCP DB. According to each method, a

[Table 1] GCP DB field name and description

DB Field name	Description
ProductID	ID of Reference image to construct GCP Chip
SatName	Satellite Name of Reference image to construct GCP Chip
senName	Sensor Name of Reference image to construct GCP Chip
pathK	Path of Reference image to construct GCP
rowJ	Row of Reference image to construct GCP Chip
productCenterTime	Acquisition date of Reference image to construct GCP Chip
mapProjection	Map projection of Reference image to construct GCP Chip
datum	Datum of Reference image to construct GCP
earthEllipsoid	Earth ellipsoid of Reference image to construct GCP Chip
modeName	Band Name of Reference image to construct GCP Chip
pixelSpacing	Pixel spacing of Reference image to construct GCP Chip
lineSpacing	Line spacing of Reference image to construct GCP
chipID	Chip ID
chipDate	Generation date of GCP Chip
chipSizeX	Width of GCP Chip (pixel)
chipSizeY	Height of GCP Chip (pixel)
chipOffsetX	X offset in reference image (pixel)
chipOffsetY	Y offset in reference image (pixel)
chipCenterXPosition	X coordinates (Center point of GCP Chip)
chipCenterYPosition	Y coordinates (Center point of GCP Chip)
chipCenterZPosition	Z values (Center point of GCP Chip)
chipDescription	Additional description of GCP Chip

generated GCP Chip is stored with patch image and related information in database. Figure 3 shows distributed position of GCP Chip generation in Landsat-7 ETM+ panchromatic band. Table 1 shows GCP DB field name and description.

4. Conclusions and Discoussions

This study presents concept and generation of GCP Chip for automatic geometric correction. GCP Chip is small image patch which has a GCP in reference coordinate image. It makes geometric correction more easy and fast.

In the future, to match GCP Chip image and new image, we have to study on several algorithms, such as Normalized cross correlation (Rosenfeld *et al.*, 1982). And we keep up our study to meet with good results. We intend to compare automatic geometric correction and traditional geometric correction manually in processing time and accuracy.

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