

An Approach To Correct The Raw FCC Satellite Image

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ABSTRACT

Remotely sensed image raw-data gathered by a satellite or aircraft needs to be corrected. Even images of seemingly flat areas are distorted by both the curvature of the Earth and the sensor being used. Hence there is a need for geometrically correcting an image. For this work data from satellite image (IRS -P6) by LISS-III sensor of 22.5m resolution is used. This image corresponds to Ramtek region of Nagpur (Maharashtra state of India). This raw FCC image is preprocessed which includes importing, subsetting and Georeferencing

Key words: FCC, Geometric Corrections, Ground Control Points, Remote Sensing, Resampling, Subsetting.

I. INTRODUCTION

The raw data received from the satellite contains flaws [1], [2] and deficiencies which are given below:

1. Errors due to earth surface: While covering larger distance of earth's surface (swath width) causes error in pixel size. And this leads to distortion.
2. Uncertainty in shape or pattern: The shape of earth is uncertain as there are peaks and troughs on its surface.
3. Atmospheric condition: with different atmospheric condition due to clouds, shadows, water vapour the information in the image is lost.
4. They may also occur due to changes in platform attitude (roll, pitch and yaw), altitude, earth rotation, earth curvature, panoramic distortion and detector delay.

To overcome these flaws and deficiencies in order to get the originality of the data, it needs to undergo several steps of processing. This will vary from image to image depending on the initial condition of the image and the information of interest.

II. PRE-PROCESSING OF THE SATELLITE IMAGE

a) IMPORTING

Importing is the converting satellite data from one format to another format. In digital image processing technique the data is transferred from generic binary format to .img format. Digital data from the various satellite systems supplied to the user in the form of computer readable tapes or CD-ROM. Satellite data is in the raw form. The color is

due to combination of bands, they are (blue, green, red, near infra red, infra red). Due to band combination we cannot identify the contents in the image. To identify the image properly we convert the image in FCC.

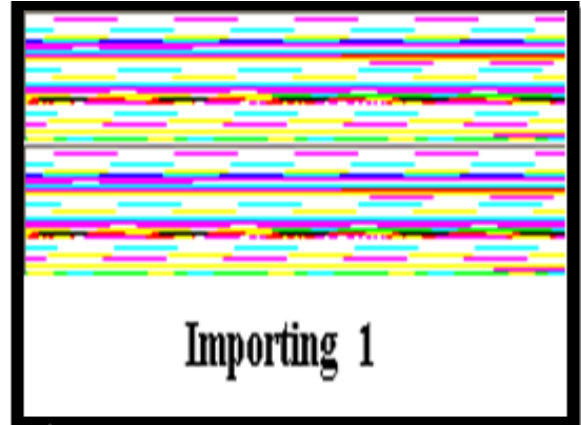


Fig. (1). Raw satellite data as on CD ROM



Fig. (2). Raw satellite data converted into FCC image

b) SUBSETTING

Subsetting refers to breaking out a portion of large image file into one or more smaller image files. Often image files contain areas much larger than a particular study area. In these cases, it is helpful to reduce the size of image file to include only area of interest (AOI). This not only eliminate the extraneous data in the file, but it speeds up processing due to smaller amount of data. This can be important when dealing with multiband data.

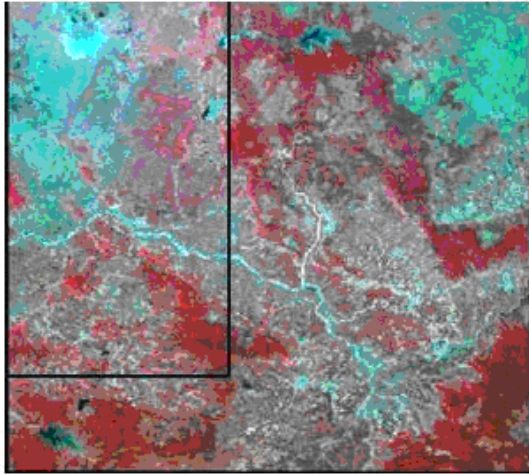


Fig. (3). Marked portion shows the area of interest of the Raw FCC.

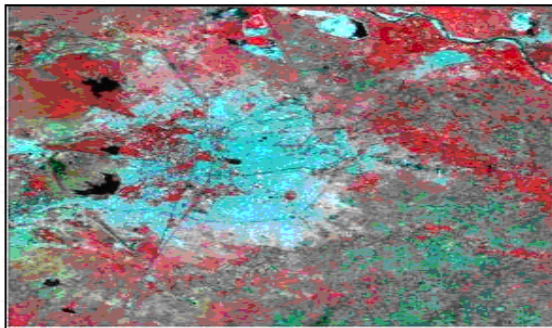


Fig. (4). Area of interest after subsetting

III.FALSE COLOUR COMPOSITE

One can understand the difference in brightness of water, soil and vegetation with the help of the Fig. (5). This shows three curves, each called a *spectrum*, for three different materials. In each spectrum, the percentage of light that is reflected is shown as a *function of wavelength*. It can be observed that vegetation is very bright, about 1.0 microns compared to soil. The relative contrast is reversed at wavelengths greater than 1.5 microns. Water, in comparison, is brightest at short.

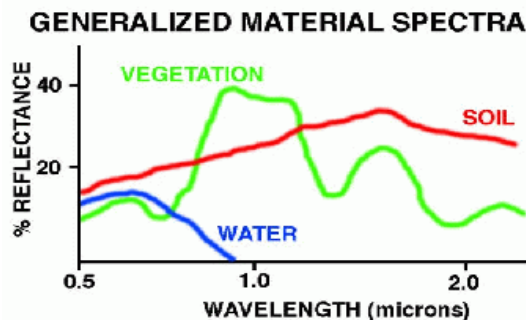


Fig. (5): Spectral signature

From Fig.(1), it is clear that different bands or wavelengths have a different contrast, based on this the computer can produce a colour image from a remote sensing data set as shown in the Fig.(6). For a true colour composite an image data used in red, green and blue spectral region must be assigned bits of red, green and blue in the image processor frame buffer memory. Standard false colour composite is displayed by placing the infrared, red, green in the red, green and blue frame in the buffer memory. In this healthy vegetation shows up in shades of red because vegetation absorbs most of green and red energy but reflects approximately half of incident Infrared energy.

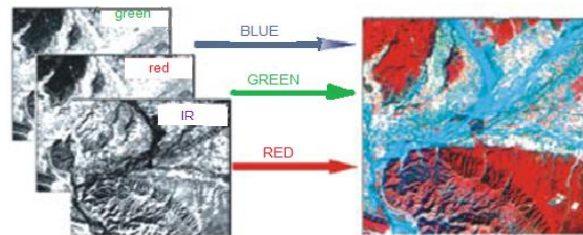


Fig. (6): Reflectance of various land covers

IV.IMAGE RECTIFICATION & RESTORATION

Geometric distortions manifest themselves as errors in the position of a pixel relative to other pixels in the scene and with respect to their absolute position within some defined map projection. If left uncorrected, these geometric distortions render any data extracted from the image useless. This is particularly so if the information is to be compared to other data sets, be it from another image or a GIS data set. Distortions occur for many reasons. For instance distortions occur due to changes in platform attitude (roll, pitch and yaw), altitude, earth rotation, earth curvature, panoramic distortion and detector delay. Most of these distortions can be modelled mathematically and are removed before you buy an image. Changes in attitude however can be difficult to account for mathematically and so a procedure called image rectification is performed. Satellite systems are however geometrically quite stable and geometric rectification is a simple procedure based on a mapping transformation relating real ground coordinates, say in easting and northing, to image line and pixel coordinates.

Rectification is a process of geometrically correcting [4],[6] an image so that it can be represented on a planar surface, conform to other images or conform to a map as shown in Fig. 7. That is, it is the process by which geometry of an image is made planimetric. It is necessary when accurate area, distance and direction measurements are required to be made from the imagery. It is achieved by transforming the data from

one grid system into another grid system using a geometric transformation.

Rectification is not necessary if there is no distortion in the image. For example, if an image file is produced by scanning or digitizing a paper map that is in the desired projection system, then that image is already planar and does not require rectification unless there is some skew or rotation of the image. Scanning and digitizing produce images that are planar, but do not contain any map coordinate information. These images need only to be geo-referenced, which is a much simpler process than rectification. In many cases, the image header can simply be updated with new map coordinate information. This involves redefining the map coordinate of the upper left corner of the image and the cell size (the area represented by each pixel).

Ground Control Points (GCP) [5] are the specific pixels in the input image for which the output map coordinates are known. By using more points than necessary to solve the transformation equations a least squares solution may be found that minimises the sum of the squares of the errors. Care should be exercised when selecting ground control points as their number, quality and distribution affect the result of the rectification.

Once the mapping transformation has been determined a procedure called resampling is employed. Resampling [5] matches the coordinates of image pixels to their real world coordinates and writes a new image on a pixel by pixel basis. Since the grid of pixels in the source image rarely matches the grid for the reference image, the pixels are resampled, so that new data file values for the output file can be calculated. In this work, the resampling technique used is Cubic convolution—uses the data file values of sixteen pixels in a 4 X 4 window to calculate an output value with a cubic function.

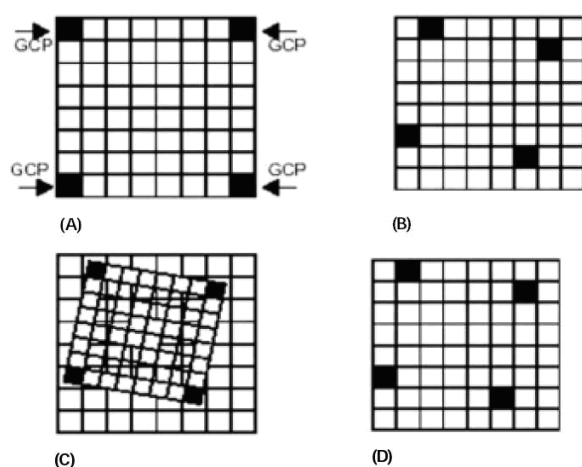


Fig.7. Image rectification (A & B) input and reference image with GCP locations, (C) using polynomial equations,

the grids are fitted together, (D) using resampling method the output grid pixel values are assigned.

Error obtained when the rectified FCC is swiped over the reference toposheet is shown in Fig. (8).

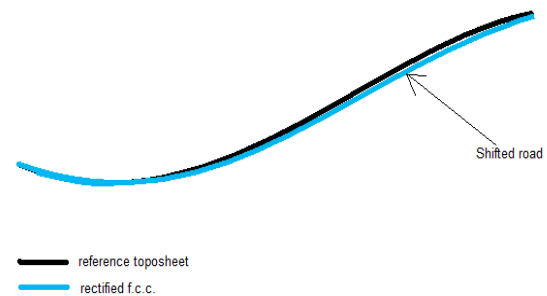


Fig. (8). Geometric errors

For removing the error, GCPs were increased and taken linearly along the road as shown in the Fig. (9).

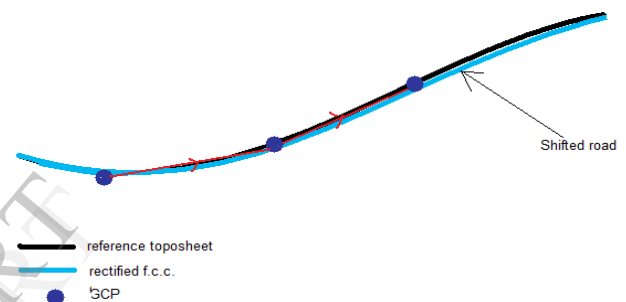


Fig. (10). Correcting the geometric errors

However the shift was still there, because of the linear stretch as shown in Fig. (10). so, for removing the error, some GCPs were taken around the road also which is shown in the Fig. (11).

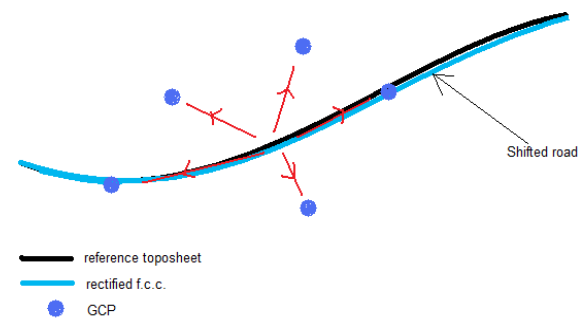


Fig. (11). Choosing the Ground Control Points

Hence, it can be observed that the roads overlap on uniform stretching. Thus the error is removed which is shown in the Fig. (8).

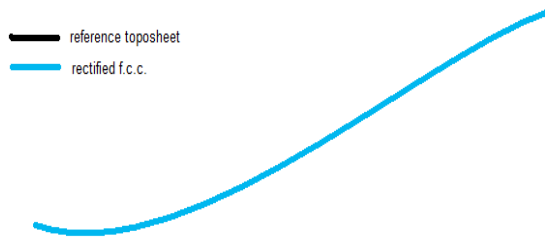


Fig. (12): After geometrically corrected

IV. CHOOSING OF THE GROUND CONTROL POINTS IN FCC

Proper care must be taken while selecting the ground control points on the FCC image in comparison to that of reference topo sheet in the process of georeferencing. Never consider water bodies as ground control points as they are sensitive to the weather conditions. Similarly anything sensitive to the weather conditions could become invalid for ground control point selection. Hence, the landmarks such as mountains, roads, railway tracks must be chosen as ground control points which results in a properly rectified image after resampling. After rectification and resampling, any position on the image would be in terms of latitude and longitude which confirms to the original map.

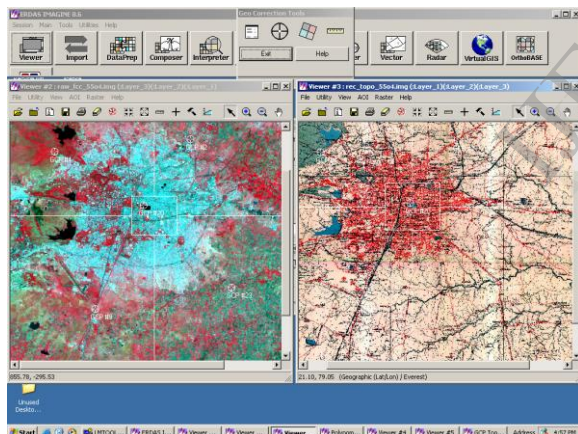


Fig. (13): Raw FCC image geo-referenced with reference topo sheet

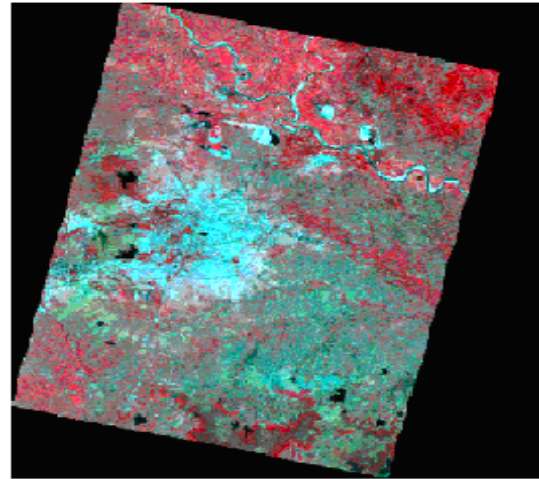


Fig. (14): Rectified FCC

VI. CONCLUSION

Selection of ground control points must be done judiciously failing which the resulting rectified FCC image would be distorted. Also, the number of ground control points and their distribution across the raw FCC affects the correctness of the rectified FCC. One must confirm the rectified FCC with the original map before the rectified image is being used for strategic applications.

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