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Improving the Spectral and Spatial Resolution of Satellite Image Using Geomatics Techniques

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Abstract. In this paper, space image of the Quick Bird satellite of a pixel size 0.6m*0.6m for the year 2007 were merge the layers through the layer stack process from seven layers to three layers and combined in color composites using ERDAS Imagine Ver. 9.2. Also monitoring ground control points with coordinates E, N, monitored by the Differential Ground Position System (DGPS) device and these points are processed through the OPUS site from the internet. The results of the tests show that the proposed strategy improves the contrast of the most essential difficulties in image processing and perform digital enhancement of the satellite image through a filter suitable to show the edges of the image appropriately, edge detect through the process principle components. This study presents a method for creating a high-resolution satellite image with corrected coordinates for the aim of creating a surveying map that includes all terrain elements and landmarks in the study area. The production of a geometric and spatial resolution image capable of producing a map of cities.

Keywords. LPS, ERDAS LPS, Remote Sensing, PCA.

INTRODUCTION

Image enhancement is the process of improving the quality of a digital image without knowing the source of retraction. When the source of retraction is known, the procedure is referred to as picture restoration [1]. Image enhancement techniques are being developed to make satellite images more informative and to aid in image interpretation [2,3]. The term enhancement refers to the alteration of a picture's appearance in order to make the information contained in that image more easily perceived visually in terms of a specific requirement [4,5].

Data from a range of sensing instruments, such as multispectral cameras, thermal scanners, infrared sensors, and side-looking airborne radar, is used for remote sensing. Instruments for remote sensing can provide both quantitative and qualitative data on objects [6].

Panchromatic imaging with high spatial (low spectral) resolution and multispectral imagery with lower spatial (but higher spectral) resolution are two forms of image data provided by satellites. Image fusion techniques can be used to combine the geometric detail of a high-resolution Pan image with the color information of low-resolution MS images to produce a high-resolution MS image as an alternative approach [7]. The temporal and spatial resolutions are very important factors to consider. Since the mapping of damages is required as soon as possible after an event, it is important to access data acquired with a high frequency, so the chance to have a clear sky day during an image acquisition after the event should be maximized: a daily product maximizes the probability to get a good image while a weekly product could create significant delays. Frequently, catastrophic natural events, such as storms, happen in seasons characterized by high precipitation and thus cloudy sky is a major constraint. On the other side, remote sensing images obtained in a period soon after the event could not be the best due to high levels of humidity, woody materials on the ground, debris, and the possible presence of snow[12] The identification of wind throws using remote sensing data is not a new topic and in the literature many studies using different methods and different

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platforms can be found. Different temporal approaches are adopted: there are studies based on single time data (one image before and one after the event[14] and others using multi temporal data (several images around the event[13].

Remotely sensed imagery can be used in a number of applications like feature extraction. Feature extraction is of essential importance for an accurate classification of remote sensing images [8]. To incorporate remote sensing data, several more spatial variables are required. The Geographic Information System (GIS) technology is used to integrate spatial data and analyze it together [9,10].

MATERIALS AND METHODS

Data and Software Used

Upload the satellite image from Landsat satellite digital data was processed using ERDAS IMAGINE digital processing processes will be divided into types Which include the spectral and radiometric optimization and correction geometry engineering patch truncation, and spectral enhancement then merge the layers through the layer stack process from seven layers to three layers and combined in color composites using ERDAS Imagine Ver. 9.2.

Using the following data:

- The Quick Bird satellite was spotted with spatial accuracy (0.6m * 0.6m) in 2007 for spectral bands (1-3). Projection: UTM, Spheroid: WGS84
- The Landsat satellite image acquired for spectral bands (1-7) of a pixel size (10 m *10m)(multispectral image 2017) Projection: UTM, Spheroid: WGS84
- Nine ground control points with coordinates E, N, monitored by DGPS and processed through OPUS web site. Table (1) which were used for the geometric correction of satellite image as showed in Figure (1).
- ERDAS LPS Imagine Ver. 9.2.

TABLE 1. Measured GCPs of the control points in the reference coordinates

Point	Easting (m)	Northing (m)
1	441444.085	3603135.091
2	445336.949	3603184.120
3	445268.309	3600389.495
4	441198.942	3600222.798
5	442787.466	3602566.361
6	444493.658	3602497.721
7	444964.332	3601389.676
8	440943.994	3600909.197
9	443424.837	3601517.150

FIGURE 1. Geometric correction of the satellite image using points GCP through ERDAS LPS Imagine.

Methodology

Image fusion is a valuable technique for many remote sensing and Geographic Information System (GIS) applications that demand high spatial and spectral resolution. Contrast is one of the most essential quality characteristics in satellite photos. In order to achieve accurate results in the applied studies of digital processing, depends mainly on the stages of this treatment and sequencing, as each stage of its application to the digital image will affect the digital optical properties, which in turn will control the value of measurements derived from them.

This research involves data acquisition and data preprocessing. Where preprocessing involves radiometric and geometric corrections. The layer stack and principle components processes were used to assemble high resolution images from panchromatic and multispectral experimental data to recreate the city of Hilla and surrounding area, Geographical location 100 km south of city of Baghdad city between, (440246.095 E, 3599988.308 N), to (445919.806 E, 3603738.728 N) by unit meter. Through the study outlined in the accompanying diagram, the image of the studied region and its statistical qualities may be seen in Figure (2) and Table (2), respectively. This methodology can be achieved according to schematic diagram as follow in Figure (3). Which relied on a set of stages of configuration, optimization and geographical orientation, as well as standardization of the discriminatory accuracy of the data used, in order to process the quality of the data where the accuracy of visual discrimination. The results differ from the discriminating accuracy of the aerial image.

a b

FIGURE 2. Original Image of study area with: (a) Quick bird image (0.6m*0.6m) consist of seven bands (panchromatic). (b) Landsat image (10m*10m) consist of three bands (multispectral).

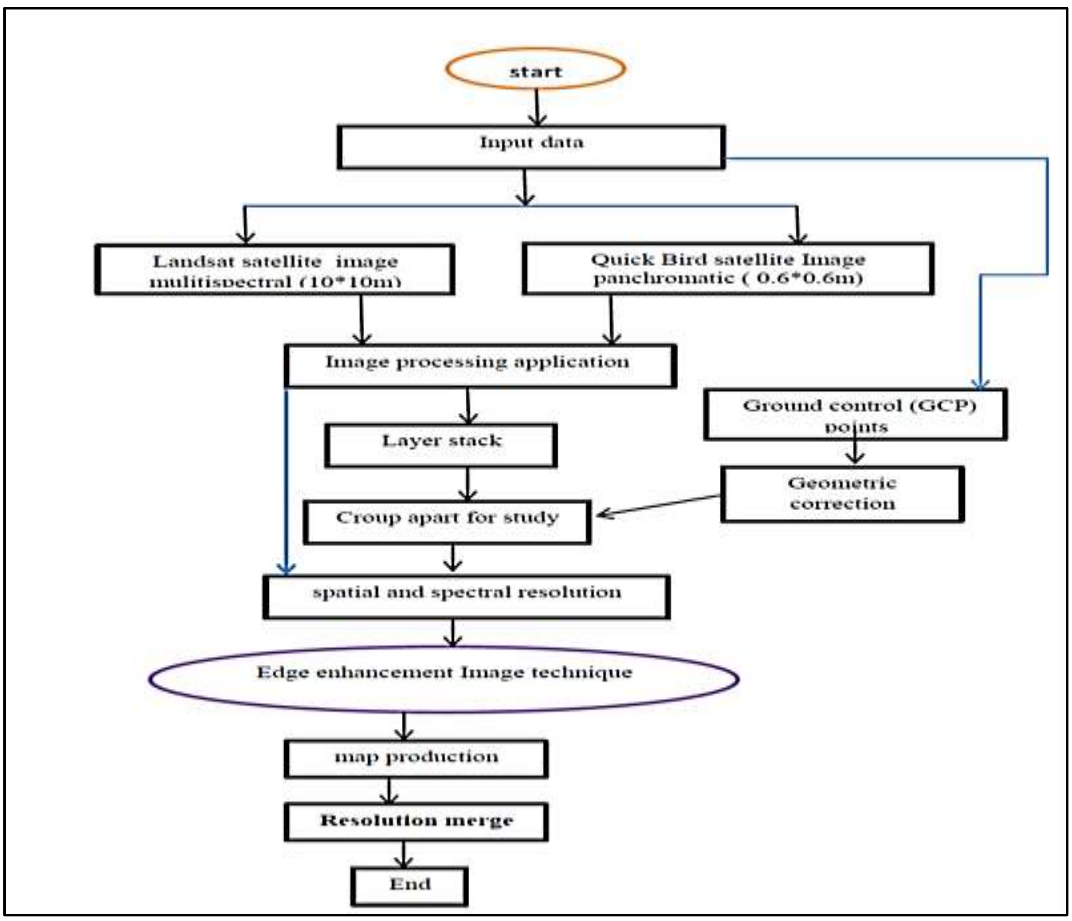


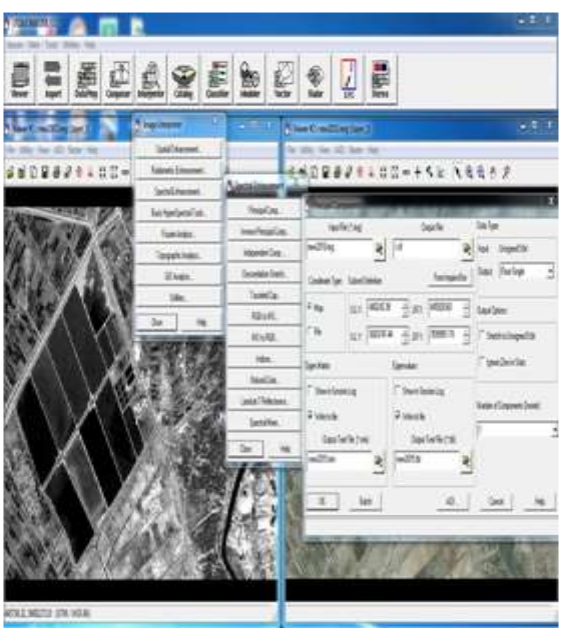
FIGURE 3. Schematic diagram of the methodology

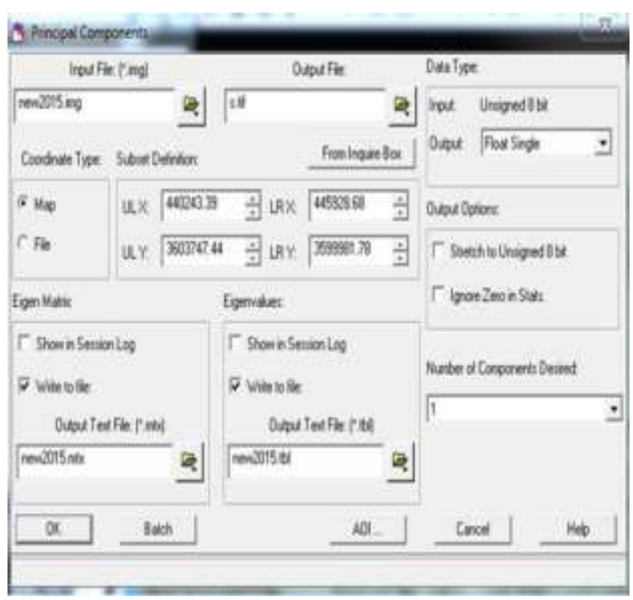
TABLE 2. Statistic properties of the original images.

Image	Bands	Min (G. S)	Max (G.S)	Mean (G.S)	Median (G.S)	Mode (G.S)	Std. Dev (G.S)	Pixel Size X (m)	Pixel Size Y (m)
Landsat image	1	1	254	112.227	85	46	60.408	1	1
	2	1	254	99.342	80	42	55.564	1	1
	3	1	254	78.569	79	37	52.096	1	1
	4	1	254	76.493	77	35	50.992	1	1
	5	1	254	72.302	76	33	47.135	1	1
	6	1	254	71.999	73	29	45.430	1	1
	7	1	254	67.821	69	28	41.492	1	1
Quick Bird image	1	1	249	81.319	78	2	54.586	0.6	0.6
	2	1	249	72.241	62	2	48.976	0.6	0.6
	3	1	249	61.236	51	2	49.268	0.6	0.6

Principal Component Analysis (PCA)

PCA is a linear collection of original variables that is designed to transform them into new, uncorrelated variables (axes). The new axes run parallel to the maximum, variance directions. PCA encourages an objective approach to finding these types of indices so that the data's variability can be accounted for as quickly as feasible [11]. Principal components depend upon the scales used to measure the variables. PCA is often allows redundant data to be compacted into fewer bands, that is, the dimensionality used in change of the data is reduced. ERDAS IMAGING Ver. 9.2 was used to find the principal components analysis that combines all image bands. The result revealed that the best PCA was between band as shown in Figure (4).





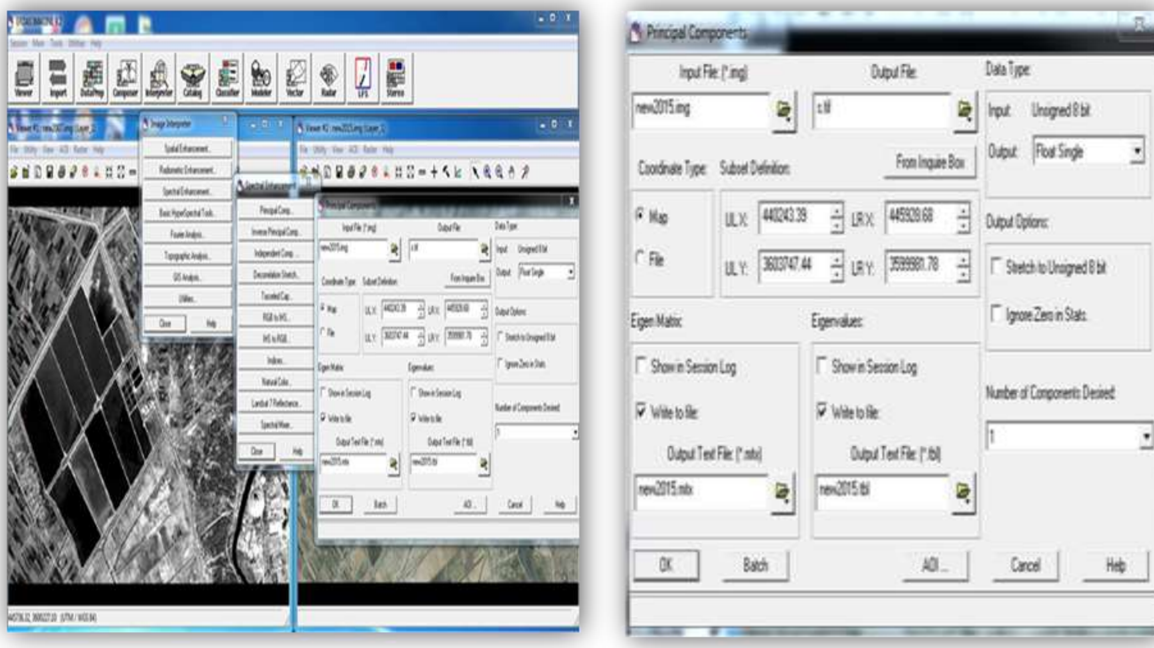


FIGURE 4. (a),(b) (c) and (d) Combines all image bands using Principal, Components Analysis (PCA) process.

RESULTS AND DISCUSSION

We analyzed a Landsat image and make spatial optimization of the space image by depending on panchromatic Quick Bird image to reduce the pixel size of the new color image through the resolution merge process shown in Figure (5), It provided elements to the satellite image that were clearer and more accurate than the original image. The spectrum enhancement composites presented in Figure (6) produced the best results. Using the resolution merge and PCA procedure, create a geometrical multispectral image with high spatial and spectral resolution capable of constructing a city map to determine which methods of digital image processing produce the best results for recognizing and delimiting different characteristics. As a result It was produced of satellite image of (1m * 1m) which inform us and produce the maps which to accurately for producing cadastral map that demonstrate all topography and urban planning Patched coordinates with high accuracy. This study presents a method for creating a high-resolution satellite image with corrected coordinates for the aim of creating a surveying map that includes all terrain elements and landmarks in the study area. With the least amount of effort and the least amount of money, based on the principle of remote sensing and satellite photos. final result of satellite image shown in Table (3) and Figure (7) respectively.

TABLE 3. displays the image's final statistical attributes

Image	Min (G.S)	Max (G.S)	Mean (G.S)	Median (G.S)	Mode (G.S)	Std. Dev (G.S)	Pixel Size X (m)	Pixel Size Y (m)
Image1	1	254	112.227	85	46	60.408	10	10
Image2	0	251	110.121	90.5	37	72.934	0.6	0.6
Result	1	249	81.319	78	2	54.586	1	1

FIGURE 5. Resolution merge process for spatial analysis using ERDAS IMAGING Ver. 9.2.

FIGURE 6. Spectral enhancement composites using ERDAS IMAGING Ver. 9.2.

FIGURE 7. Final result of satellite image with spatial resolution of) 1m*1m.(

CONCLUSION

1. Comparison between the original images and the modified image in terms of spatial accuracy of the pixel size in terms of geometrical coordinates of the image after correction showing all the symptoms are clear and precise.
2. Uses PCA and resolution merge approaches to produce great outcomes in statistical evaluations for color preservation with a spatial resolution of) 1m1*m(which adopted accurately to draw and urban planning Furthermore, we also showed the suitability of PCA for detecting wind throws independently of the multispectral images and the weather conditions. The data considered are characterized by very different resolutions (spectral, spatial, and temporal) but the results obtained in both scenarios are very similar..
3. This study demonstrates the importance of consistent evaluation methodologies and the need for a combined strategy for a quantitative assessment of spatial improvement and spectral preservation.

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