Palestine Polytechnic University
Hebron – Palestine

Change Detection for Monitoring Urban Development

Project Team

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In according with the recommendation of the project supervisors and the acceptance of all examining committee members, this project has been submitted to the department of Civil and Architectural Engineering in the College of Engineering and Technology in partial fulfillment of the requirements of the department for the degree of Bachelor of Engineering .

Project Supervisor Signature. Signature of Head of Department.

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25/06/2012

May - 2012

Abstract

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Project Supervisor

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The project is using the aerial photographs in monitoring urban development in Hebron city using change detection. And its help to establish a system with a high transparency in the control so that everyone is equal in front of the law

The project will develop modern methods within government institutions and the Ministry of Local Government to monitor violations in a year or less period of time in order to improve the quality of the buildings and roads monitoring in addition to other things such as monitoring of vegetation.

ملخص المشروع

استخدام الصور الجوية في مراقبة التطور العمراني

فريق المشروع

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إشراف

م.مصعب شاهين

المشروع عبارة عن استخدام الصور الجوية في رصد التغير العمراني ومراقبة المخالفات في مدينة الخليل باستخدام طريقة الكشف عن التغييرات ، لمساعدة المؤسسات الحكومية مثل البلديات والوزارات على إنشاء نظام ذو شفافية عالية في مراقبة الأبنية وكشف المخالفات التي تحدث خلال فترة زمنية معينة بحيث يكون الجميع متساوون أمام القانون. بالاضافة الى مراقبة التطور الذي يحدث في المدينة مثل الطرق .

وطريقة كشف التغيرات المستخدمة في المشروع تعتبر وسيلة فعالة وحديثة لكشف ادق واصغر التفاصيل والتغيرات التي تحدث خلال فترة زمنية محددة بتواريخ الصور الجوية .

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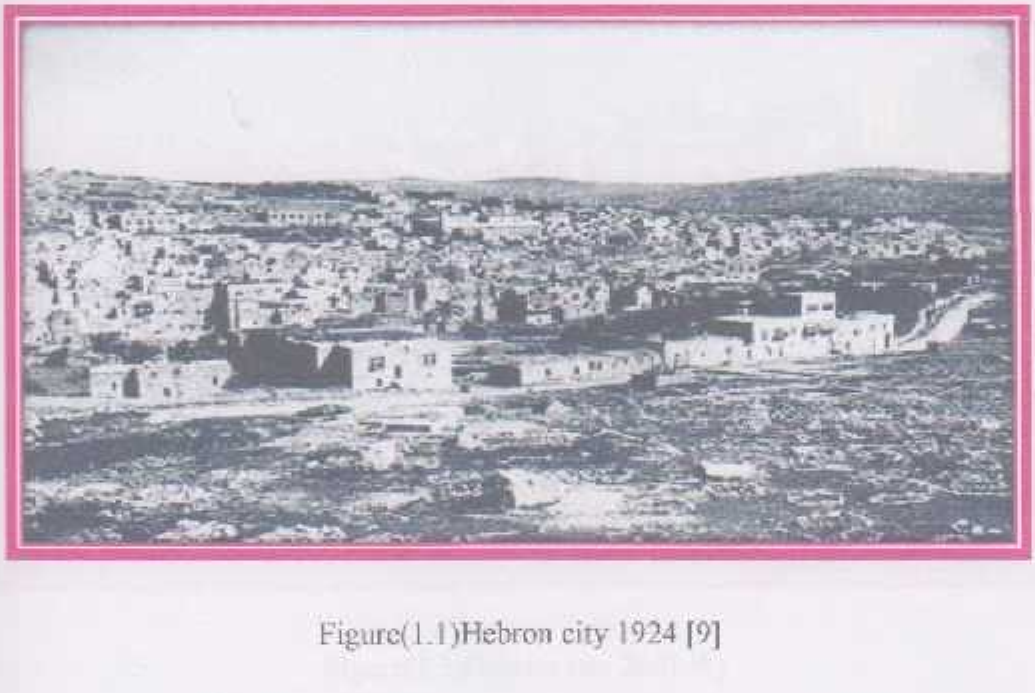
INTRODUCTION

1-1 Introduction

1-1-1 A Historical Overview Of Hebron City

Al-Khalil in Arabic is the heart of a wide hilly region. Some of its neighborhoods reach the altitude of 1000 meters above sea level. The Old City, also called Qasba in Arabic, and the Ibrahim Mosque/Cave of Machpela are situated on the northern flank of a valley at an altitude of approximately 860m. This relatively high altitude grants the city cool weather during summer time and abundant rainfalls in winter. Agricultural areas surround the city. Farmers in Hebron region usually cultivate fruits such as grapes and plums. In addition to agriculture, local economy relies on handicraft, small- and medium-scale industry and construction. Surrounded by towns as Halhul, Yatta, Dura, Al-Daheriya, each counting more than 20,000 inhabitants, Hebron is one of the most important market place in Palestinian Territories



Figure(1.1)Hebron city 1924 [9]

Figure(1.2)Hebron city 1979 [9]

Figure(1.3)Hebron city 2001 [9]

Figure(1.4) Hebron city 2010 [9]

1-1-2 Population Of Hebron City

Since the beginning of the twentieth century, the city has expanded dramatically, mostly along the roads leading to Jerusalem and Beersheba. In 1997, Hebron counted 120,000 inhabitants. This makes it the second most populated West Bank city after Jerusalem. The municipality borders delimit a territory of approximately 17 km^2.

Apart from Jewish settlers and Israeli troops, the population of the city is mostly Muslim. For centuries, however, an important Jewish community was part of Hebron society. This peaceful coexistence ended brutally with the 1929 riots, during which some 60 Hebronite Jews were killed. Subsequently, the British mandatory authorities transferred the Jewish population from the city.

Hebron has the reputation of being a conservative and traditional city. the city enjoys a rich community life, with a number of popular institutions, such as women and youth groups, and art centers. Hebron also has its own university, founded in 1973, and Palestine polytechnic university .

Table (1-1) Hebron population for several years [15]

Year	Total population	Notes
1922	16,577	British Mandate Census
1931	17,532	Source: British Mandate Census
1944	24,550	Estimate
1967	38,309	Census
1997	119,093	Census 1997
2007	163,146	Census 2007

1-1-3 Administration

The 1993 Oslo Accords declared the final status of the West Bank to be subject to a forthcoming settlement between Israel and the Palestinian leadership. Following these interim accords, Israel withdrew its military rule from some parts of the West Bank, which was divided into three administrative divisions of Oslo Accord :

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Table(1-2)Administrative divisions of WB

Area	Control	Administration	% of WB land	% of WB Palestinians
A	Palestinian	Palestinian	17%	55%
B	Israeli	Palestinian	24%	41%
C	Israeli	Israeli	59%	4%

Figure(1.1) Closed and restricted areas for Palestinians. [9]

Figure (1-2)Administrative divisions of WB [9]

1-1-4 Hebron Municipality

Hebron Municipality is the largest institution in the city of Hebron in terms of operational labor force, number of services offered, and projects carried out. Thus the municipality is the backbone of development in the city and the engine that keeps it going.

The municipality dedicates all its time to its affairs and has the support and unmatched cooperation of civilians, especially now that Khaled Osaily has become mayor. Osaily and his colleagues, members of the municipal council, the institutions in the city of Hebron, and the various municipalities of the Hebron District are constantly seeking to upgrade public services and respond to the needs of citizens.

The Hebron Municipality was impacted by the current volatile political circumstances. Despite difficulties, it managed to survive and raise the standard of services. Consequently, the city has recently evinced signs of rapid development in public services and infrastructure. There are approximately 1,200 employees who currently work for the municipality.

The municipality offers a variety of services, the most important of which are electricity, water, roads, sanitation, the environment, and construction. In addition, the municipality provides services to the industrial and agricultural sectors, as well as cultural and sports services to all sectors of society.

Hebron Municipality is proud of its achievements and is looking forward to continued progress. It remains a major catalyst in making the city of Hebron a developed and thriving city.

1-2 Importance And Goals Of The Project

1. Using the aerial photographs in monitoring urban development in the city of Hebron via the using change detection.
2. develop modern methods within government institutions and the Ministry of Local Government to monitor violations in a year or less period of time in order to improve the quality of the buildings and roads monitoring in addition to other things such as monitoring of vegetation.
3. help to establish a system with a high transparency in the control so that everyone is equal in front of the law

1-3 Project Phases

Phase I: DATA COLLECTION

1. collected aerial photo for Hebron city from Hebron municipality for some years as 1998 , 2004 , 2006 and 2009. And in the next semester we will try to collect more photos for different years.

2. Study information of the building and authorized system which Hebron municipality uses , and how they deal with unauthorized building.

3.Estimate Hebron population for different years by taking it from Hebron municipality.

Phase II: STUDY ALL IMAGES AND DETERMINE THE DIFFICULTIES

We studied the photos and determined the problems, after that we put the mechanism that will be used for process.

- Pixel size.
- Projection system.
- Brightness.
- Coverage area.
- Image clipping .

Phase III: IMAGE PROCESSING

IMAGE PROCESSING :The comparison of two or more geographically identical but temporally separate images to identify variation in surface cover components. And its contain:

1) Image clipping.

2) Histogram matching.

3) Change detection.

Phase IV: MAP GENERATION AND COMPARISON WITH HEBRON DATA

This phase includes produce maps for authorized building in Hebron and compare it with Hebron municipality data .

1-4 Difficulties

1) Determine coverage area in each image

2) Collection images for different period

3) Understanding of authorizing process in Hebron municipality

4) Understanding of Mathematical models behind each process such as Image histogram and change detection

5) Determine the regions of authorized and non-authorized building, roads etc...

6) Difficulties in digitizing .

7) Clearness in image and needing different enhancement .

1-5 The Software Used In This Project

1. ERDAS program.

2. ARC GIS 10 program.

3. AUTOCAD program.

4. PHOTOSHOP program .

1-6 Time Table Of The Introduction Of The Project

Activity	No. of weeks	2	4	6	8	10	12	14	16	18	20	22	24	26	28
Choosing project name	2														
Data collection	4														
Study image	2														
Image analysis	6														
Image enhancement	8														
Digitizing	10														
Mapping	2														
Results	2														
Preparation of the first report	2														
Preparation of the final report	2														

Table(1-3)Time table for the introduction project

MATHEMATICAL MODEL

2-1 Introduction

2-1-1 Image

In general terms, an image is a digital picture or representation of an object. Remotely Sensed image data are digital representations of the Earth. Image data are stored in Data files, also called image files, on magnetic tapes, computer disks, or other media. The data consist only of numbers. These representations form images when they are displayed on a screen or are output to hardcopy. Each number in an image file is a data file value. Data file values are sometimes referred to as pixels. The term pixel is abbreviated from picture element. A pixel is the smallest part of a picture (the area being scanned) with a single value. The data file value is the measured brightness value of the pixel at a specific wavelength.

2-1-2 Image Type

There different type of images:

1) Binary image : It's an image take only two values either 1 or 0 .
2) Gray scale image : Grayscale contain only brightness information each pixel value in a grayscale image, corresponds to amount or quantity of light
3) Color image : A color image has 3 values (red, green, and Blue)
4) Multi-spectral .

2-1-3 Bands

Image data may include several bands of information. Each band is a set of data file values for a specific portion of the electromagnetic spectrum of reflected light or emitted heat (red, green, blue, near-infrared, infrared, thermal, etc.) or some other user-defined information created by combining or enhancing the original bands, or creating new bands from other sources.

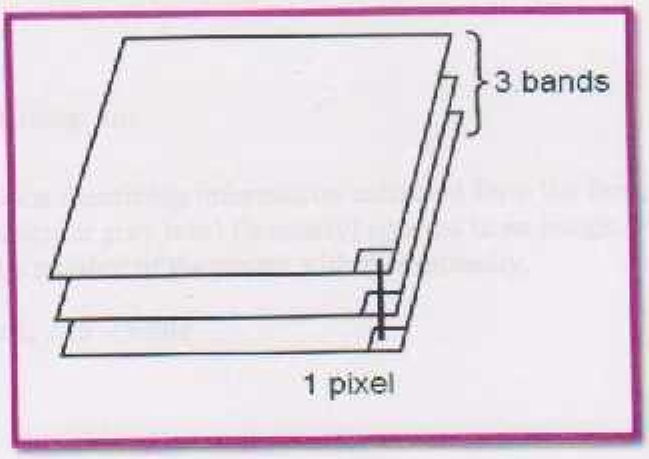


Figure (2.1) Bands

2-1-4 Coordinate System

The location of a pixel in a file or on a displayed or printed image is expressed using a coordinate system. In two-dimensional coordinate systems, locations are organized in a grid of columns and rows. Each location on the grid is expressed as a pair of coordinates known as X and Y. The X coordinate specifies the column of the grid, and the Y coordinate specifies the row. Image data organized into such a grid are known as raster data.

There are two basic coordinate systems used in ERDAS IMAGINE:

- file coordinates—indicate the location of a pixel within the image (data file)
- map coordinates—indicate the location of a pixel in a map

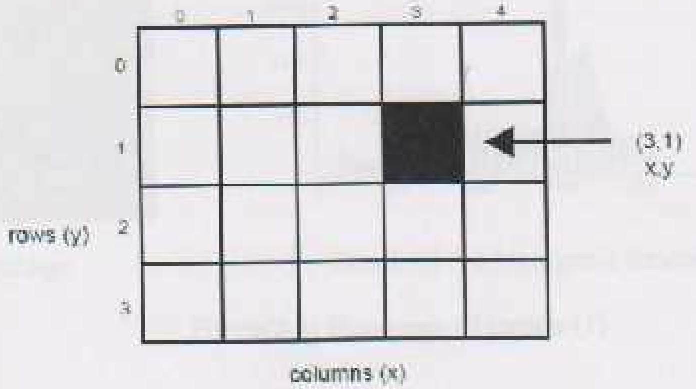


Figure (2.2) File coordinate

2-2 Histogram

2-2-1 Definition Of Histogram

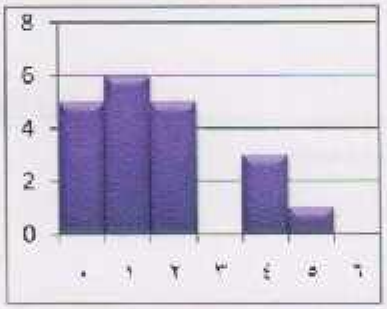
Histograms are functions describing information extracted form the image. The histogram shows how many times a particular grey level (intensity) appears in an image. For each intensity level, its value is equal to the number of the pixels with that intensity.

For example: 0 - black, 255 – white

Examples:

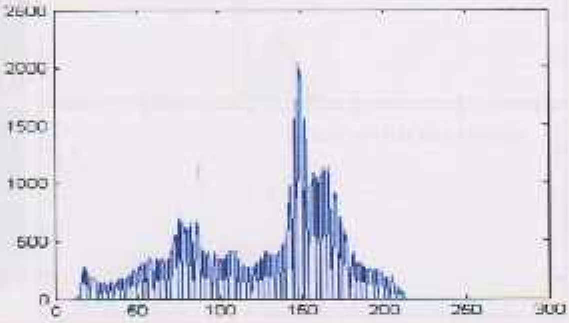
0	1	1	2	4
2	1	0	0	2
5	2	0	0	4
1	1	2	4	1

Image



histogram

Original image



Graph of the histogram function

Figure(2.3) Histogram of images (1)

2-2-2 Histogram Cases :

1. Histogram of dark image : this histogram will be clustred towards the lower gray level.
2. Histogram of bright image : this histogram will be clustred twwards the higher gray level.
3. Histogram for low contrast : this histogram will not be sepread eqally and will be very narrow.
4. Histogram for high contrast .

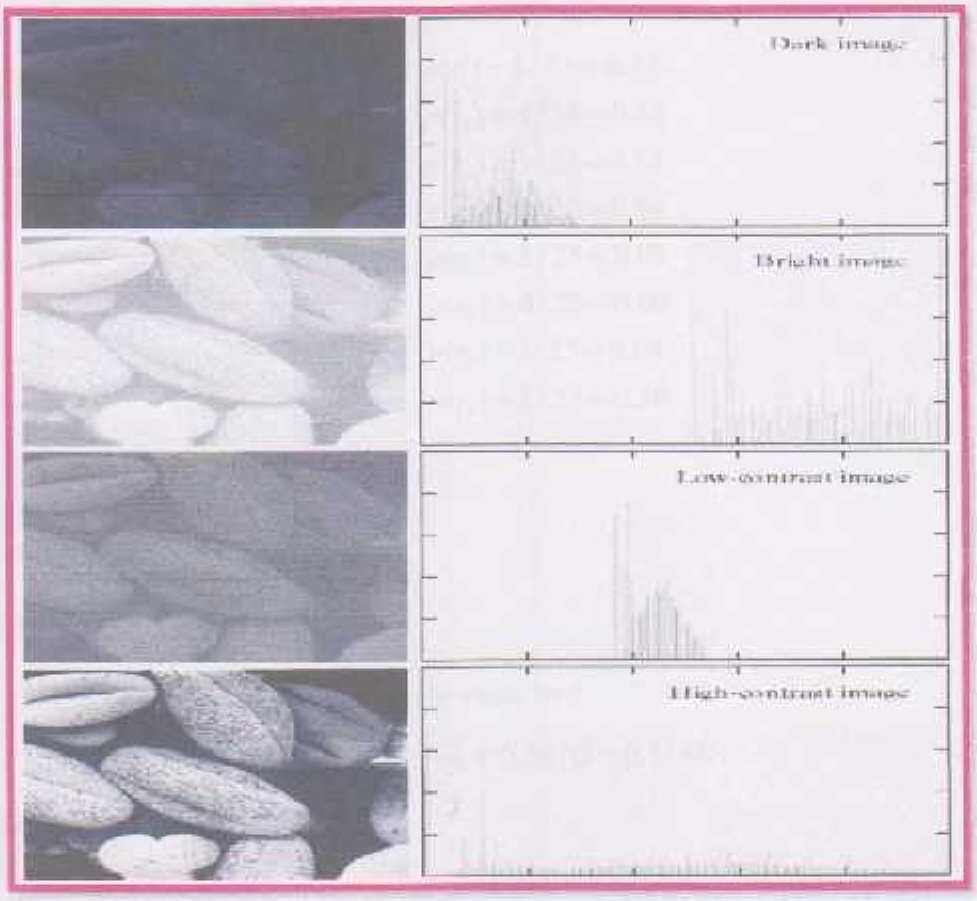


Figure (2.4) Histogram cases [6]

2-2-3 Normalized Histogram Function

The normalised histogram function is the histogram function divided by the total number of the pixels of the image:

$$p(r_k) = \frac{h(r_k)}{n} = \frac{n_k}{n}$$

It gives a measure of how likely is for a pixel to have a certain intensity. That is, it gives the probability of occurrence the intensity.

The sum of the normalised histogram function over the range of all intensities is 1.

Example:

$h(r_1)=8$		$p(r_1)=8/25=0.32$
$h(r_2)=4$		$p(r_2)=4/25=0.16$
$h(r_3)=3$		$p(r_3)=3/25=0.12$
$h(r_4)=2$	→	$p(r_4)=3/25=0.08$
$h(r_5)=2$		$p(r_5)=2/25=0.08$
$h(r_6)=0$		$p(r_6)=0/25=0.00$
$h(r_7)=1$		$p(r_7)=1/25=0.04$
$h(r_8)=5$		$p(r_8)=5/25=0.20$

2-2-4 Histogram Of Color Image

RGB color can be converted to a gray scale value by :

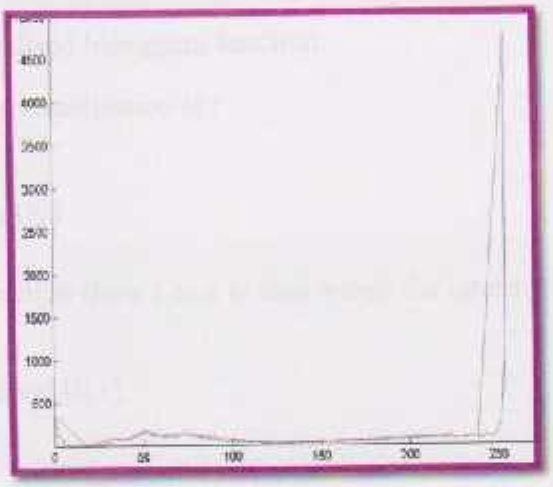
$$Y = 0.299R + 0.587G + 0.114B$$

RGB: colour model (Red, Green, Blue).

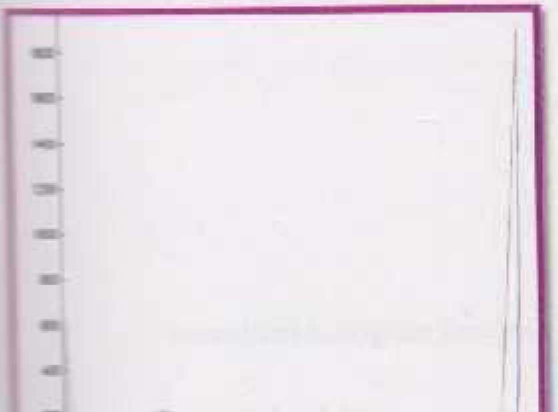
Y: the grayscale component in the YIQ color space used in NTSC television. The weights reflect the eye's brightness sensitivity to the color primaries.

Examples

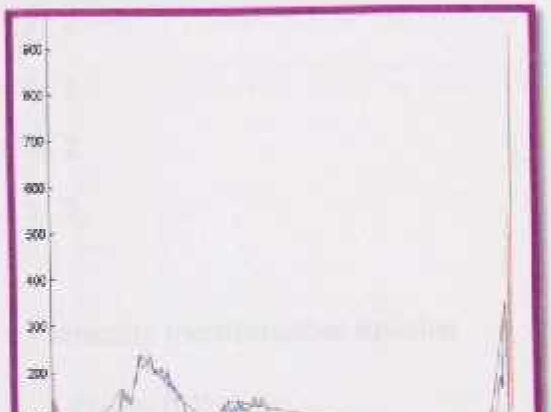
(individual histograms of red, green and blue):



Red



Green



Blue

Figure (2.5) Individual histograms of red, green and blue .

2-2-5 Histogram Equalization (HE)

Transforms the intensity values so that the histogram of the output image approximately matches the flat (uniform) histogram .

Histogram equalisation algorithm: Let r_k, $k = 1,2,...,m$ be the intensities of the image, and let $p(r_k)$ be its normalised histogram function.

The intensity transformation function for histogram equalisation is :

$$T(r_k) = \sum_{j=1}^{k} p(r_k)$$

Adding the values of the normalised histogram function from 1 to k to find where the intensity r_k will be mapped.

Note : The range of the equalised image is the interval [0,1].

Examples

1) 5x5 image with integer intensities in the range between one and eight (3 bits):

1	8	4	3	4
1	1	1	7	8
8	8	3	3	1
2	2	1	5	2
1	1	8	5	2

Normalised histogram function

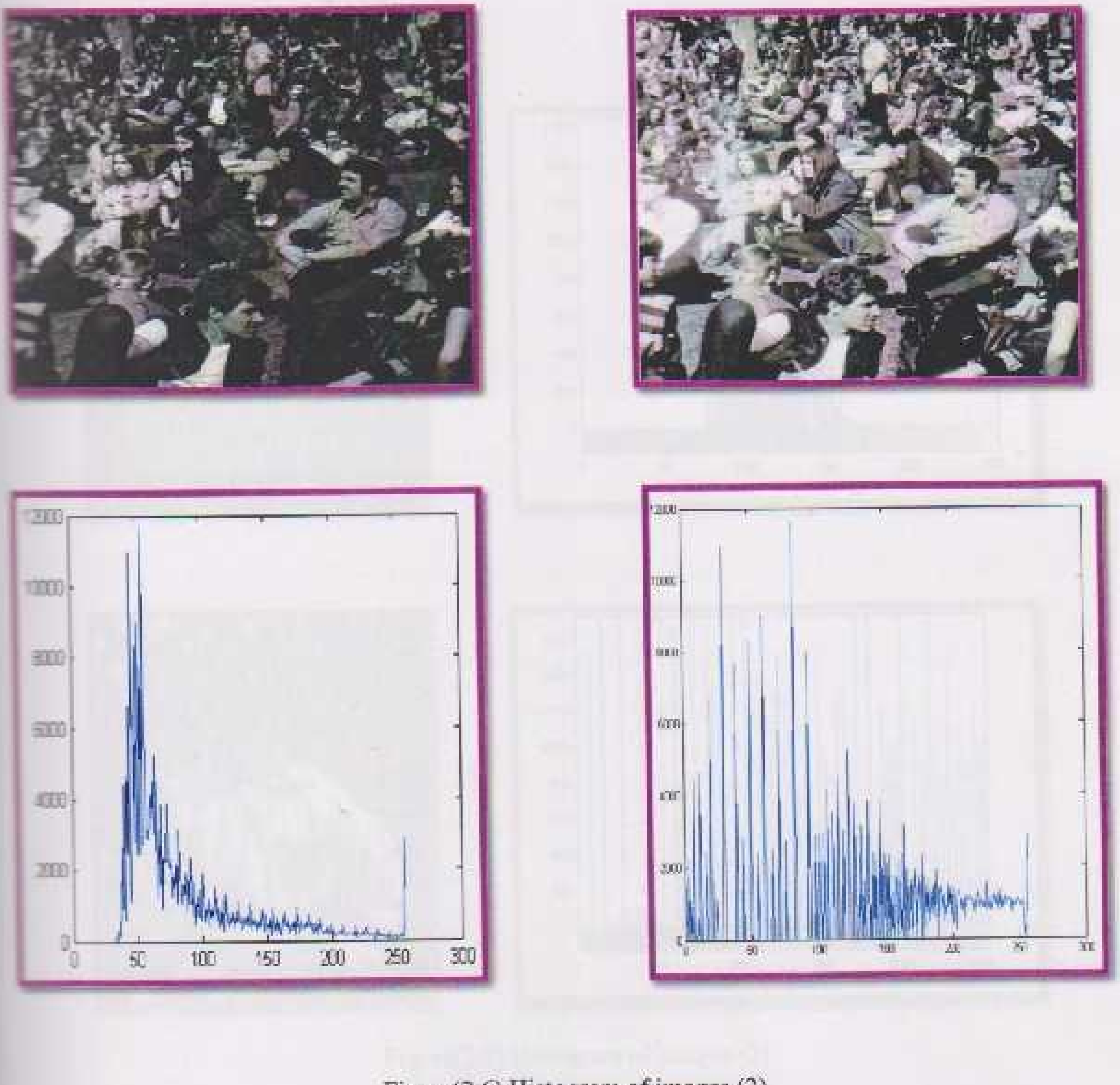
$p(r_1) = 0.32$
$p(r_2) = 0.16$
$p(r_3) = 0.12$
$p(r_4) = 0.08$
$p(r_5) = 0.08$
$p(r_6) = 0.00$
$p(r_7) = 0.04$
$p(r_8) = 0.20$

Intensity transformation function

$T(r_1) = 0.32$
$T(r_2) = 0.32 + 0.16 = 0.48$
$T(r_3) = 0.32 + 0.16 + 0.12 = 0.60$
$T(r_4) = 0.32 + 0.16 + 0.12 + 0.08 = 0.68$
$T(r_5) = 0.76$
$T(r_6) = 0.76$
$T(r_7) = 0.80$
$T(r_8) = 1.00$

- The 32% of the pixels have intensity r_1. We expect them to cover 32% of the possible intensities.
- The 48% of the pixels have intensity r2 or less. We expect them to cover 48% of the possible intensities.
- The 60% of the pixels have intensity r_3 or less. We expect them to cover 60% of the possible intensities.

2)



Figure(2.6) Histogram of images (2)

As for the discrete case the following formula applies:

$$s_k = T(r_k) = \sum_{j=0}^{k} \frac{n_j}{n} \cdot (L-1)$$

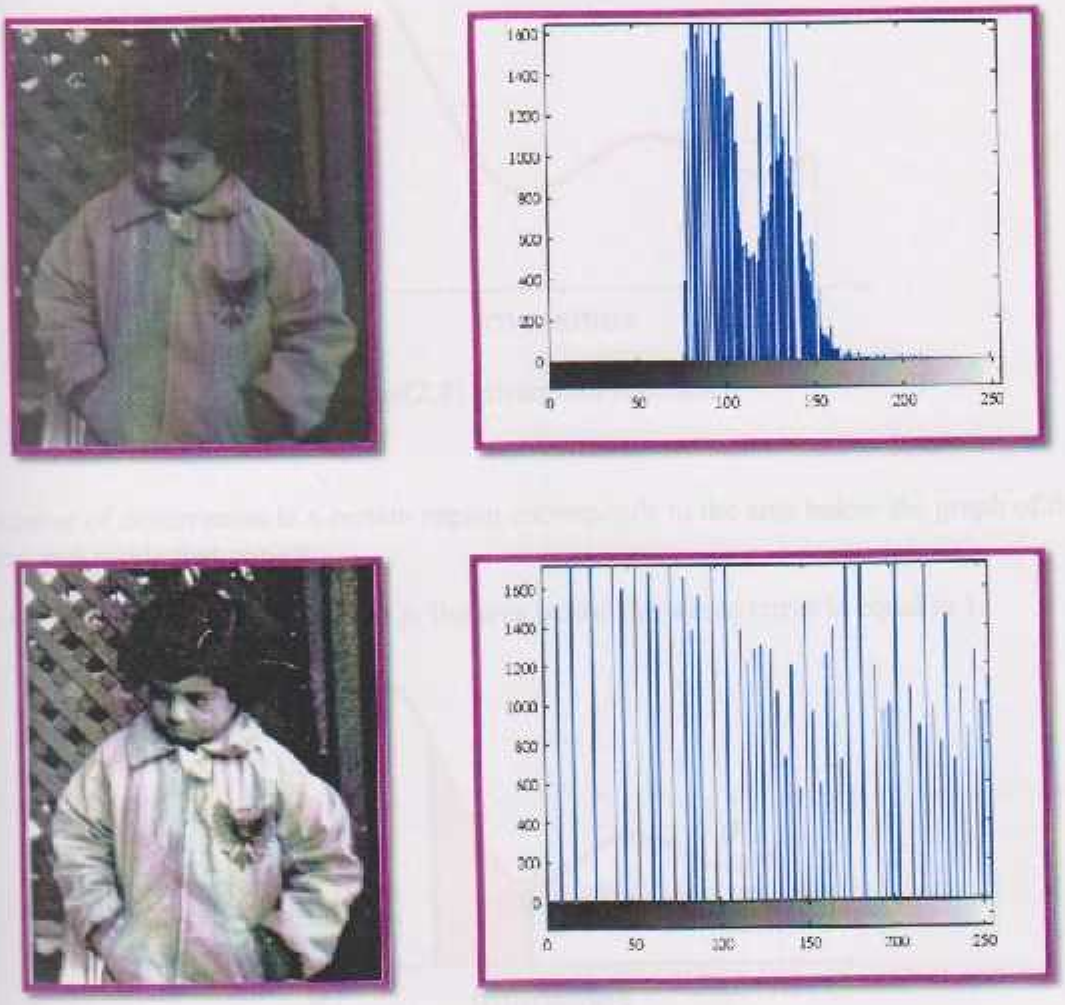
$k = 0,1,2,\ldots,L-1$

L: number of grey levels in image (e.g., 255)

n_j: number of times j-th grey level appears in image

n: total number of pixels in the image

Example:



Figure(2.7) Histogram of images (3)

2-2-6 Histogram Specification (HS)

Is a technique that transforms histogram of one image into the histogram of another image. This transformation can be easily accomplished by recognizing that if instead of using an equally-spaced ideal histogram. In this way it is possible to impose an arbitrary histogram on any image, subject to the constraint that single bins may not be split up.

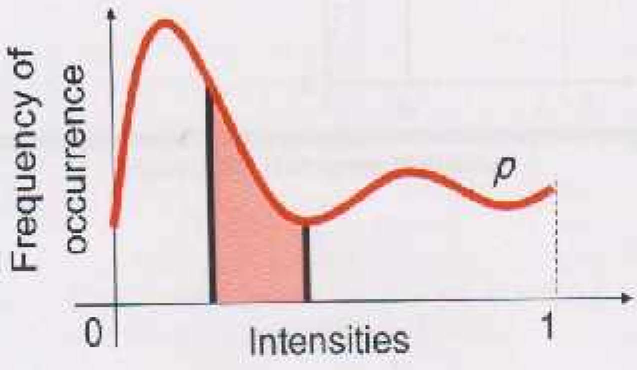
An image's histogram is transformed according to a desired function. Transforming the intensity values so that the histogram of the output image approximately matches a specified histogram.

The histogram function h can be seen as a continuous function:

Figure(2.8) Histogram function h

The number of occurrences in a certain region corresponds to the area below the graph of the function and inside that region.

In the normalized histogram function p, the area below the whole curve is equal to 1.



Figure(2.9) Histogram function h

2-2-7 Histogram Matching

Is a method in image processing of color adjustment of two images using the image histograms. It can be used to normalize two images, when the images were acquired at the same local illumination (such as shadows) over the same location, but by different sensors, atmospheric conditions or global illumination .It is useful sometimes to be able to specify the shape of the histogram that we wish the processed image to have. The method used to generate a process dimage that has a specified histogram is called
histogram matching or histogram specification.

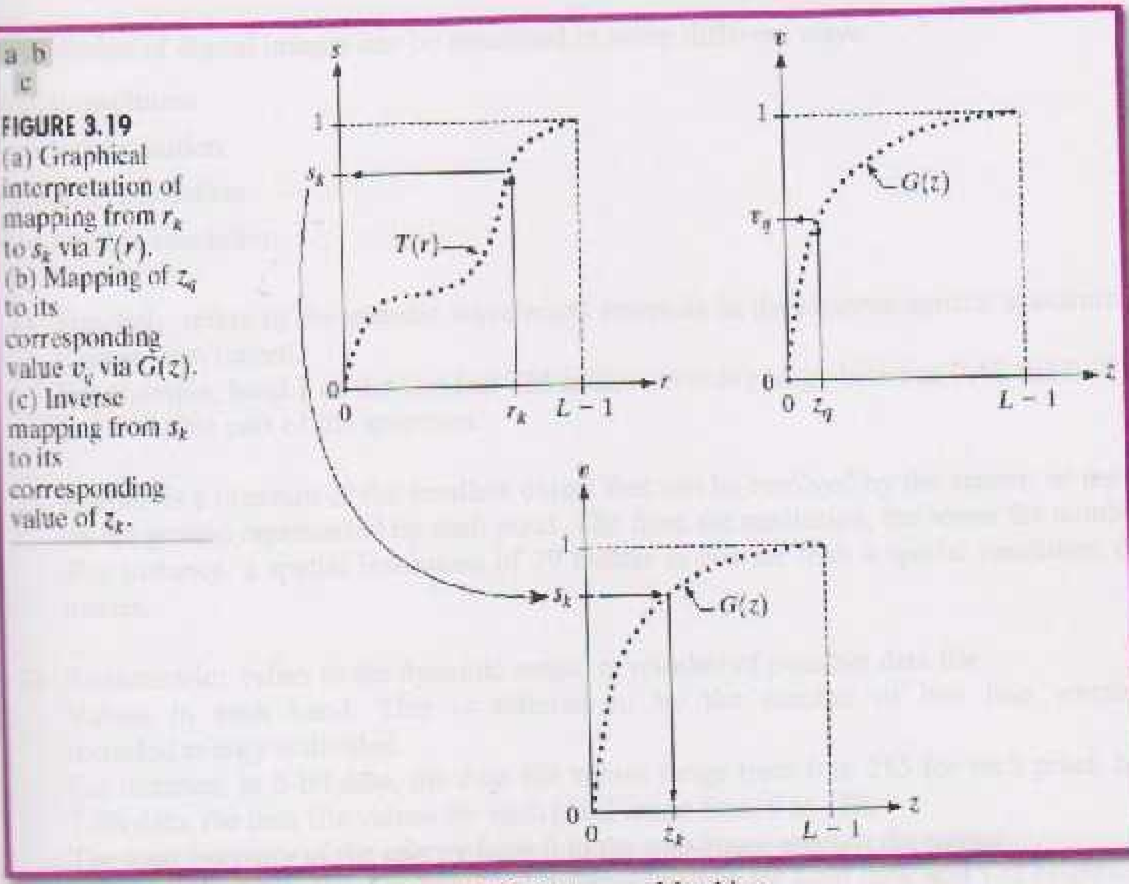


Figure (2.10) Histogram Matching.

2-3 Pixel Size And Spatial Resolution

Image resolution : Is an umbrella term that describes the detail an image holds. The term applies to raster digital images, film images, and other types of images.

Higher resolution means more image detail.

Resolution refers to the number of pixels in an image. Resolution is sometimes identified by the width and height of the image as well as the total number of pixels in the image. For example, an image that is 2048 pixels wide and 1536 pixels high (2048X1536) contains (multiply) 3,145,728 pixels (or 3.1 Megapixels).

The resolution of digital images can be described in many different ways:

1)Spatial resolution

2) Spectral resolution

3) Temporal resolution

4) Radiometric resolution

1) Spectral: refers to the specific wavelength intervals in the electromagnetic spectrum that a sensor can record.
   For example, band 1 of the Landsat TM sensor records energy between 0.45 and 0.52 mm in the visible part of the spectrum

2) Spatial: is a measure of the smallest object that can be resolved by the sensor, or the area on the ground represented by each pixel .The finer the resolution, the lower the number.
   For instance, a spatial resolution of 79 meters is coarser than a spatial resolution of 10 meters.

3) Radiometric: refers to the dynamic range, or number of possible data file Values in each band. This is referred to by the number of bits into which the recorded energy is divided.
   For instance, in 8-bit data, the data file values range from 0 to 255 for each pixel, but in 7-bit data, the data file values for each pixel range from 0 to 128.
   The total intensity of the energy from 0 to the maximum amount the sensor Measures are broken down into 256 brightness values for 8-bit data, and 128 brightness values for 7-bit data.

4) Temporal: refers to how often a sensor obtains imagery of a particular area.
   For example, the Landsat satellite can view the same area of the globe once every 16 days. SPOT, on the other hand, can revisit the same area every three days.

2-4 Change Detection

2-4-1 Definition Of Change Detection

is The comparison of two or more geographically identical but temporally separate images to identify variation in surface cover components.

2-4-2 Inputs

- Aerial image for the year 2006
- Aerial image for the year 2009

2-4-3 Outputs

- Map of change vs. no-change
- Map describing the types of change

2-4-4 Display Bands From Dates 1 And 2 in Different Color Guns Display

- No-change is grayish
- Change appears as non-grey
- Limited use
- On-screen delineation
- Masking

2-4-5 Change Detection Methods

1- Image Difference.

2- Image Ratio.

3- Change Vector Analysis.

In our project we used Image difference method because it is simple and Erdas program apply just this method .

2-4-5-1 Image Differencing

- Date 1 - Date 2.
- No-change = 0.
- Positive and negative values interpretable.
- Pick a threshold for change.
- Often uses vegetation index as start point, but not necessary.

1.PROPERTIES:

1. Simple (some say it's the most commonly used method).
2. Easy to interpret.
3. Robust.

2.CONCLUSIONS :

1. Difference value is absolute, so same value may have different meaning depending on the starting class.
2. Requires atmospheric calibration for expectation of "no-change = zero".

8	10	8	11
240	11	10	22
205	210	205	54
220	98	88	46

Image date 1

5	9	7	10
97	9	8	22
98	100	205	222
103	98	254	210

image date 2

3	1	1	1
143	2	2	0
107	110	0	-168
117	0	-166	-164

Difference image=image 1- image 2

Figure(2.11) Image differences

2-4-5-2 Image Ratio

- Date 1 / Date 2.
- No-change = 1.
- Values less than and greater than 1 are interpretable.
- Pick a threshold for change.

- **PROPERTIES**
  - Simple.
  - May mitigate problems with viewing conditions, esp. sun angle.

- **CONCLUSION**
  - Scales change according to a single date, so same change on the ground may have different score depending on direction of change: I.e. 50/100 = .5, 100/50 = 2.0

Figure (2 .12) Image difference (TM99 – TM88)

Figure (2 .13) Image ratio (TM99 / TM88)

2-4-6 Procedure Of Detection

1. One image is selected to serve as a master image to which all other images are normalized to. The master image should represent a period of time with superior atmospheric conditions.

2. Each subsequent image in the time series is considered a "slave image" to the master. Slaves are normalized to the master.

3. Master image is converted to exo-atmospheric reflectance using the COST correction algorithm.

4. Slave images are also converted to exo-atmospheric reflectance using the same COST algorithm.

5. The output, COST corrected master image serves as the standard.

6 The output COST corrected slave is ready for comparison with the master Change Detection

7. output, master.

8. The pseudo-invariant feature (PIF) algorithm is used to locate spatially coincident pixels in both slave and master that have not changed through time.

9. The PIF algorithm is used to normalize the slave image to the master.

10. All normalized imagery (including the master) is converted to NDVI.

11. NDVI values for each image is normalized into fractional vegetation cover (Fv).

12. All Fv images are added to the temporal database of fractional vegetation cover.

13. Land cover and Land use maps can be used to parameterize individual cover and use categories.

2-5 Image Processing

2-5-1 Introduction

An image is defined as a 2-d function *f(x,y)* where *x* and *y* are spatial coordinates and amplitude of *f* at any pair of coordinates *(x,y)* is called the intensity or grey level of image at that point. The image consists of number of elements called pixels and we process these pixels .
Digital image processing refers to processing digital images such they are used for human or autonomous machine interpretation.

An image processing operation typically defines a new image *g* in terms of an existing image *f*.

We can transform either the range of *f*.

$$g(x, y) = t(f(x, y))$$

Or the domain of *f*:

$$g(x, y) = f(t_x(x, y), t_y(x, y))$$

2-5-2 Steps Digital Image Processing

Image acquisition.

Image enhancement.

Image restoration.

color image processing.

wavelets and multiresolution processing.

compression..

segmentation.

representation and description..

2-5-3 Enhancement

Objective of enhancement is: to process image so that result is more suitable than original image for specific application.

2-5-4 Enhancement Categories

Enhancement has two broad categories:

- Spatial domain techniques
  - Point operations
  - Histogram equalization and matching
  - Applications of histogram-based enhancement
- Frequency domain techniques
  - Unsharp masking
  - Homomorphic filtering

2-5-5 Point Operation

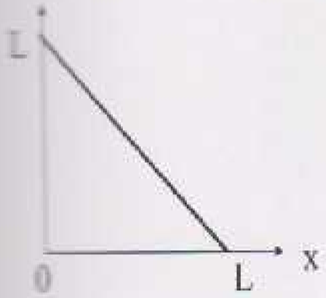
Point operations are zero-memory operations wherea given gray level $x \in [0,L]$ is mapped to anothergray level $y \in [0,L]$ according to a transformation.

$$y = f(x)$$

L=255: for grayscale images.

2-5-5-1 Digital Negative:

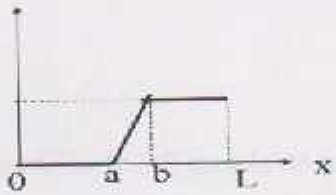
Y= L -X



Figure(2.14) Digital Negative operation

2-5-5-2 Clipping:

$$y=\begin{cases}0 & 0\le x<a\\ \beta(x-a) & a\le x<b\\ \beta(b-a) & b\le x<L\end{cases}$$



$a=50, b=150, \beta=2$

Figure(2.15) Digital clipping operation

2-5-5-3 Range Compression

$y = c\log_a(1+x)$

C=100

Figure(2.16) Range compression operation

2-5-5-4 Contrast Streching (CS)

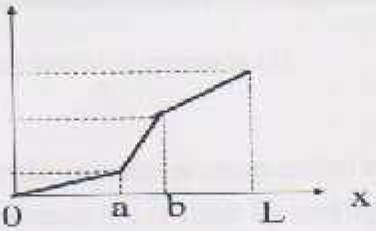
By stretching the histogram we attempt to use the available full grey level range.

The appropriate CS transformation :

$$s_k = 255\cdot(r_k\text{-min})/(\text{max-min})$$

a more general CS:

$$y=\begin{cases} \alpha x & 0\le x<a \\ \beta(x-a)+y_a & a\le x<b \\ \gamma(x-b)+y_b & b\le x<L \end{cases}$$



Example:

$a=50, b=150, \alpha=0.2, \beta=2, \gamma=1, y_a=30, y_b=200$

Figure(2.17) Contrast streching operation

Another law of contrast:

New value= (old value- 0.5) * contrast + 0.5

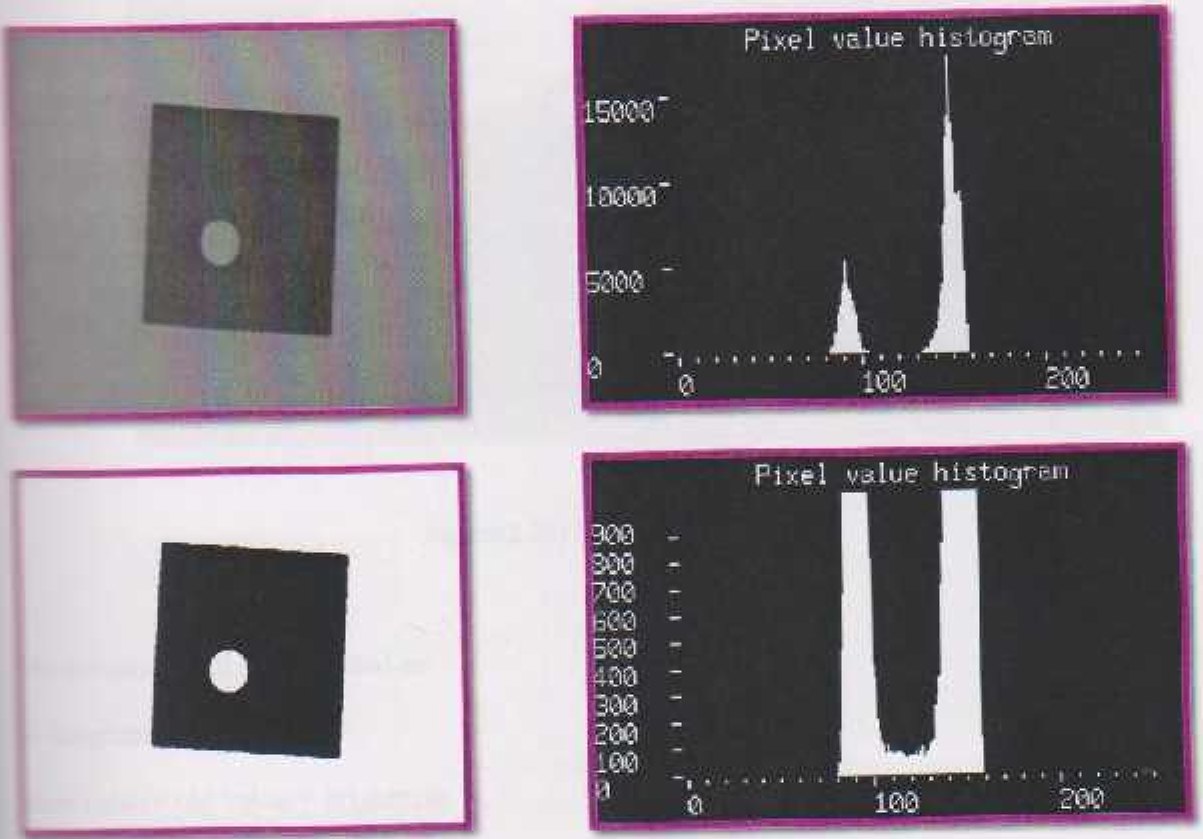
Figure(2.18) Contrast streching operation (2)

The subtraction and addition of 0.5 is to center the expansion/compression of the range around 50% gray. Specifying a value above 1.0 will increase the contrast by making bright samples brighter and dark samples darker thus expanding on the range used. While a value below 1.0 will do the opposite and reduce use a smaller range of sample values.

2-5-5-5 Thresholding

converting a greyscale image to a binary one .

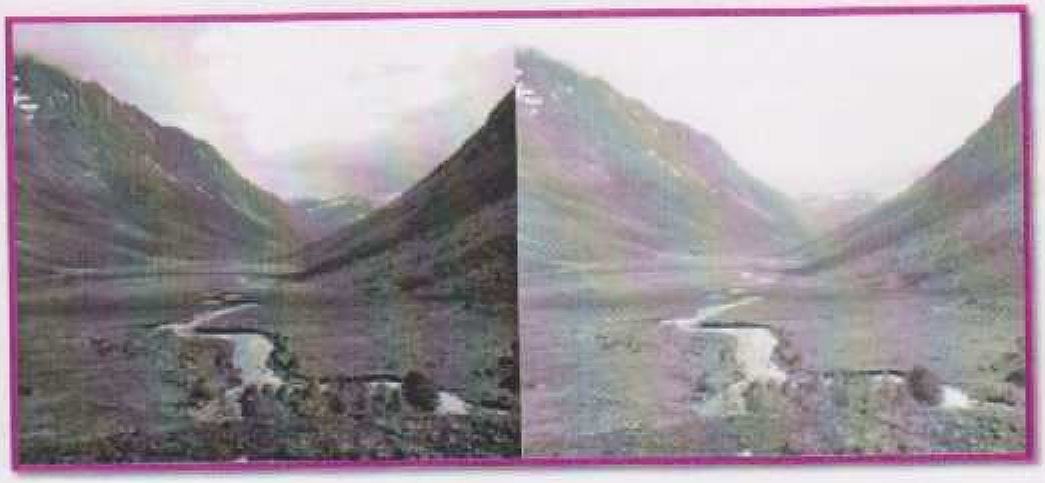
for example, when the histogram is bi-modal:



Figure(2.19) Thresholding operation

2-5-5-6 Brightness

When changing the brightness of an image, a constant is added or subtracted from the luminance of all sample values. This is equivalent to shifting the contents of the histogram left (subtraction) or right (addition).



Figure(2.20) Brightness operation

Mathematically it is expressed as:

1- Brightness addition:

New value= old value + brightness

$$G(x,y)= F(x,y) + K$$

2)-Brightness subtraction:

New value= old value - brightness

$$G(x,y)= F(x,y) - K$$

2-6 Spatial Domain Techniques

- Order statistic filters : Mean, Median and Mode Filters
- Digital Laplacian filter.

- Gradient filters: Horizontal and vertical edge detection +45 and -45 degree edge detection.

2-6-1 Order Statistic Filters

2-6-1-1 Mean Filtering

Mean filtering: is a simple, intuitive and easy to implement method of smoothing images, i.e. reducing the amount of intensity variation between one pixel and the next. It is often used to reduce noise in images

The idea of mean filtering is simply to replace each pixel value in an image with the mean ('average') value of its neighbours, including itself. This has the effect of eliminating pixel values which are unrepresentative of their surroundings.

$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$

Computing the straightforward convolution of an image with this kernel carries out the mean filtering process.

Figure(2.21) Mean flitering

The two main problems with mean filtering are:

A single pixel with a very unrepresentative value can significantly affect the mean value of all the pixels in its neighbourhood.

When the filter neighbourhood straddles an edge, the filter will interpolate new values for pixels on the edge and so will blur that edge. This may be a problem if sharp edges are required in the output.

2-6-1-2 Median Filter

* The median filter is normally used to reduce noise in an image, somewhat like the mean filter. However, it often does a better job than the mean filter of preserving useful detail in the image.

*Instead of simply replacing the pixel value with the mean of neighbouring pixel values, it replaces it with the median of those values. The median is calculated by first sorting all the pixel values from the surrounding neighbourhood into numerical order and then replacing the pixel being considered with the middle pixel value.

Example:

123	125	126	130	140
122	124	126	127	135
118	120	150	125	134
119	115	119	123	133
111	116	110	120	130

Neighbourhood values:

115, 119, 120, 123, 124,
125, 126, 127, 150

Median value: 124

Figure(2.22) Median flitering

2-6-1-3 Mode

The mode filter computes the mode of the grey-level values (the most frequently occurring grey-level value) within the filter window surrounding each pixel. Mode filtering is ideal for cleaning up thematic maps for presentation purposes, in that it replaces small "island" themes by their larger, surrounding themes.

Example:

Consider the following window

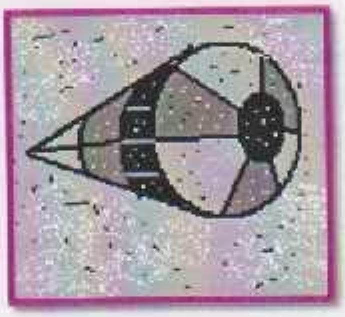
| 5 3 3 |

| 3 5 3 | <-- Filter window

[3 4 5]

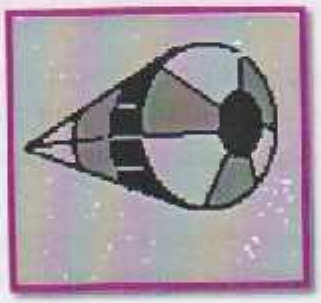
Filtered pixel of filter window (3,3,3,3,3,4,5,5,5) is set to 3.

Example:

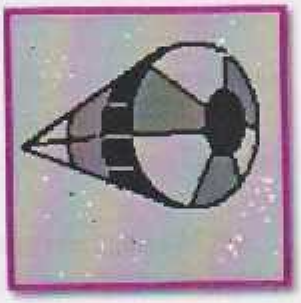


Original image

Mean



Median



Mode

Figure(2.23) Mean & median & mode flitering

CHAPTER THREE

BUILDING PERMIT SERVICES

3-1 INTRODUCTION

The issuance of building permits is the municipality major activity due to its general impact on many of the architectural economic, ecological cultural and political aspects of the city and its population it is also a major affluent of funds accounting for 25% of all municipal income excluding water and electricity revenues .

3-1 -1 Building Section Objectives

Issuing building permits and collecting fees is not a goal for the building sections as much as it is a means to achieve a number of goals.

The sections main goal is to guarantee the application of building and urban planning rules and regulations which were originally created to achieve the following objectives :

1. Preserve the citys organizational aspects :one of the main objectives of building permits is to guarantee compliance with the citys preset organizational plan and maintain its divisions into residential ,commercial ,industrial, agricultural and green areas , in addition to city expansion areas.
2. Architectural harmony :Building –related activities guarantee the preservation of the architectural type of the cities neighborhoods and streets . they also guarantee that buildings are harmoniously built thus preserving the esthetics of various city quarters .
3. Ecological safety : probably one of the sections major activities is to ensure the citys ecological safety by keeping industrial areas separate from residential ones .it is also in charge of verifying legal repercussions and monitoring construction ratios in residential ,commercial and industrial areas…
4. Public safety :setting up the organizational plan of main and side streets both existing and proposed _and preserving them from structural aggressions, actively contributes to achieving security on the streets and reducing road accidents.
5. Economic aspects: Uploading building and urban planning laws prevents squandering Economic resources by erected unauthorized building ,in violation of urban planning and building laws ,which would be subject to removal.
6. Political aspects: Finalizing the organizational plan and determining possible city expansion areas necessarily leads to confronting Israel s drive for settlements expansions in the city ,which is still under the threat settlements.

7. Cultural aspects: Preserving the city s ancient architectural and historical style and esthetics is an integral part of the building sections activities, with a direct impact on the cities culture and heritage

Areas licensed during the year 2009 totaled 273266.59 m²,and where divided as follows :

Residential	155579.75
Commercial	81252.76
Public buildings	36434.20

We would also like to inform you in regard to areas, in square meters licensed over the last four years , as per the following table :

No.	Year	No of licenses	License areas
1	2006	285	166290
2	2007	226	149165
3	2008	311	190734
4	2009	383	273266.59

Hebron Municipality divided city of Hebron into nine regions to monitor the buildings and distributed monitoring work on nine monitors each of them in a certain area.
The studies show the existence of irregularities in large buildings, both existing buildings or those under construction.
1. In some cases the process of monitor doesn't work properly due to the large area of the city of Hebron, observers can not visit all the buildings where there are areas that are not visited by the observers may be tolerated in the control of some buildings as there are irregularities may not notice by monitors
2. There aren't enough observers to monitor the city of Hebron
3. The work of the monitors concentrate in the regions which have a higher number of population, and they neglect far areas which have less number of population.

4. There are new areas annexed to the borders of Hebron city, in which there is a difficulty in monitoring.

3-1-2 The Mechanism Of The Engineering Work In The Municipality

1. **Civil Engineer :** he is directly responsible for all projects in the municipality.
2. **surveying engineer :** his work is to receive the license applications from citizens then

process them to obtain approval from the local committee of the organization and construction.
Also he matches the existing building with the license to give the necessary services to citizen
3. buildings **monitor** : he monitors the work on the new buildings that are held in the town, as well as follow-up to protect the public roads from the infringements.

3-1 -3 Automatic Licensing Procedure For Requests For Building Licenses

1. Bring surveying plan for the land to be built upon.
2. Bring proof of ownership of the land (being out / agency periodically).
3. Adoption of opened file by the civil engineer.
4. Pay the fees to open a new file.
5. Field inspection on the site by the surveying .
6. Bring books of plans by the Office of certified engineers, accompanied by the approval of the neighbors, and the endorsement of the neighboring office of the engineer, and the Engineers Association, to be displayed later to the Committee of Buildings.

Therefore, we suggest a new mechanism for licensing to reveal changes by using aerial photographs ,which we can detect all irregularities in the multi-storey buildings and the changing boundaries, roads and vegetation.
Using the method of change detection

1. We can monitor large areas easily and without having to visit all these areas by the observers but just visit the changed areas.
2. All areas will be under control.

Working procedure

4-1 Erdas program

4-1-1 Open ERDAS Program

1.Click on ERDAS IMAGINE 2011.

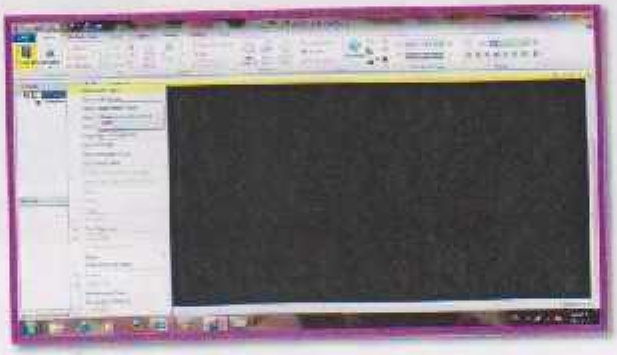
2.After run the program this screen will appear.

Figure (4.1) Strat-up Erdas program screen

4-1-2 Add Photo

1. Make right click on 

This screen will appear:



Choose 

Figure (4.2) Adding images in Erdas

This window will appear:

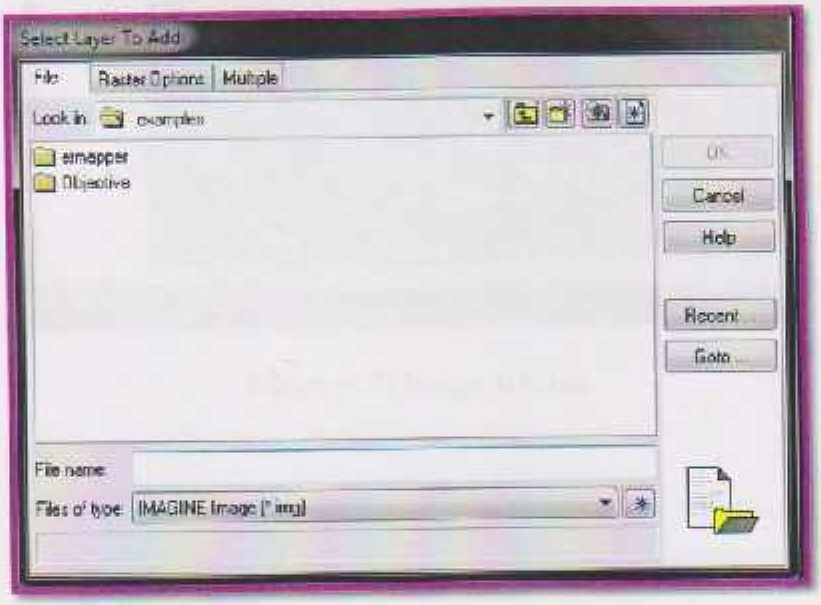


Figure (4.3) Adding images window

Choose the image:

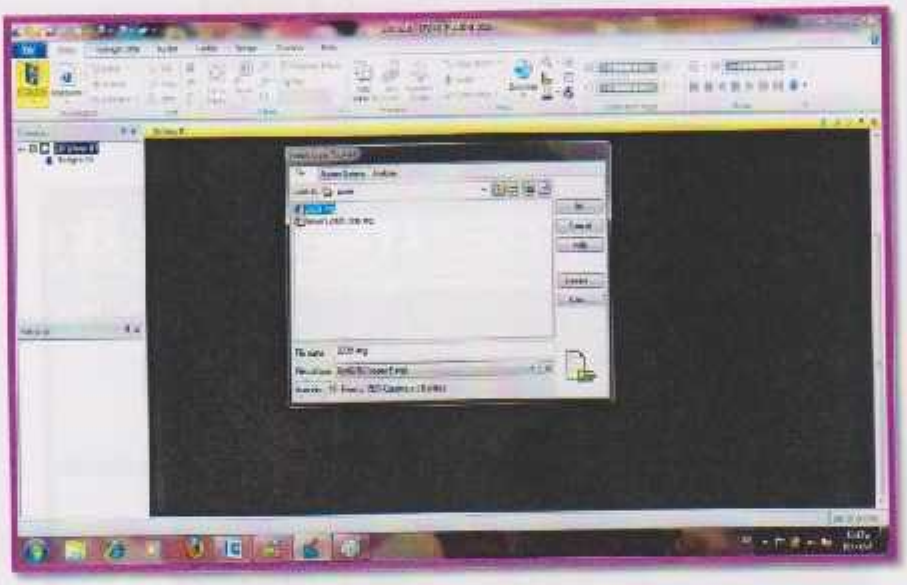


Figure (4.4) Selecting images window

The picture appears on the program screen:

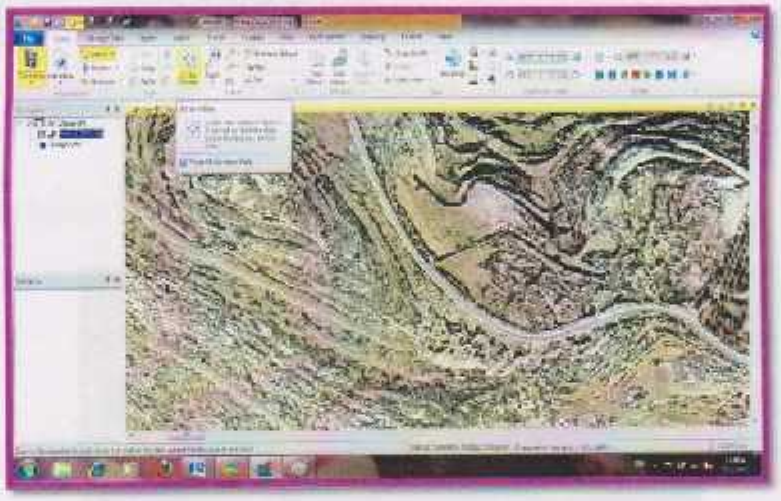


Figure (4.5) Image in Erdas

4-1-3 Fit to Frame

1-From home icons 

2-Click at fit to frame icons 

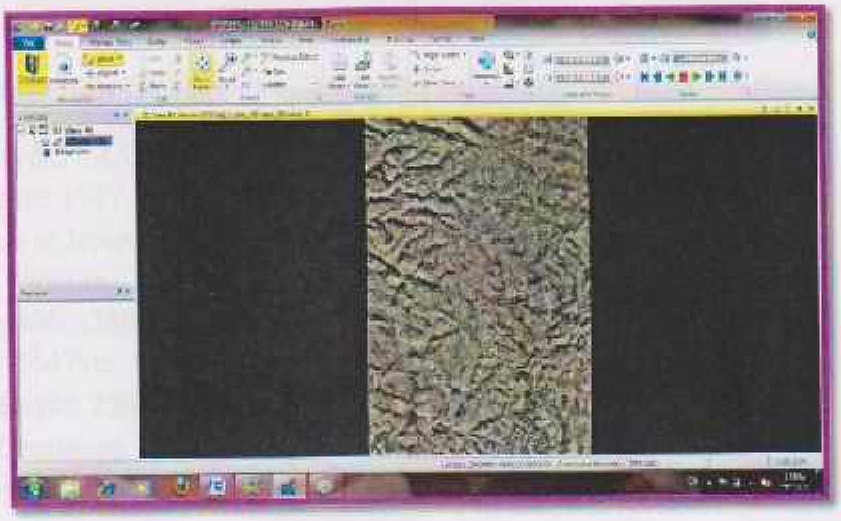


Figure (4.6) Fit Frame command

4-2 The Original Images Of Hebron City (2006 & 2009) Before Processing And Modification

4-2-1 The Original Image 2009

Figure (4.7) Original image 2009

4-2-1-1 The Properties Of This Image Before Processing And Modification

1- Image type: IMAGINE image.
2- Image size: 1957.32 MB.
3- Numbers of layers: 3 –bands.
4- Width: 18620m.
5- Block width:1280m.
6- Height: 26479m.
7- Block height: 256m.
8- Type: Continous.
9- Data type: 8- bits.

10- Compression: Run Length Encoding.
11- Pyramid Layer Algorithm: ErdasBions(3*3)
12- Range: (0-255) , Min:1 , Max:255 .
13- Mean: 128.942 .
14- Median: 130 .
15- Mode: 129 .
16- Standard Deviation: 44.288 .
17- Upper Left X: 203740.249999999970 .
18- Upper Right Y: 608544.74999999880 .
19- Lower Left X: 213049.479999999970 .
20- Lower Right Y: 595305.74999999880 .
21- Projection: Transverse Mercator .
22- Spheroid: GRS 1980 .
23- EPSG Code: 0 .
24- Piel size: 0.5 m.
25- Unit: Meters .

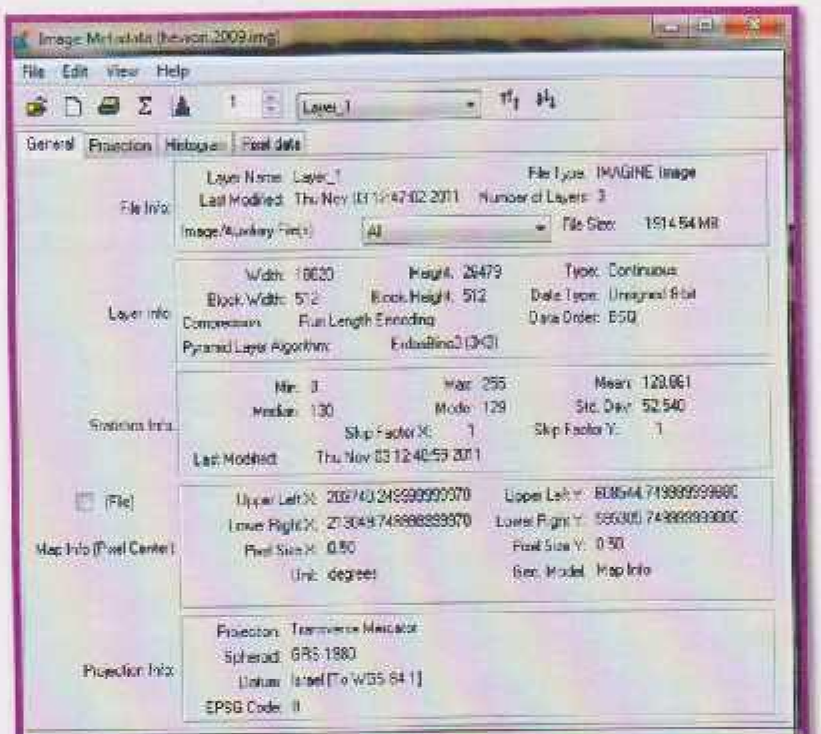


Figure (4.8) Image Metadata "Genral" for image 2009

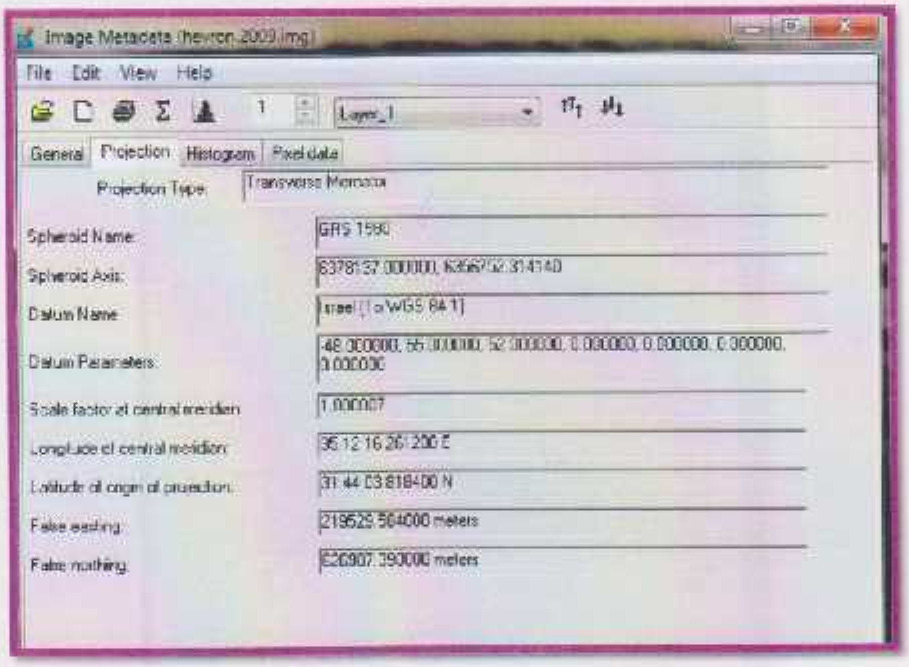


Figure (4.9) Image Metadata "Projection" for image 2009

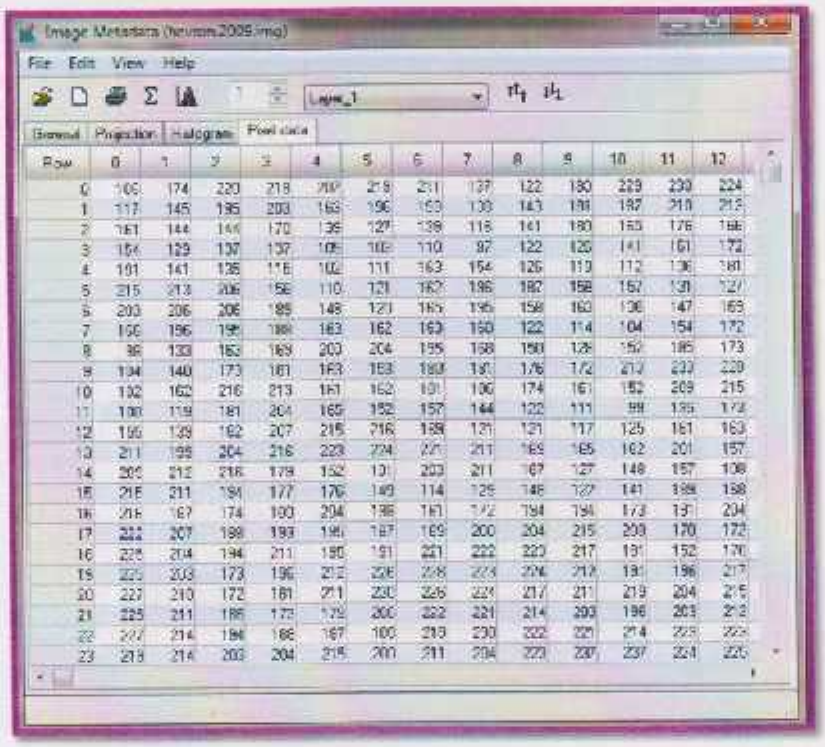
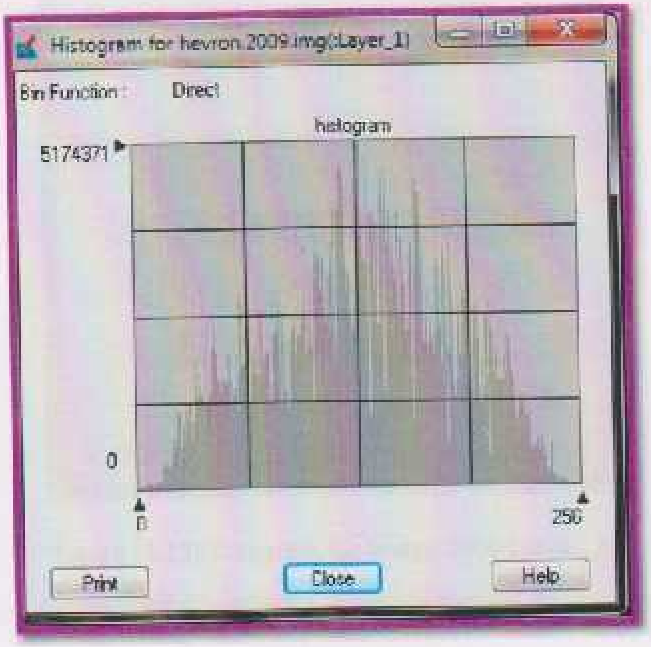


Figure (4.10) Image Metadata "Pixel data" for image 2009

4-2-1-2 Histogram For Image 2009:



2Figure (4.11)Histogram for image 2009 (Layer_1)

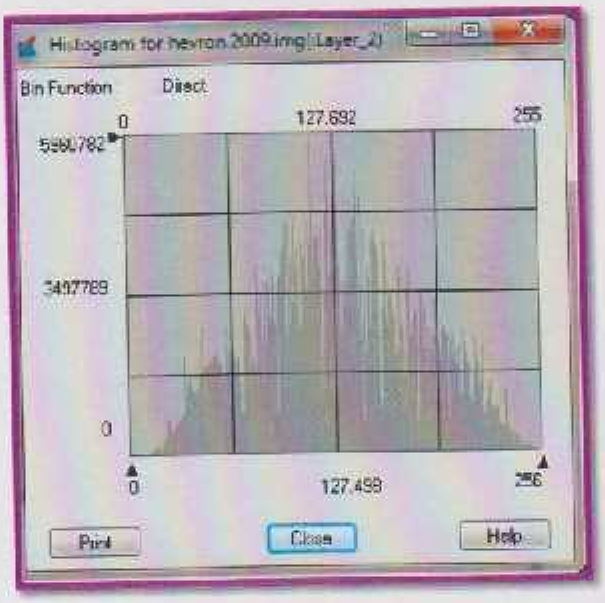


Figure (4.12)Histogram for image 2009 (Layer_2)

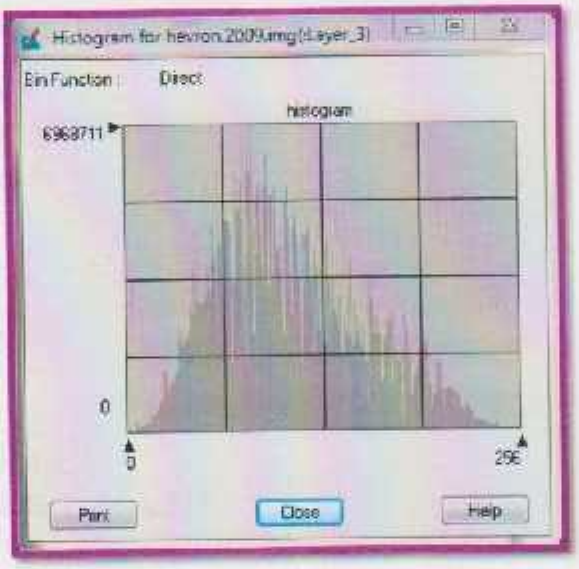


Figure (4.13)Histogram for image 2009 (Layer_3)

4-2-2 The Original Image 2006

Figure (4.14)Original image 2006

4-2-2-1 The Properties Of This Image Before Processing And Modification

1- Image type: ECW.
2- Image size: 542.22 MB.
3- Numbers of layers: 3.
4- Width: 64944.
5- Block width: 512.
6- Height: 70216.
7- Block height: 512.
8- Type: continous.
9- Data type: 8- bits.
10- Compression: wavelet.
11- Range: (1-255) , Min:1 , Max:255
12- Mean: 94.550.
13- Median: 93.
14- Mode:91.
15- Standard Deviation: 31.998.
16- Upper Left X: 155182.062499999940.
17- Upper Right Y: 108913.97349999990.
18- Lower Left X: 163299.973099999940.
19- Lower Right Y: 100137.06249999990.
20- Projection: LOCAL.
21- Piel size: 0.13 m.
22- Unit: meters.

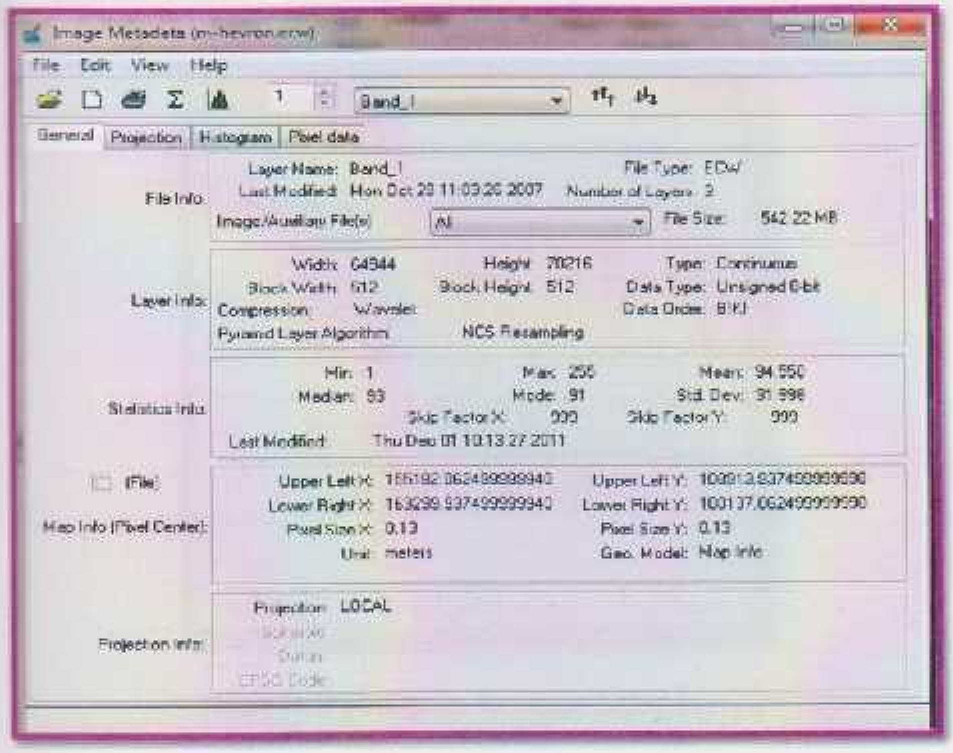
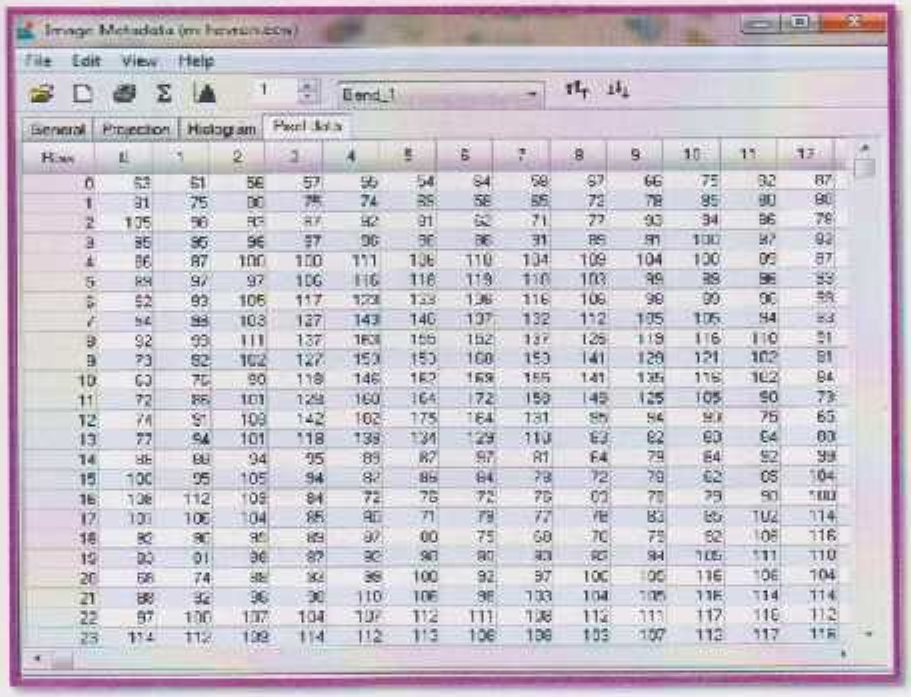


Figure (4.15) Image Metadata "Projection" for image 2006



Row	0	1	2	3	4	5	6	7	8	9	10	11	12
0	53	51	56	57	56	54	64	58	67	66	75	82	87
1	81	75	80	75	74	85	58	65	72	78	85	80	90
2	105	96	93	87	92	81	62	71	77	93	84	86	76
3	85	95	96	97	96	96	96	91	85	91	100	87	92
4	86	87	100	100	111	106	110	104	109	104	100	05	87
5	89	97	97	106	116	118	119	110	103	99	89	86	93
6	52	93	106	117	123	123	136	116	106	98	90	96	88
7	94	98	103	127	143	140	137	132	112	105	105	94	93
8	92	93	111	137	163	155	152	137	126	119	116	110	91
9	73	82	102	127	153	150	160	153	141	129	121	102	81
10	63	76	90	118	146	162	169	155	141	135	116	102	84
11	72	86	101	129	160	164	172	159	145	125	105	90	73
12	74	91	109	142	162	175	164	131	85	84	90	75	65
13	77	94	101	118	138	134	129	110	63	82	60	64	60
14	86	88	94	95	89	87	97	81	64	79	64	52	99
15	100	95	105	94	87	86	84	78	72	78	62	05	104
16	108	112	109	84	72	76	72	76	03	78	79	90	100
17	101	106	104	85	90	71	78	77	78	83	85	102	114
18	90	90	95	89	97	80	75	68	70	75	52	108	116
19	90	91	96	87	90	98	80	93	90	94	105	111	110
20	68	74	98	92	98	100	92	97	100	105	116	106	104
21	88	92	96	90	110	106	98	133	104	105	116	114	114
22	97	100	107	104	107	112	111	108	112	111	117	116	112
23	114	112	108	114	112	113	108	108	103	107	112	117	116

Figure (4.16) Image Metadata "Projection" for image 2006

4-2-2-2 Histogram For Image 2006

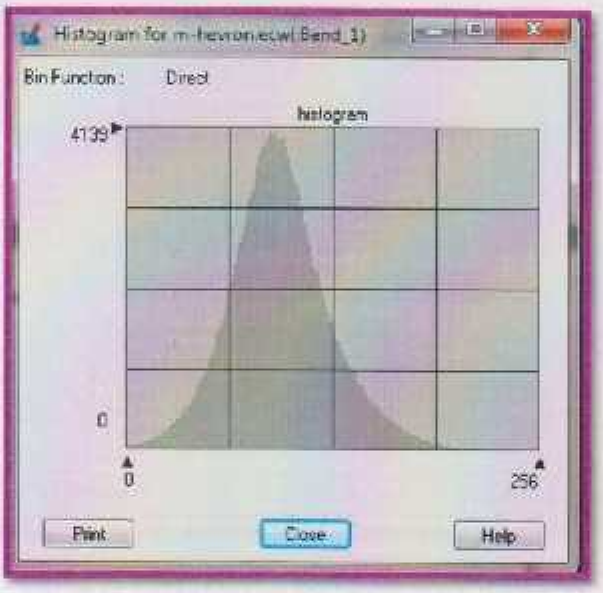


Figure (4.17)Histogram for image 2006 (Layer_1)

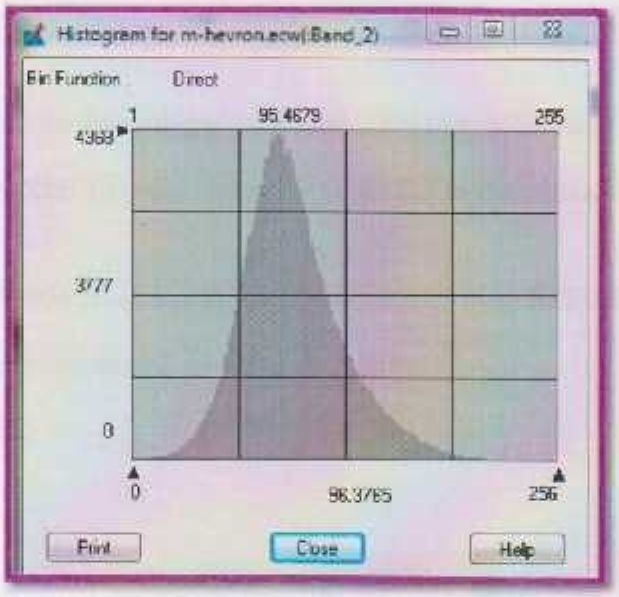


Figure (4.18)Histogram for image 2006 (Layer_2)

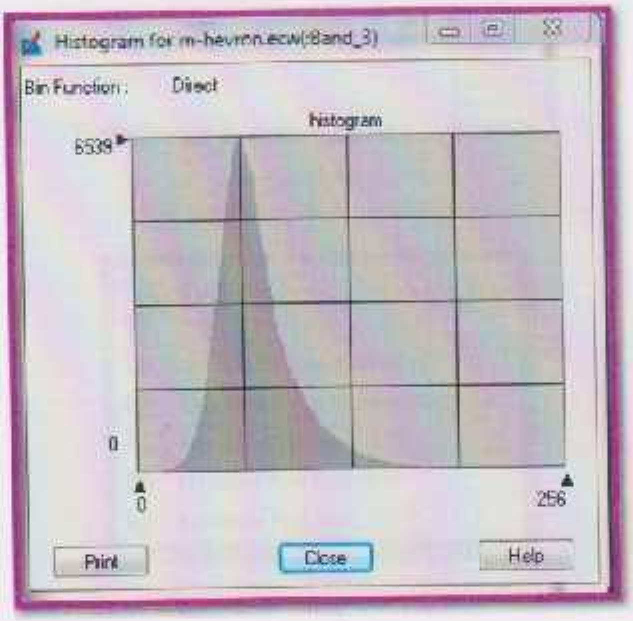


Figure (4.19)Histogram for image 2006 (Layer_3)

4-3 Resample Pixel Size

To make change detection for two images 2006 and 2009 they must have the same pixel size.

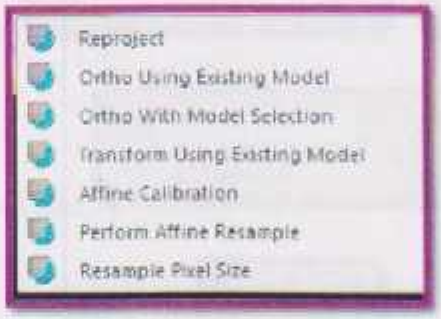
Image 2006 has 12.5 cm pixel size and image 2009 has 0.5 m pixel size so there is necessary to unify their pixel sizes.

Steps to Convert image 2006 pixel size from 12.5 cm to 0.5 m in ERDAS :

*Enter image 2006 to the program.

*Choose multispectral list.

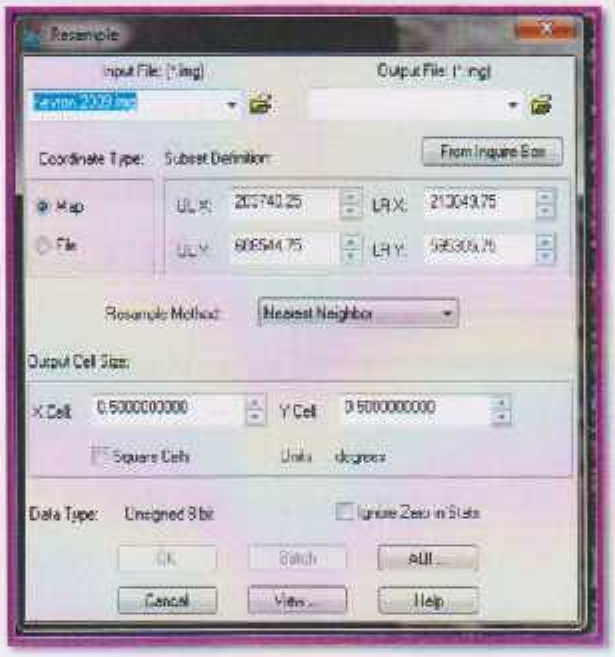
Transforms & ortho correct



Resample Pixel size

Figure (4.20) Resample pixel size selecting

This window will appear:



Choose r input file


*Choose required output file.


*Change X Cell and Y Cell size.

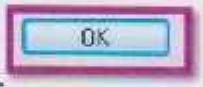

*Click Ok.


Figure (4.21) Resample pixel size steps

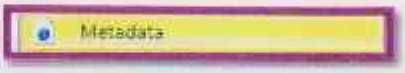
4-4 Change Projection

To make change detection for two images 2006 and 2009 they must have the same projection type.

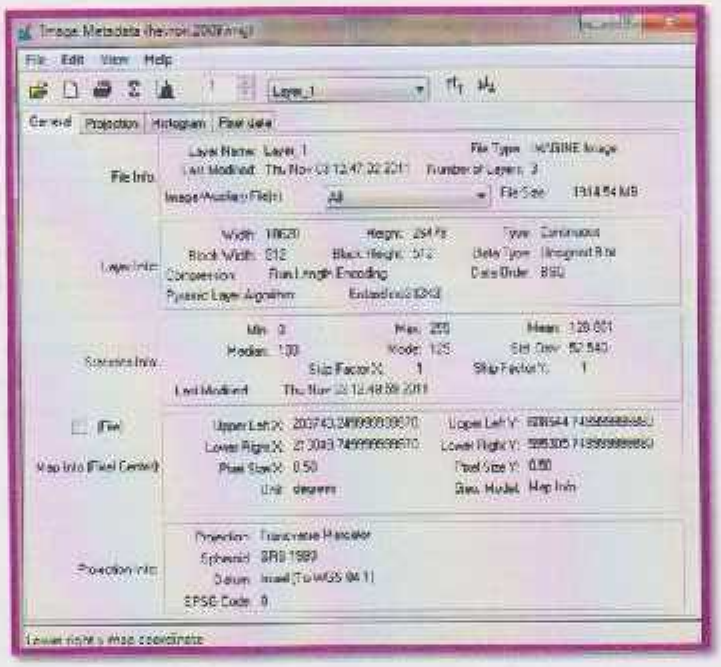
Image 2006 projection is Palestine Grid 1923 and image 2009 projection is Transver Mercator(spheroid:GRS 1980 Israel Datum) so there is necessary to unify their projection type.

Steps to Change image 2006 projection type in ERDAS :

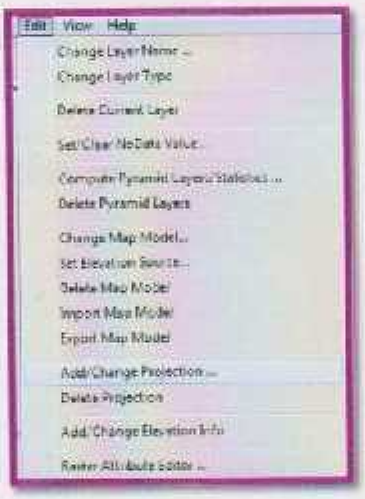
First define coordinate system of image 2006:

*From the right mouse button select Metadata


This window will appear:



Select Edit



Add /Change projection

Figure (4.22) Define coordinate system steps

This window will appear:

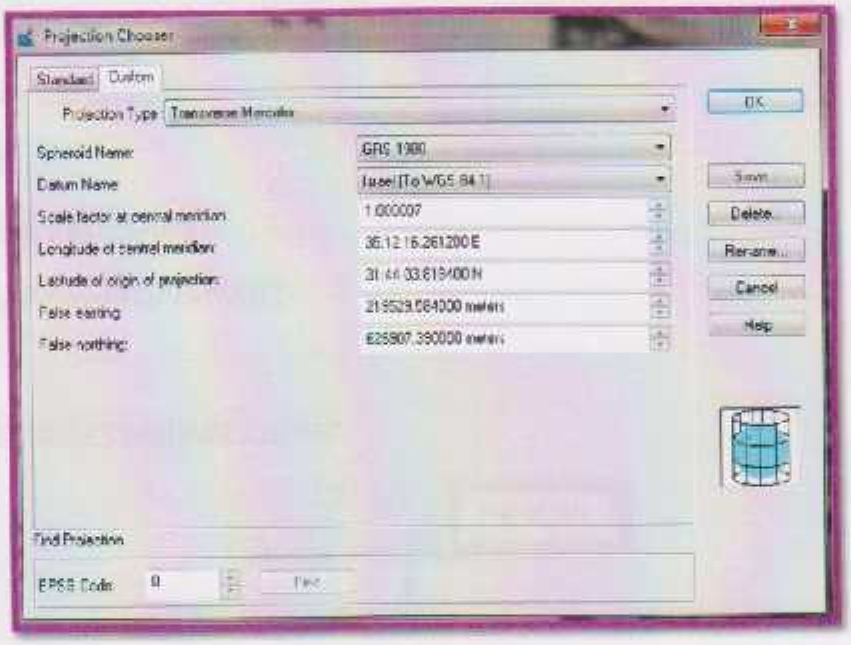


Figure (4.23) Projection chooser

From Catlog GIS take information about coordinate system and put them in the window above.

This information include:

1. projection information for 2009 images :

Projection :transverse Mercator

False easting : 219529.584

False northing : 626907.39

Central meridian : 35.204517

Scale factor : 1.000007

Latitude of origin : 31.734394

Spheroid : GRS-1980

2. projection information for 2006 IMAGES :

Projection :CASSINI

False easting : 170251.555

False northing : 126867.909

Central meridian : 35.212081

Scale factor : 1.

Latitude of origin : 31.734097

Spheroid : CLARKE -1880-BENOIT

Second transform the coordinate system:

*Manage data list

Edit image Metadata

This window will appear:

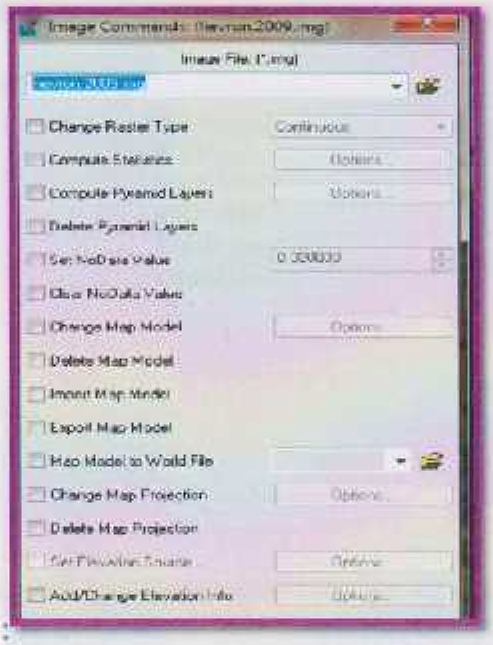


Figure (4.24) Image coordinate window

From this window select “change map projection →

This Window will appear :

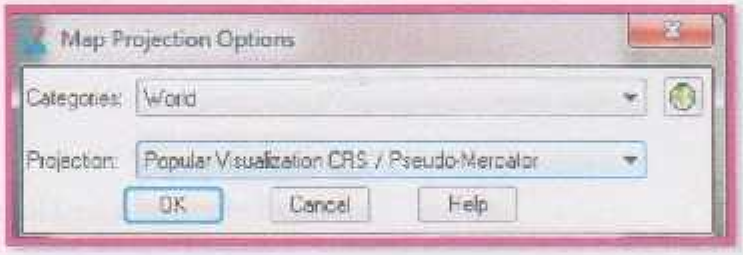
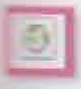


Figure (4.25) Map Projection Options

Press On:



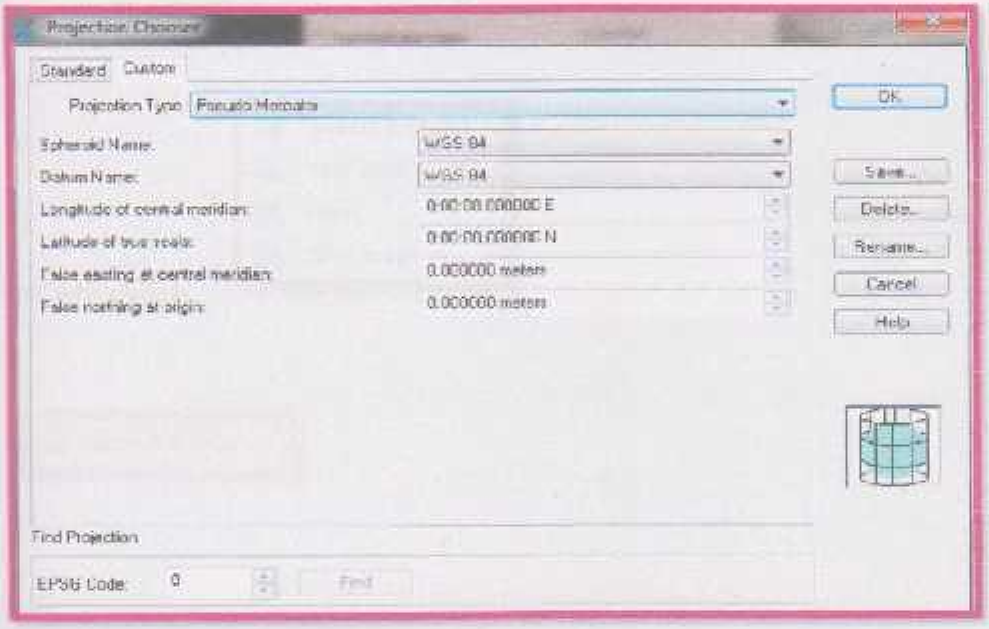


Figure (4.26) Projection Chooser

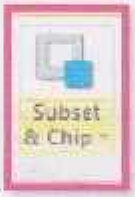
Finally change the information needed in these windows , after that the two images have the same projection.

Clipping Image

from raster 

menu 

Select Multispectral icons 

Then select subset & chip icon 

This menu will appear 

Select 

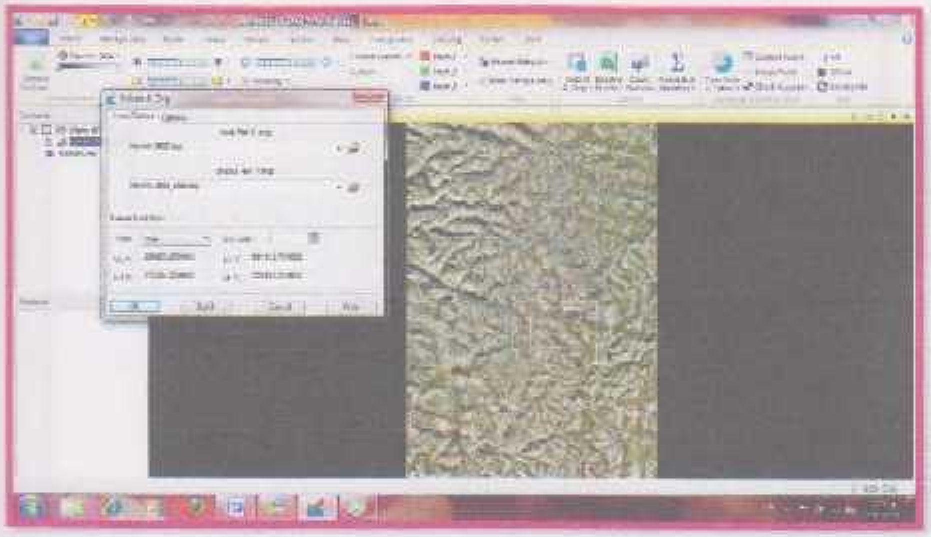


Figure (4.27) Clip image proceedure

window will appear:

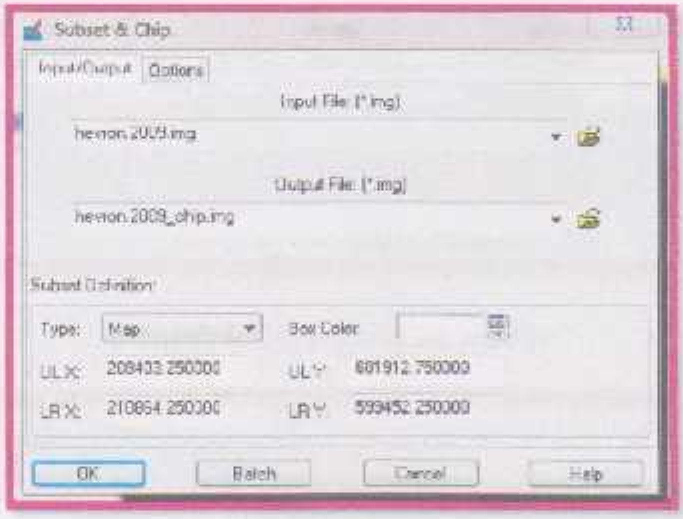


Figure (4.28) Subset & clip window

mine the area that's you want to clip:

Figure (4.29) Determing the area of clipping

Click ok

The program will make clip for the image

Figure (4.30) Process list window

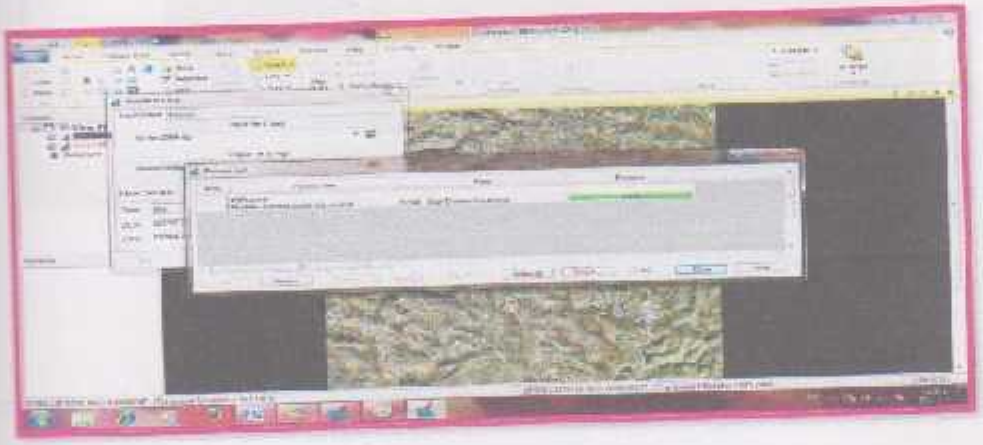


Figure (4.31) The end of clipping window

Click dismiss icons

Click close

The clipped image will appear

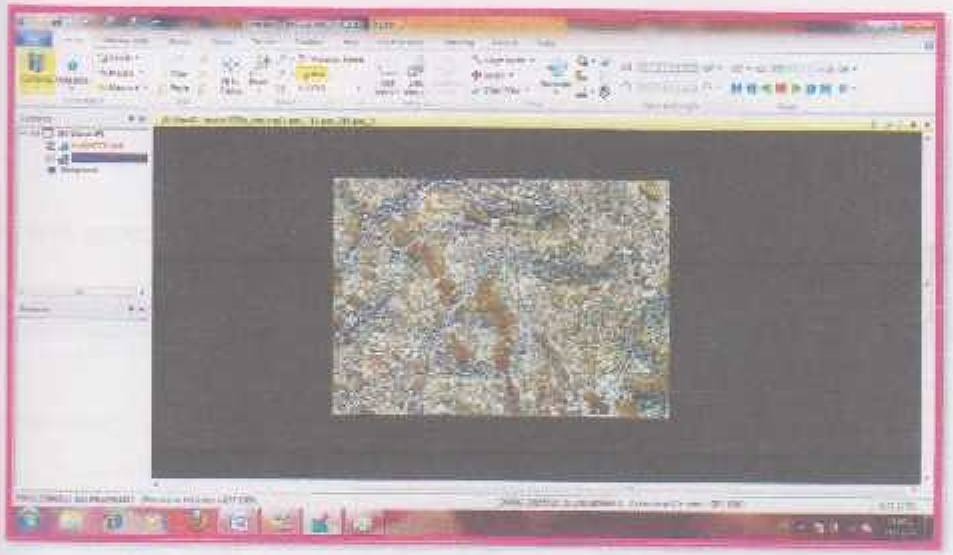


Figure (4.32) The final resulting clipped image

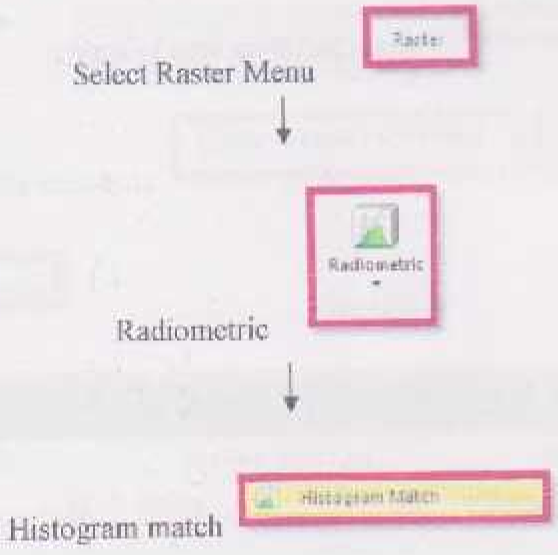
After these steps the two images (2006 & 2009) were clipped as the same Boundaries and area.

Histogram Matching

To have better result in working we need to make the same brightness for two images (2006 & 2009).

The brightness of image 2009 is better than 2006 so make histogram matching between two images taking the brightness of image 2009.

Histogram Matching Proceedure in Erdas :



The screen will appear :

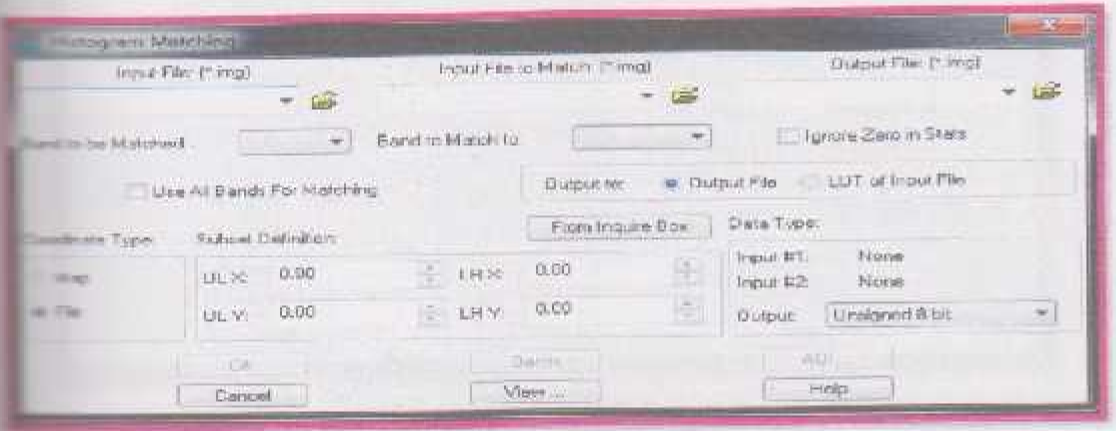
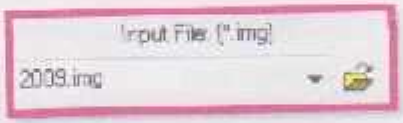


Figure (4.33) Histogram matching wimdow

Write in:



1-input file → (image 2009)

2- input file to match → (image 2006)

3-Output file → (Name of new modified image)

4-Select ☑ use all bands for matching .

5-Then click Ok .

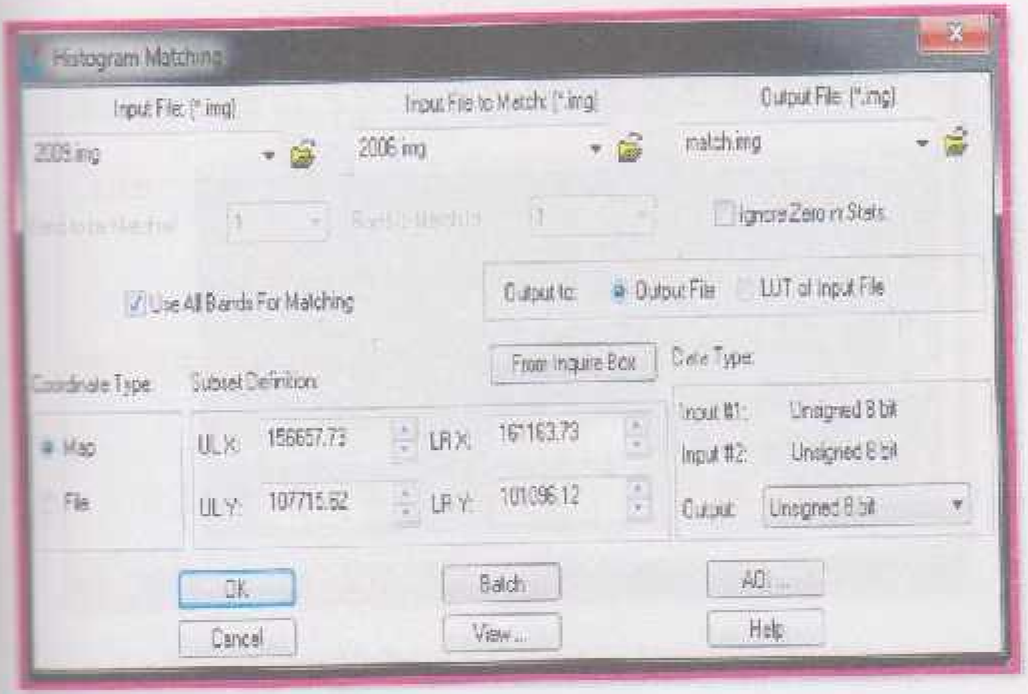


Figure (4.34) Histogram matching

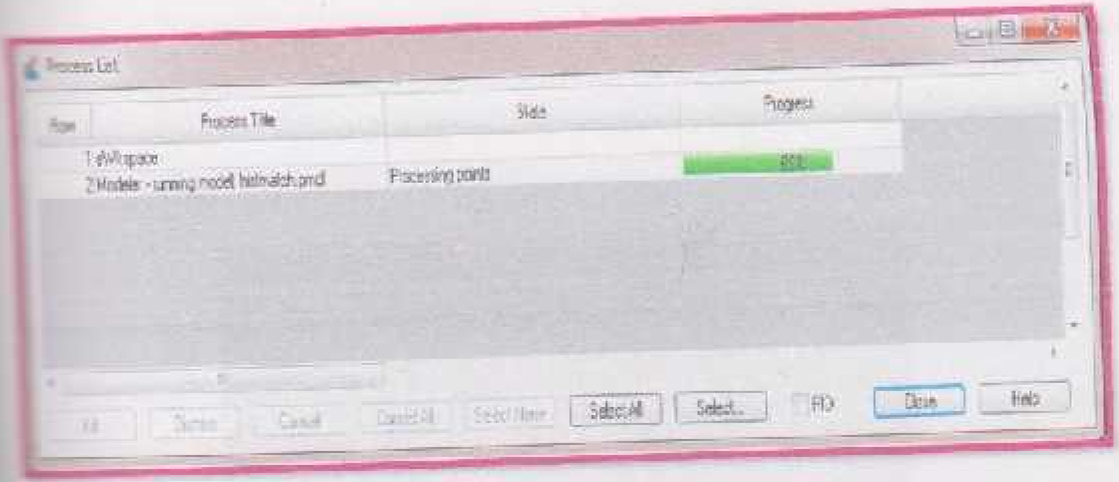


Figure (4.35) Process list

Click 

The window will appear:

Figure (4.36) The image after making histogram matching

4-7 The Images Of Hebron City (2006 & 2009) After Processing And Modification

4-7-1 The Processed Image 2009

Figure (4.37) image 2009 after processing

4-7-1-1 The Properties Of Processed Image 2009 :

1- Image type: IMAGINE image.
2- Image size: 472.76 MB.
3- Numbers of layers: 3 –bands.
4- Width: 9013m.
5- Block width:512m.
6- Height: 13240 m.
7- Block height: 512m.
8- Type: Continous.
9- Data type: 8- bits.

10- Compression: Run Length Encoding.
11- Pyramid Layer Algorithm: ErdasBions(3*3)
12- Range: (0-255) , Min:0 , Max:255 .
13- Mean: 126.383.
14- Median: 128 .
15- Mode: 123 .
16- Standard Deviation: 51.619 .
17- Upper Left X: 156657.7260350 .
18- Upper Right Y: 107715.6192280 .
19- Lower Left X: 161163.7260350 .
20- Lower Right Y: 101096.1192280 .
21- Projection: Transverse Cassini .
22- Spheroid: Clarke 1880 (Benoit) .
23- EPSG Code: 0 .
24- Piel size: 0.5 m.
25- Unit: Meters .

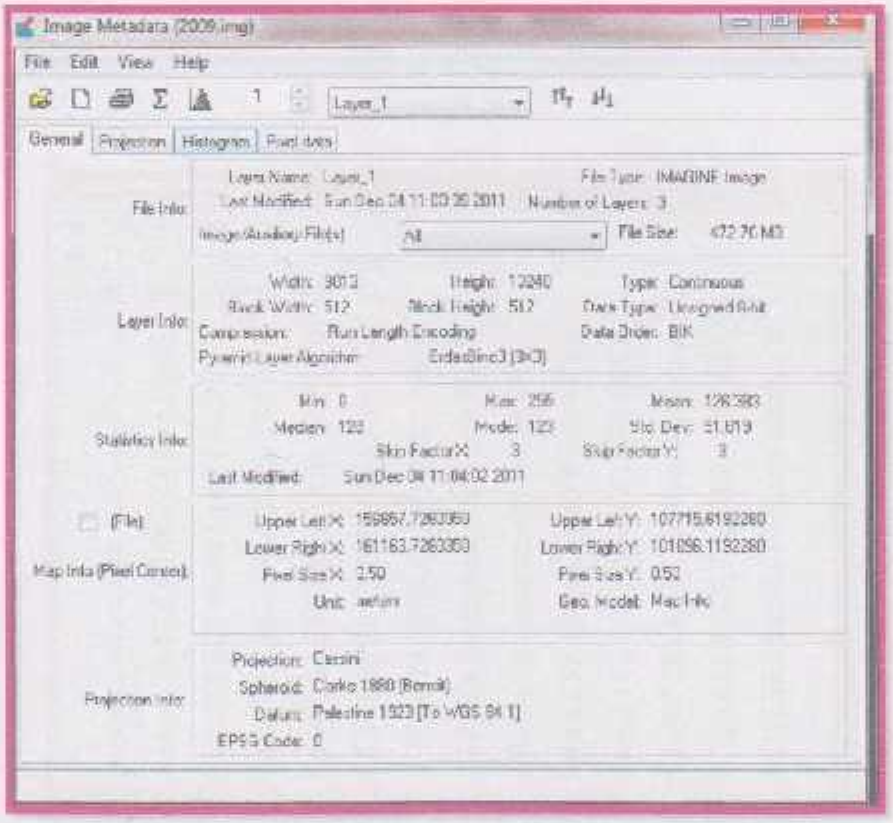


Figure (4.38) Image Metadata "Genral" for processed image 2009

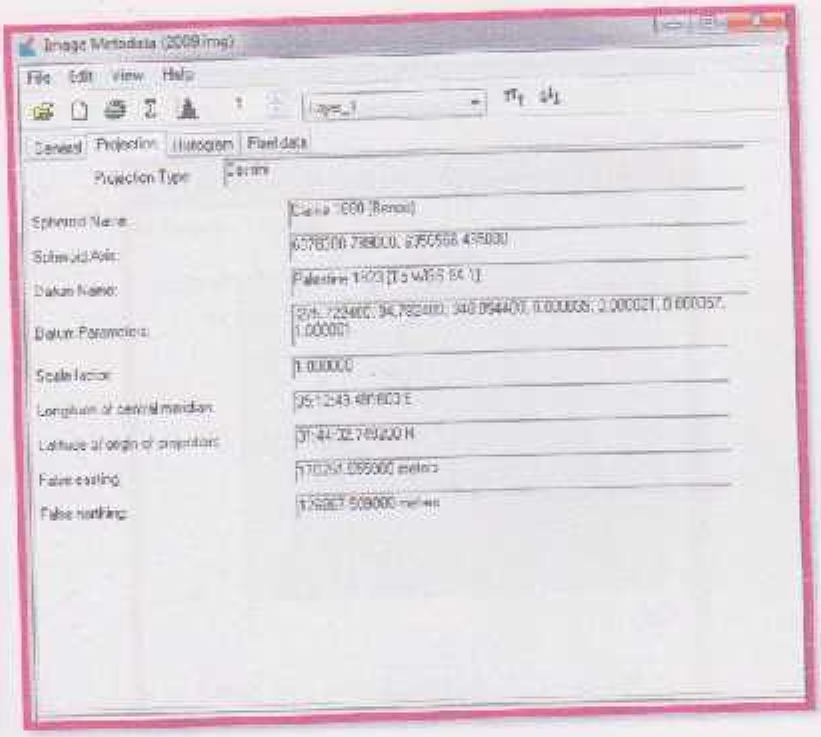


Figure (4.39) Image Metadata "Projection" for processed image 2009

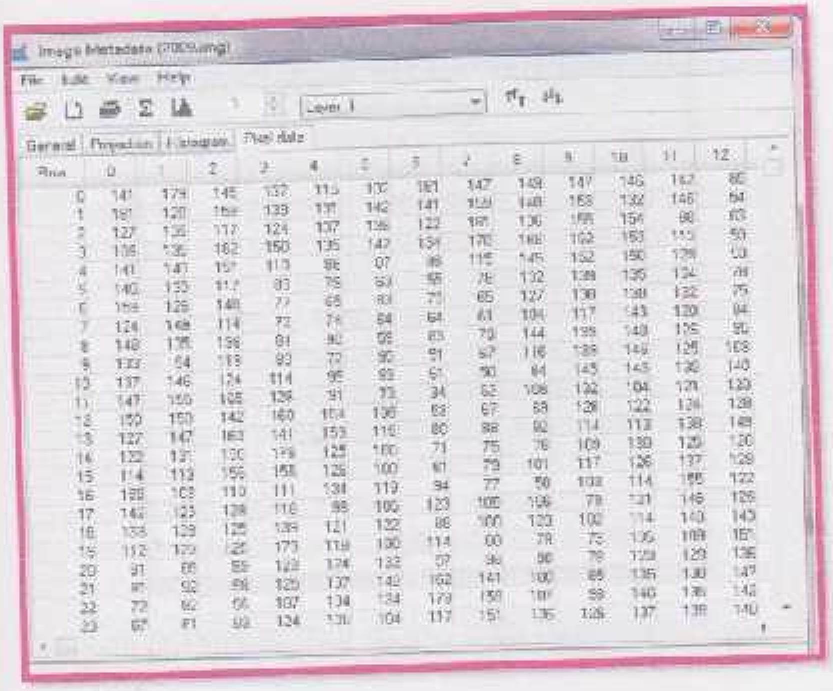


Figure (4.40) Image Metadata "Pixel data" for processed image 2009

4-7-1-2 Histogram For 2009 Image After Processing

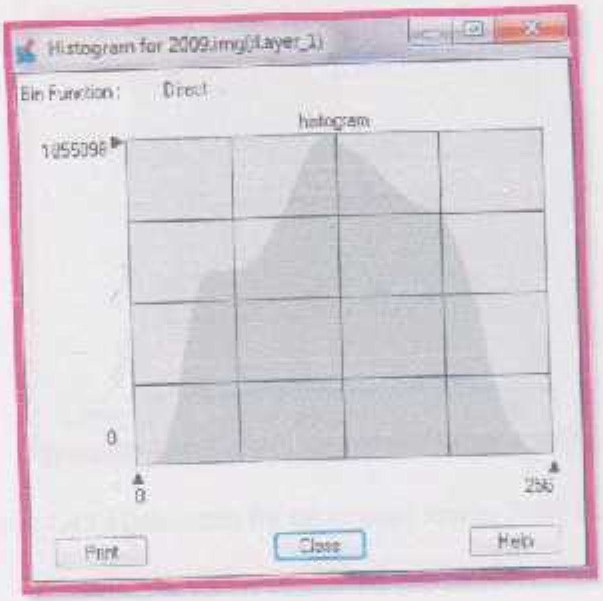


Figure (4.41)Histogram for processed image 2009 (Layer_1)

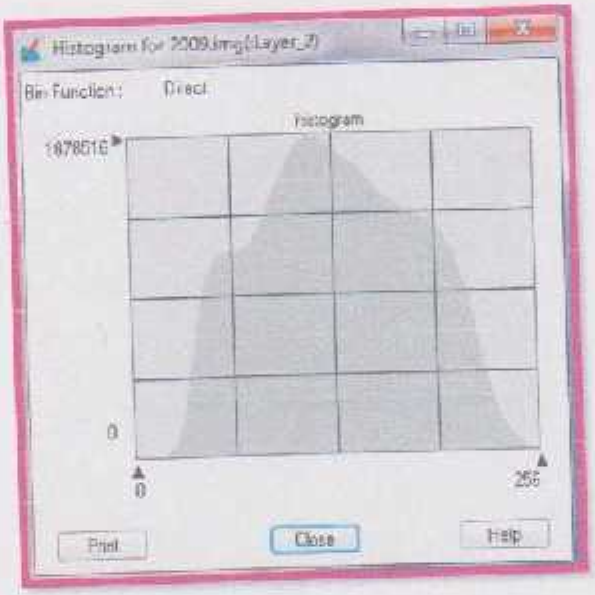


Figure (4.42)Histogram for processed image 2009 (Layer_2)

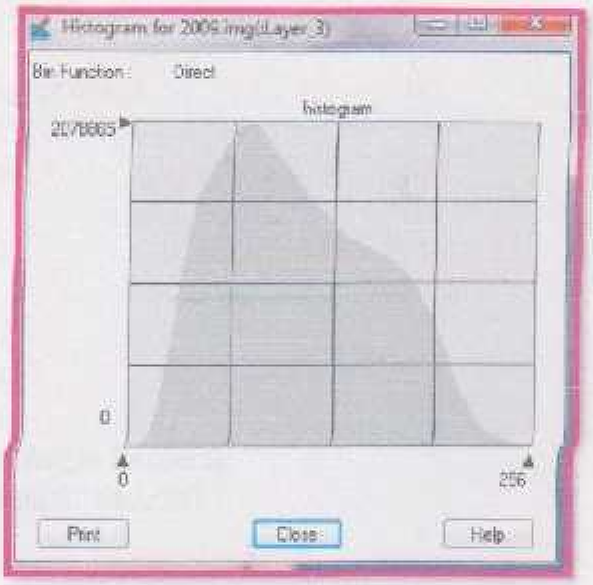


Figure (4.43)Histogram for processed image 2009 (Layer_3)

The Image 2006 After Processing

Figure (4.44) image 2006 after processing

The Properties Of Processed Image 2006

1- Image type: Imagine image.
2- Image size: 429.90 MB.
3- Numbers of layers: 3.
4- Width: 8937.
5- Block width: 512.
6- Height: 11969.
7- Block height: 512.
8- Type: continuous.
9- Data type: 8- bits.
10- Compression: Run length Encoding.
11- Range: (1-255) , Min:0 , Max:247
12- Mean: 88.093.
13- Median: 85.
14- Mode:83.
15- Standard Deviation: 40.981.
16- Upper Left X: 156677.7260350.
17- Upper Right Y: 107662.1192280.
18- Lower Left X: 161145.7260350.
19- Lower Right Y: 1011678.1192280.
20- Projection: Cassini.
21- Spheroid: Clarke 1880 (Benoit).
22- Pixel size: 0.50.
23- Unit: meters.

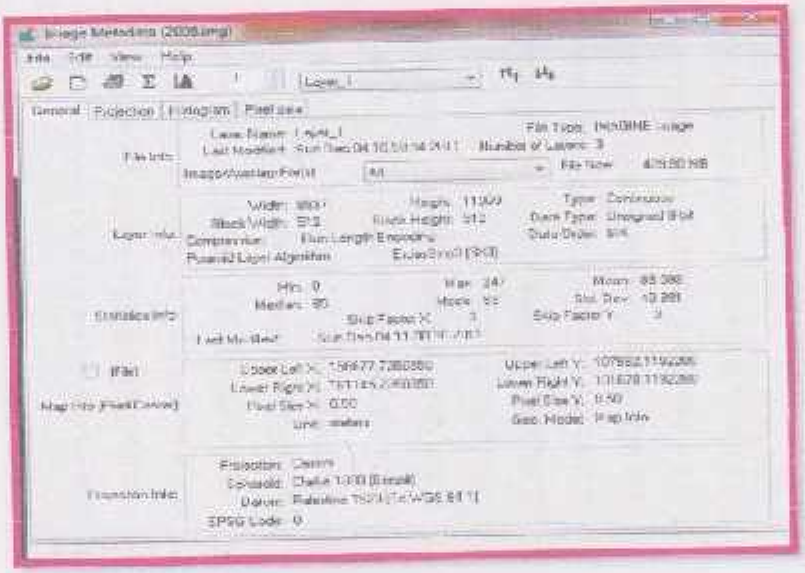


Figure (4.45) Image Metadata "General" for processed image 2006

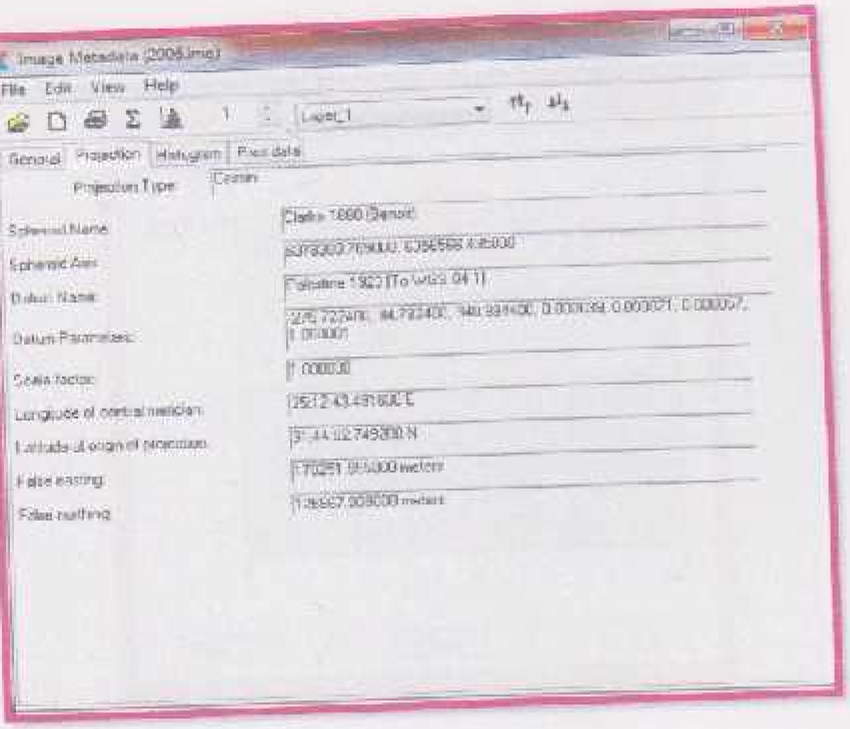


Figure (4.46) Image Metadata "Projection" for processed image 2006

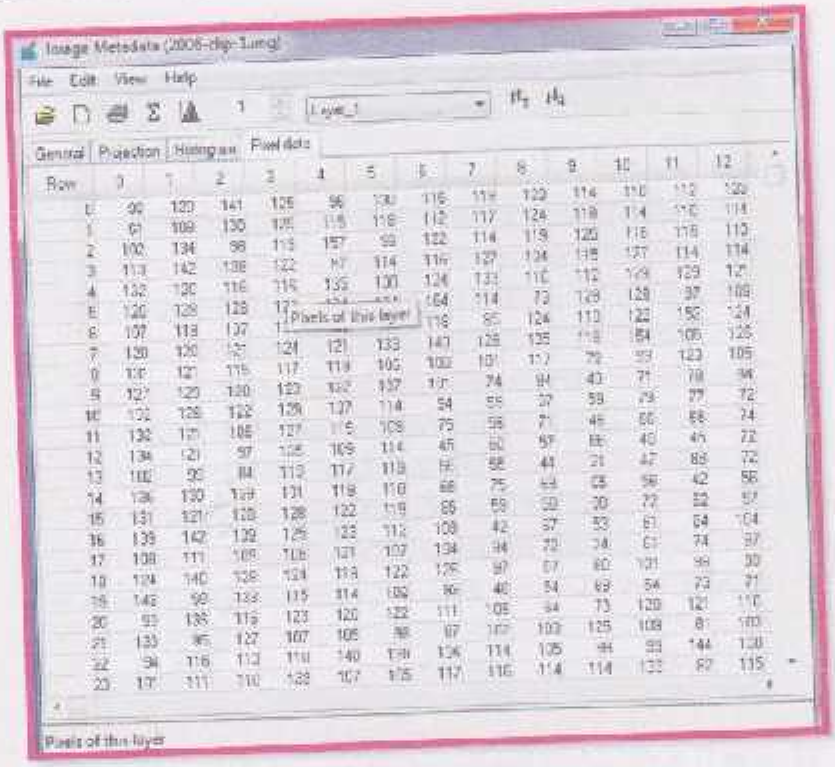


Figure (4.47) Image Metadata "Pixel data" for processed image 2006

4.2.2 Histogram For 2006 Image

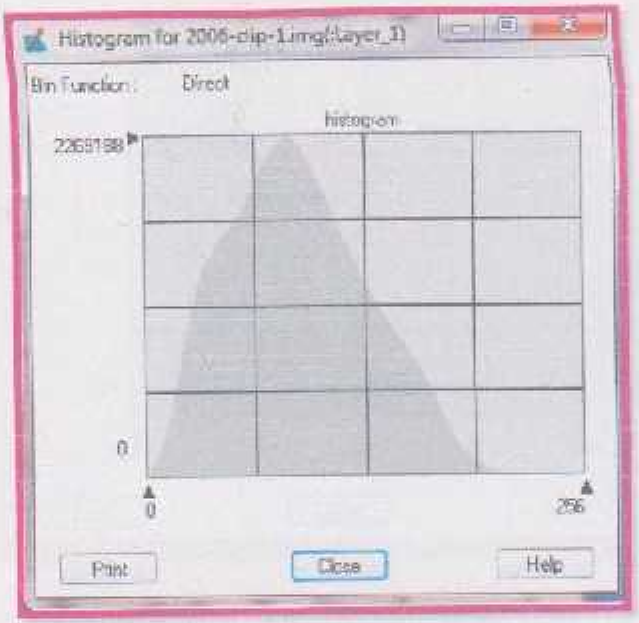


Figure (4.48)Histogram for processed image 2006 (Layer_1)

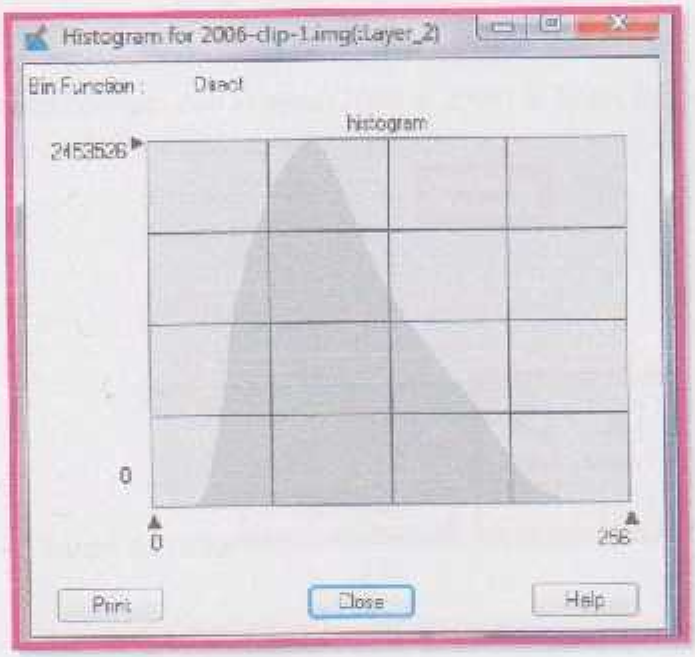


Figure (4.49)Histogram for processed image 2006 (Layer_2)

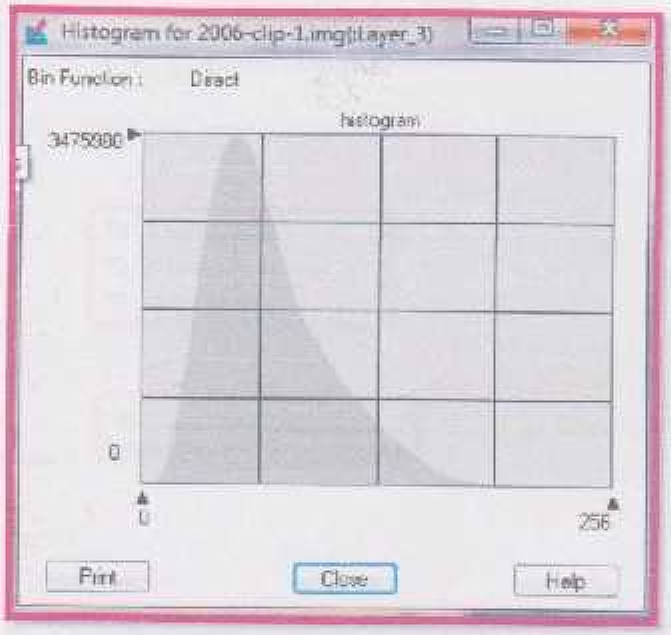


Figure (4.50) Histogram for processed image 2006 (Layer_3)

Change Detection

To make chage detection between two images (2006 & 2009) in Erdas follow these steps :

Select Raster menu

↓

Change detection

↓

Zonal change 

This menu will appear :

Choose image difference

This window will appear:

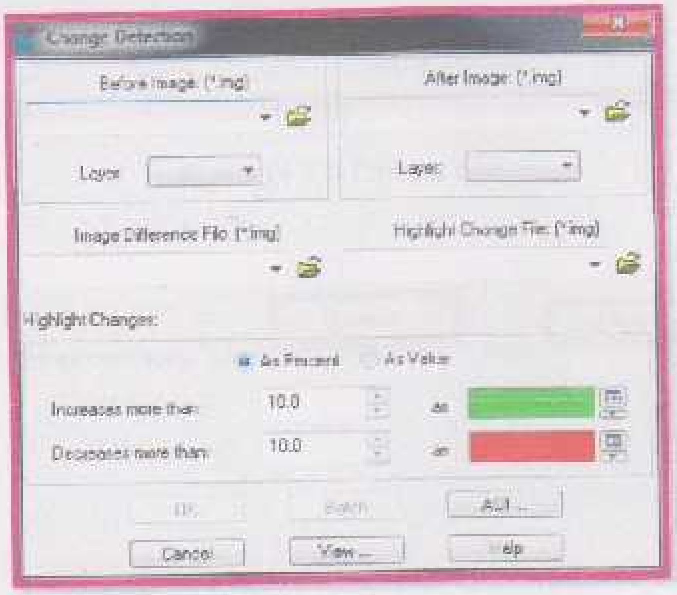


Figure (4.51) Change detection window

Then :

Input before image → (image 2006)

Input after image → (image 2009) 

Then Click Ok. 

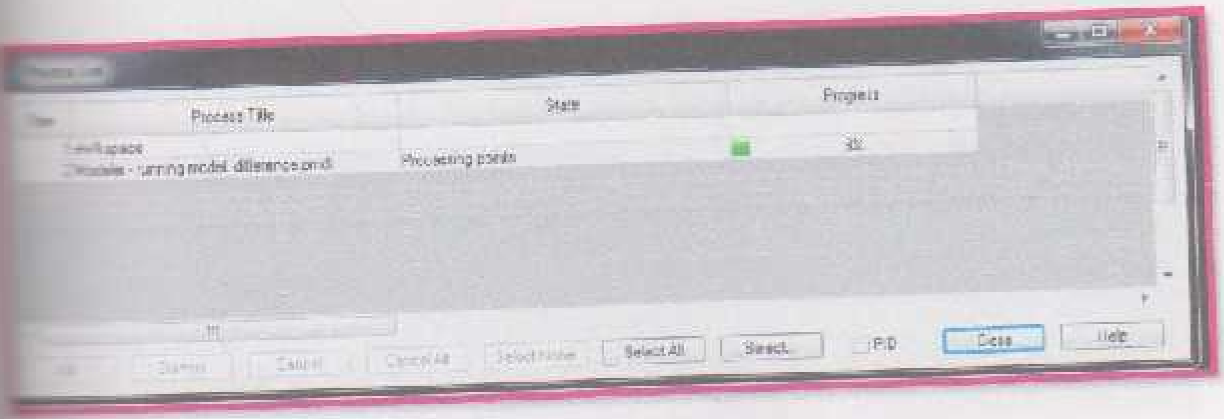


Figure (4.52) Process List

After ERDAS finish the processing click  then 

We will get this map :

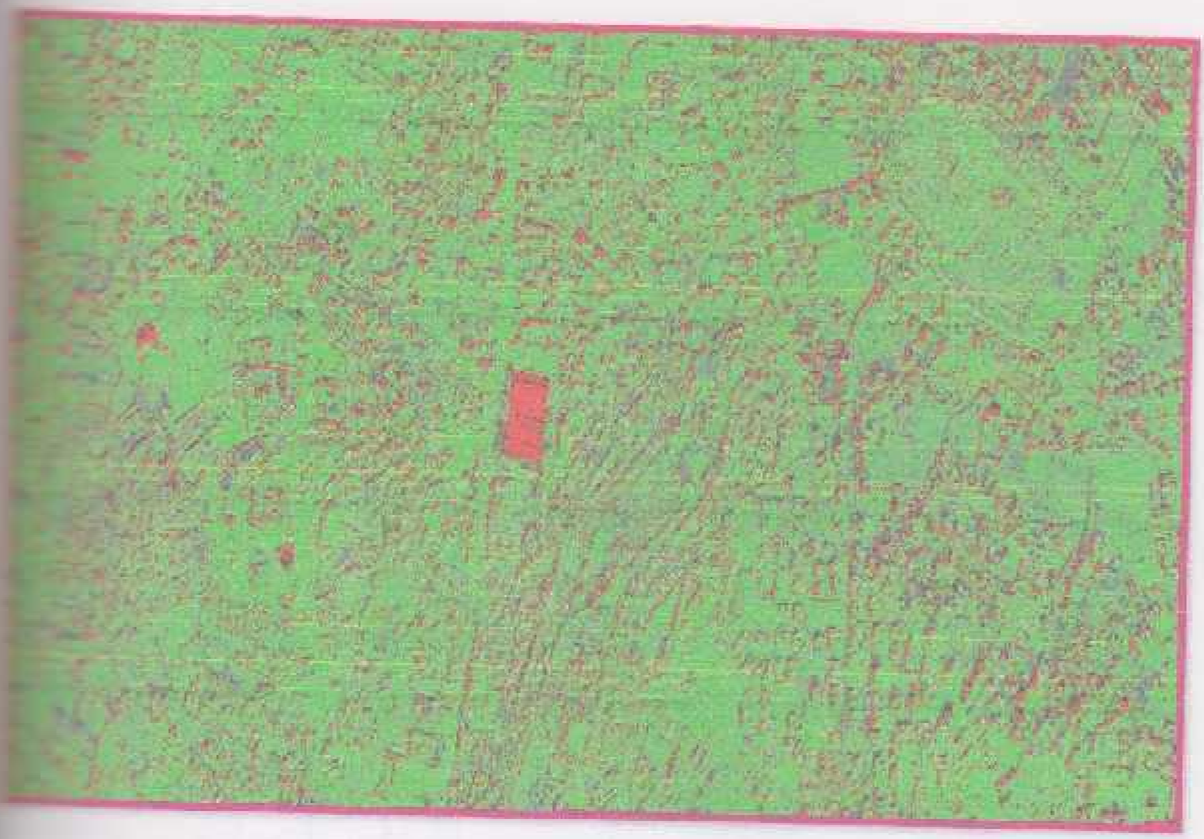


Figure (4.53) Chage Detection Image "highlight image"

Figure (4.54) Chage Detection Image "Gray image"

Mathematical Model

Definition Of Histogram

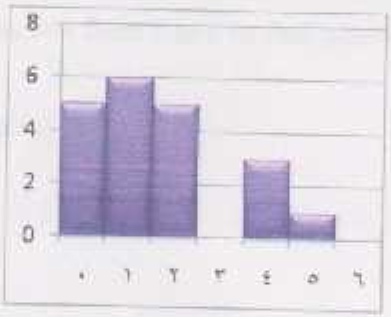
Histograms are functions describing information extracted form the image. The histogram shows how many times a particular grey level (intensity) appears in an image. For each intensity level, its value is equal to the number of the pixels with that intensity.

For example: 0 - black, 255 – white

Examples:

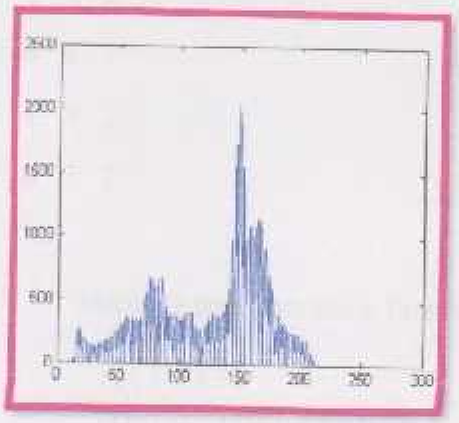
0	1	1	2	4
2	1	0	0	2
5	2	0	0	4
1	1	2	4	1

Image



histogram

Original image



Graph of the histogram function

Figure (5.1) Histogram of images

Histogram Equalization

Histogram equalization : is a technique for adjusting image intensities to enhance contrast.

Transforms the intensity values so that the histogram of the output image approximately matches the flat (uniform) histogram .

Histogram equalisation algorithm: Let $r_k, k = 1,2,...,m$ be the intensities of the image, and let $p(r_k)$ be the normalised histogram function.

The intensity transformation function for histogram equalisation is :

$$T(r_k) = \sum_{j=1}^{k} p(r_k)$$

Summing the values of the normalised histogram function from 1 to k to find where the intensity r_k will be mapped.

Note: The range of the equalised image is the interval [0,1].

Example

A 5x5 image with integer intensities in the range between one and eight (3 bits):

1	8	4	3	4
1	1	1	7	8
8	8	3	3	1
2	2	1	5	2
1	1	8	5	2

Normalised histogram function	Intensity transformation function
$p(r_1) = 0.32$	$T(r_1) = 0.32$
$p(r_2) = 0.16$	$T(r_2) = 0.32 + 0.16 = 0.48$
$p(r_3) = 0.12$	$T(r_3) = 0.32 + 0.16 + 0.12 = 0.60$
$p(r_4) = 0.08$	$T(r_4) = 0.32 + 0.16 + 0.12 + 0.08 = 0.68$
$p(r_5) = 0.08$	$T(r_5) = 0.76$
$p(r_6) = 0.00$	$T(r_6) = 0.76$
$p(r_7) = 0.04$	$T(r_7) = 0.80$
$p(r_8) = 0.20$	$T(r_8) = 1.00$

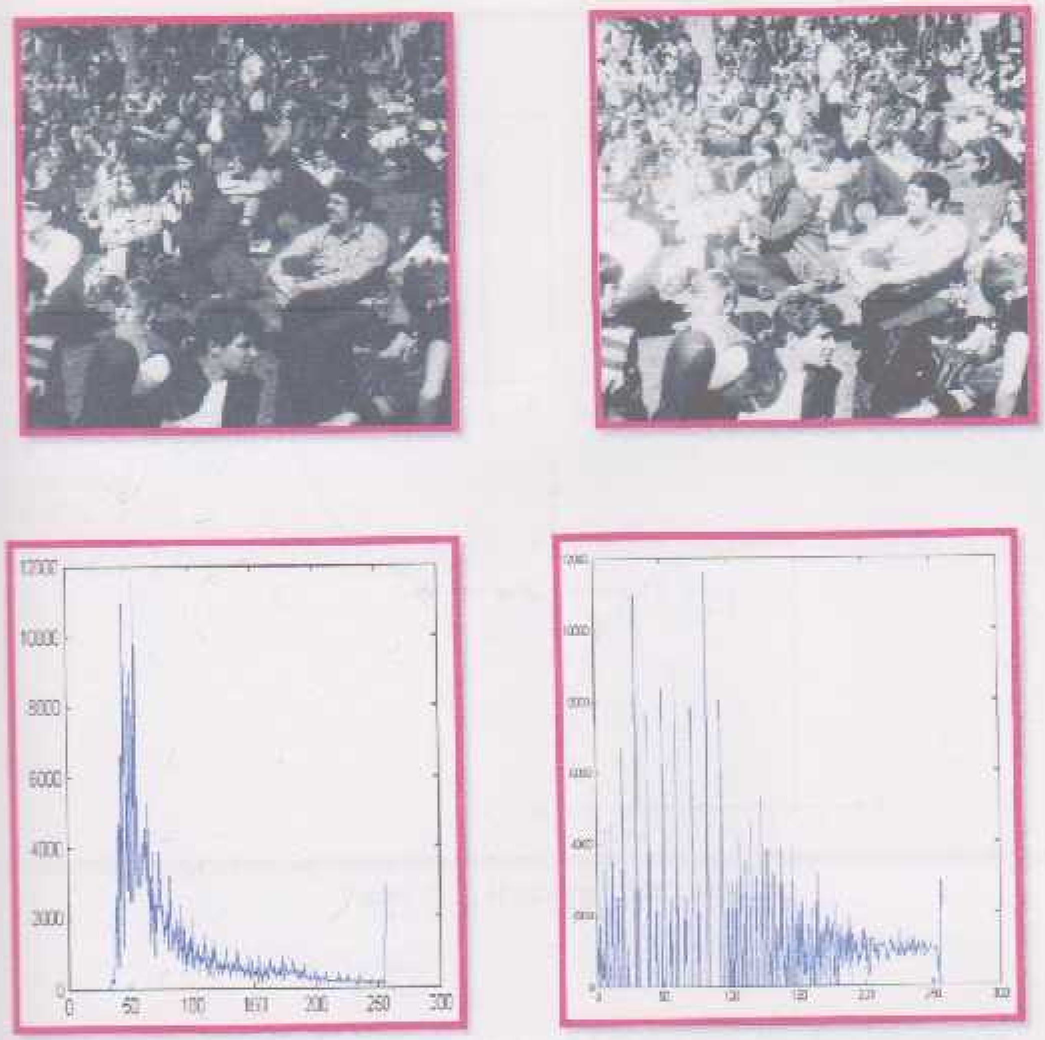


Figure (5.2) Histogram of images

Histogram Matching

method in image processing of color adjustment of two images using the image histograms. can be used to normalize two images, when the images were acquired at the same local illumination (such as shadows) over the same location, but by different sensors, atmospheric conditions or global illumination . It is useful sometimes to be able to specify the shape of the histogram that we wish the processed image to have. The method used to generate a process image that has a specified histogram is called histogram matching or histogram specification .

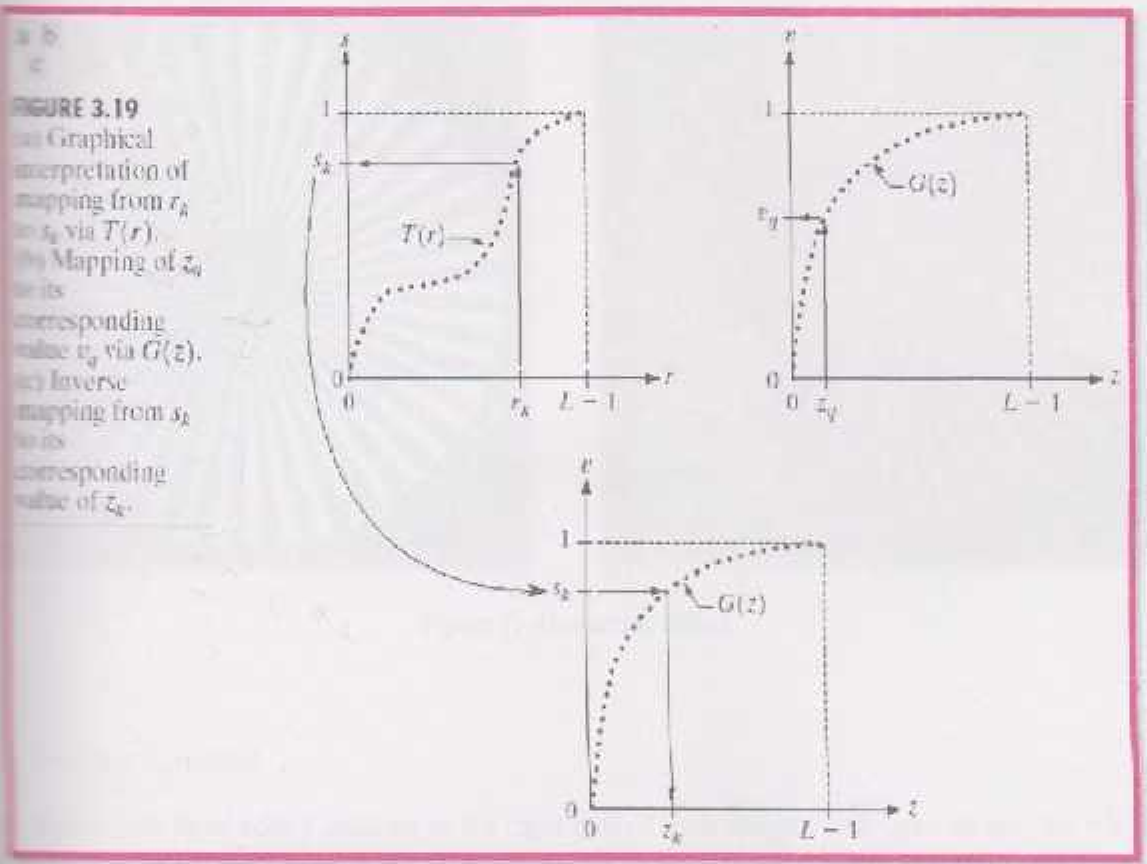


Figure (5.3) Histogram Matching.

function mathematically determines a lookup table that converts the histogram of image to resemble the histogram of another.

Mathematical Model And Algorithm

match the histograms, a lookup table is mathematically derived which serves as a function for converting one histogram to the other.

Brightness and Contrast

Contrast:

defined as the separation between the darkest areas of the image . Increase contrast and you increase the separation between dark and bright , making shadows darker and highlights brighter. Decrease contrast and you bring the shadows up and the highlights down to make them closer to one another. Adding contrast usually adds pop and makes an image look more vibrant while decreasing contrast can make an image look duller.

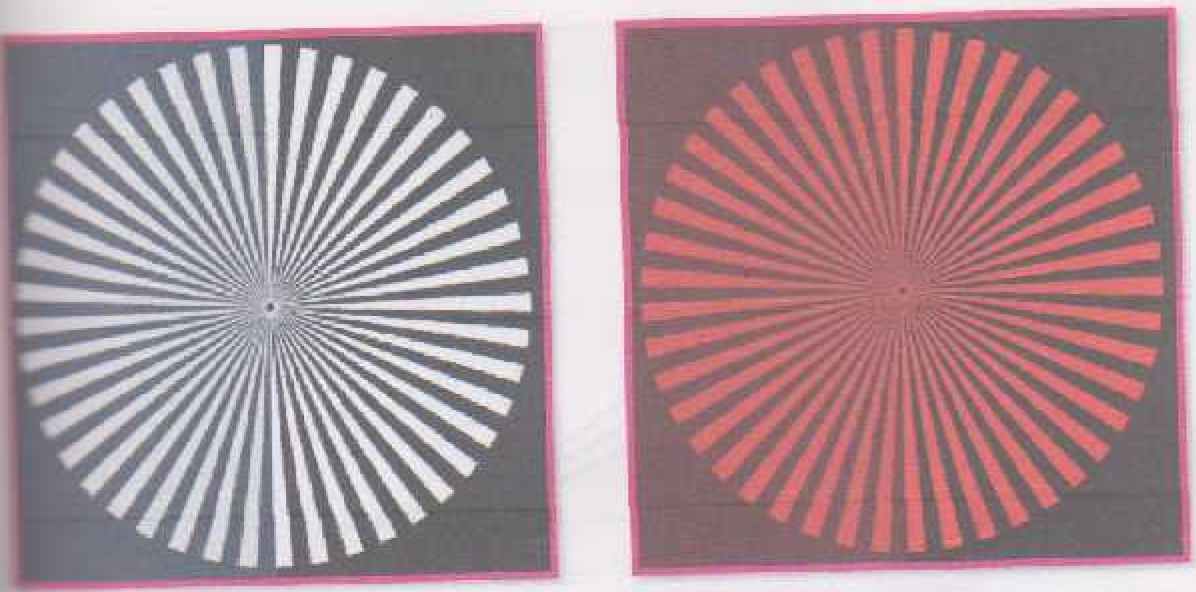


Figure (5.4) contrast Effect

5-2 Increase Contrast

In the figure , we have added contrast to the right half of both images . As you can see, the white red spokes have gotten brighter while the background has gotten darker . This causes the image to look more defined . By making the highlights brighter , however , we have also increased the brightness of the spokes , causing the image to appear brighter since the spokes are the main focus of the image . On the red image, increasing the brightness of the spokes has also increase saturation .

Law of contrast:

New value= (old value- 0.5) * contrast + 0.5

The subtraction and addition of 0.5 is to center the expansion/compression of the range around 50% gray. Specifying a value above 1.0 will increase the contrast by making bright samples brighter and dark samples darker thus expanding on the range used. While a value below 1.0 will do the opposite and reduce use a smaller range of sample values.

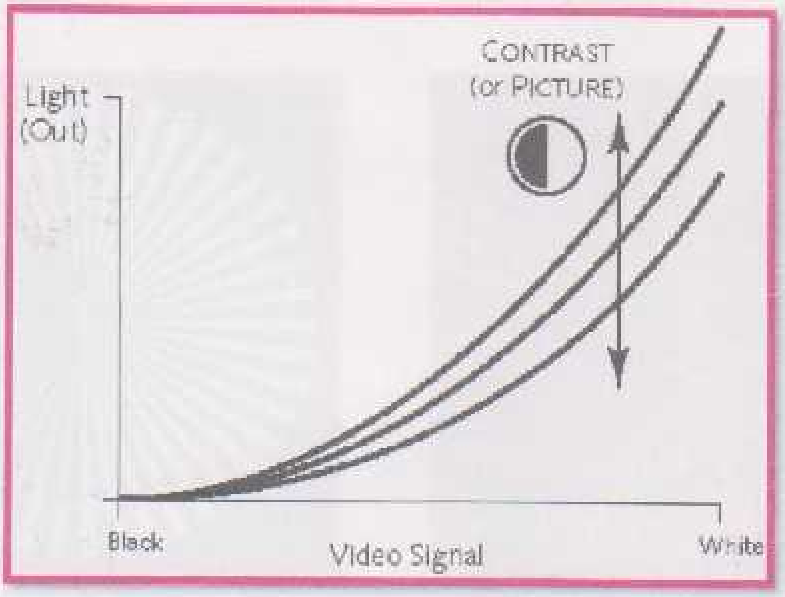


Figure (5.5) contrast control

...figure show the contrast control determines the luminance (proportional to intensity) produced ... with intermediate values toward black being scaled appropriately. In a well-designed ..., adjusting Contrast maintains the correct black setting, indicated in this graph by the fact ... input signal produces zero luminance at any setting.

... Brightness

...ly thought to be the simplest in concept . Just make the image brighter or darker by a ... amount.
... must distinguish between true brightness and something else called "gamma". Increasing ... by moving a mid-tone slider on a histogram is not the same as increasing brightness ... Gamma / mid –tones can make an image look brighter , but it is non-linear in that it only ... brightness of the shadows and mid-tones in an image without affecting the highlights .
... brightness on the other hand , simply brightens the entire image from the shadows to the ... equally.
...cally it is expressed as:

... Brightness:

...= old value + brightness

$G(x,y) = F(x,y) + K$

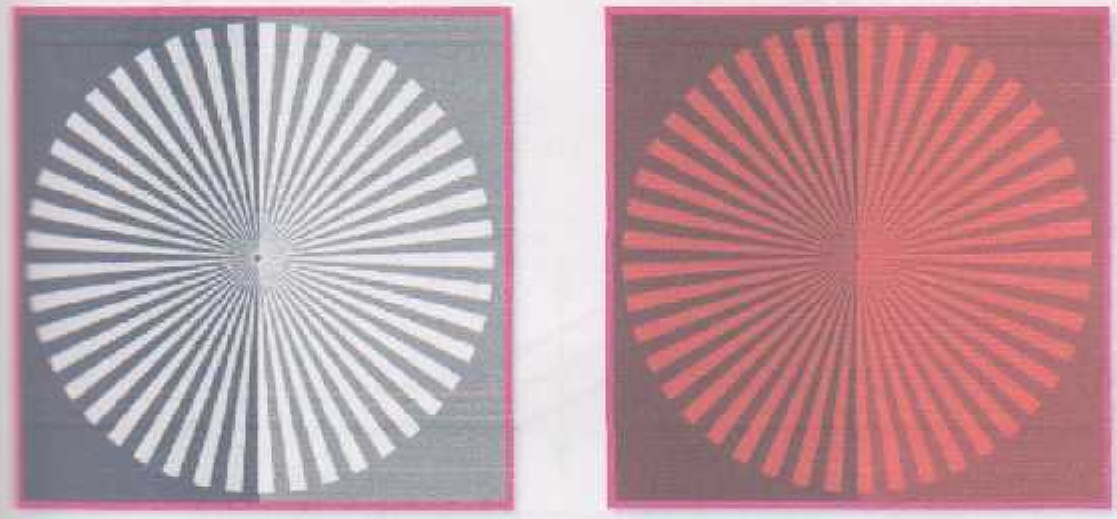


Figure (5.6) Brightness

Decrease Brightness:

New value= old value - brightness

$G(x,y) = F(x,y) - K$

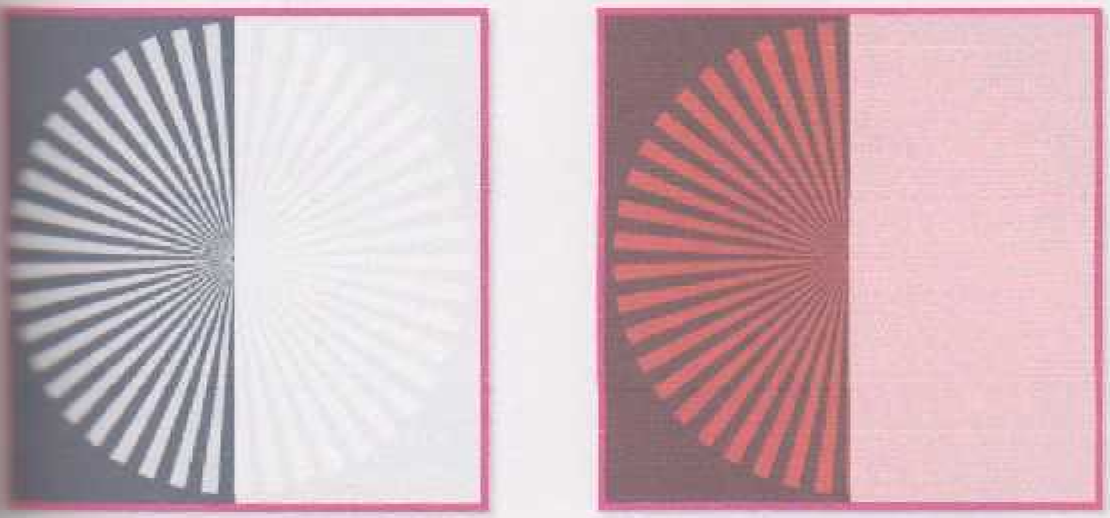


Figure (5.7) Decrease brightness

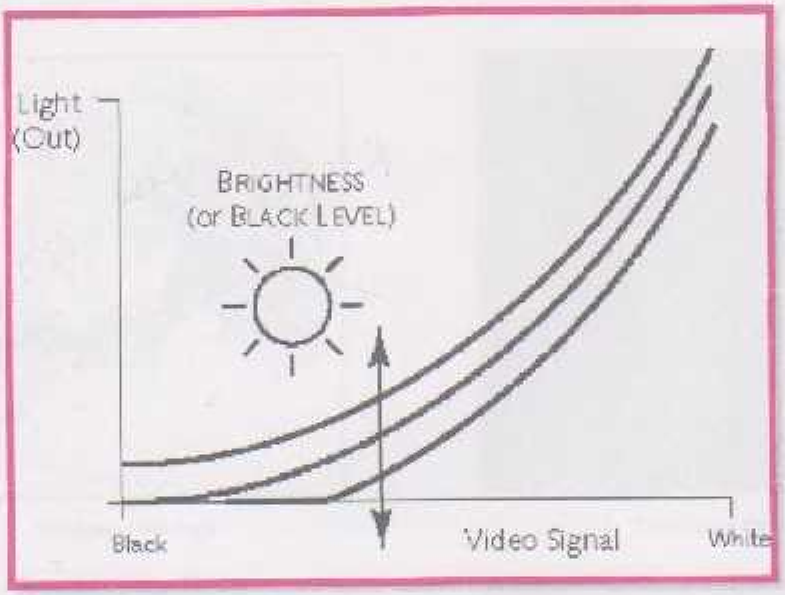
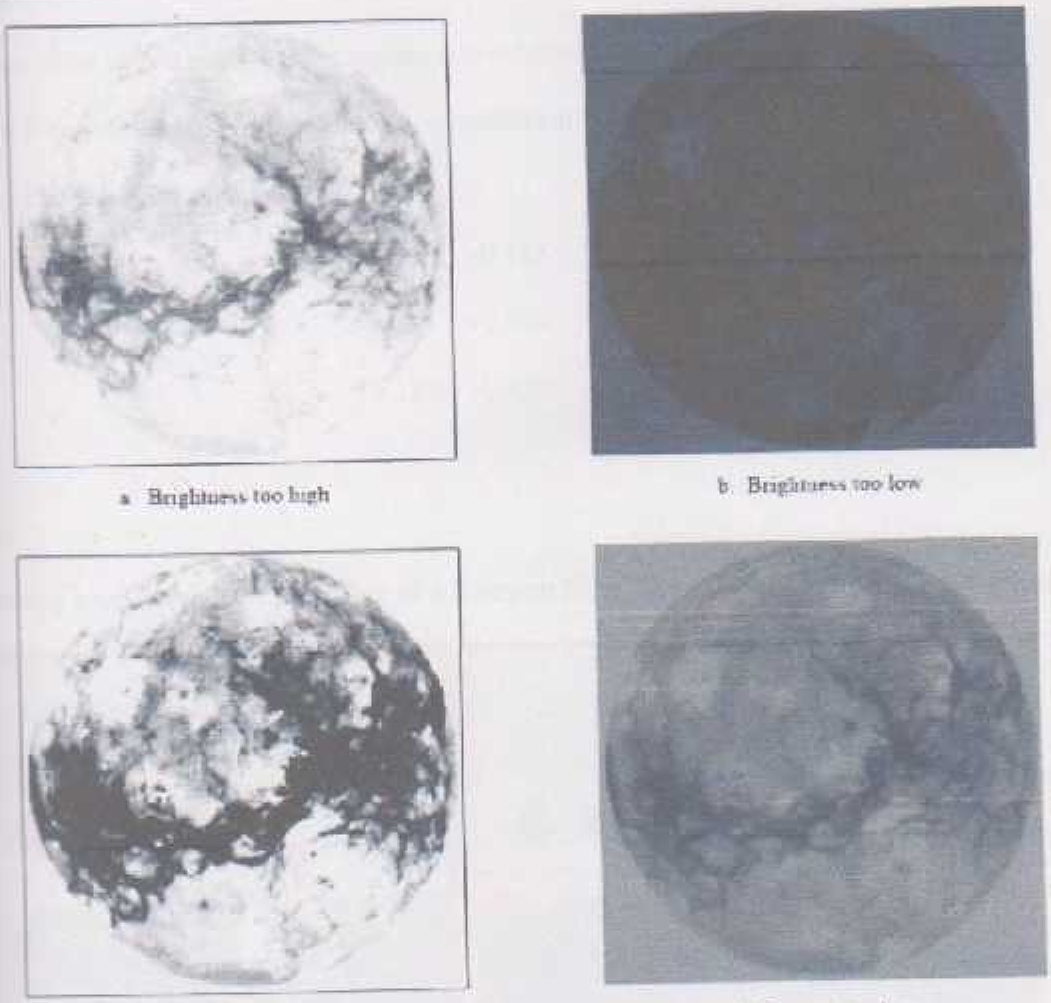


Figure (5.8) Brightness control

Figure: brightness control raises or lowers the entire curve with respect to light output. Although luminance reproduced for any input signal is affected by the setting of the control, its most pronounced effect is at the lower end of the scale, near black. In electrical terms, brightness controls the bias or offset of the video signal.



a. Brightness too high

b. Brightness too low

c. Contrast too high

d. Contrast too low

FIGURE 23-10
Brightness and contrast adjustments. Increasing the *brightness* makes every pixel in the image becomes lighter. In comparison, increasing the *contrast* makes the light areas become lighter, and the dark areas become darker. These images show the effect of misadjusting the brightness and contrast.

Figure (5.9) Brightness and contrast adjustments

Sharpen:

sharpen filter enhances using a simple algorithm . This is very compute but can produce ficially over-sharp or over-noisy if not used carefully .

ening is one of the most impressive transformations you can apply to an image since it seems g out image detail that was not there before . What it actually does , however , is to emphasize in the image and make them easier for the eye to pick out – while the visual effect is to make image seem sharper , no new details are actually create

How it work ?

The sharpen filter uses a simple three square convolution to enhance edges.

The matrix filter uses a simple three square convolution to enhance edges .

The matrix for this convolution is:

$$\begin{matrix} -0.125 & -0.125 & -0.125 \\ -0.125 & +2.000 & -0.125 \\ -0.125 & -0.125 & -0.125 \end{matrix}$$

Example:

The following examples show the effect of a Sharpen filter applied to a number of different images .

Original Image before Sharpen Filter After Sharpen Filter applied

Figure (5.10) Sharpen

Note that the main effect here has been to enhance noise rather than improve quality.

Low Pass Filtering

A low pass filter is the basis for most smoothing methods. An image is smoothed by decreasing the disparity between pixel values by averaging nearby pixels .

Using a low pass filter tends to retain the low frequency information within an image while reducing the high frequency information. An example is an array of ones divided by the number of elements within the kernel, such as the following 3 by 3 kernel:

$$\begin{bmatrix} 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \end{bmatrix}$$

Note:

The above array is an example of one possible Kernel for a low pass filter . Other filters may include more weighting for the center point , or have different smoothing in each dimension .

The properties of low pass filter:

1- It is designed to emphasize larger, homogenous areas of similar tone.
2- Reduce the smaller detail in an image.
3- Serve to smooth the appearance of an image.
4- Reduce the differenace between digital number in image.
5-

High Pass Filtering

A high pass filter is the basis for most sharpening methods. An image is sharpened when contrast is enhanced between adjoining areas with little variation in brightness or darkness.

A high pass filter tends to retain the high frequency information within an image while reducing the low frequency information. The kernel of the high pass filter is designed to increase the brightness of the center pixel relative to neighboring pixels. The kernel array usually contains a single positive value at its center, which is completely surrounded by negative values. The following array is an example of a 3 by 3 kernel for a high pass filter:

$$\begin{bmatrix} -1/9 & -1/9 & -1/9 \\ -1/9 & 8/9 & -1/9 \\ -1/9 & -1/9 & -1/9 \end{bmatrix}$$

Note

The above array is an example of one possible kernel for a high pass filter. Other filters may include more weighting for the center point

The properties of high pass filter:

1. Show the small details in the image and increase it .

2. Do the opposite and serve to sharpen the appearance of the detail in an image.

3. It must make low pass filter then apply the high pass filter.

4. Increase the differenace between digital number in image.

5. Large differenace in tones.

Directional Filtering

A directional filter forms the basis for some edge detection methods. An edge within an image is visible when a large change (a steep gradient) occurs between adjacent pixel values. This change in values is measured by the first derivatives (often referred to as slopes) of an image. Directional filters can be used to compute the first derivatives of an image .

Directional filters can be designed for any direction within a given space. For images, x- and y-directional filters are commonly used to compute derivatives in their respective directions. The following array is an example of a 3 by 3 kernel for an x-directional filter (the kernel for the y-direction is the transpose of this kernel

$$\begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$

Note :

The above array is an example of one possible kernel for a x-directional filter. Other filters may include more weighting in the center of the nonzero columns.

Laplacian Filtering

A Laplacian filter forms another basis for edge detection methods. A Laplacian filter can be used to compute the second derivatives of an image, which measure the rate at which the first derivatives change. This helps to determine if a change in adjacent pixel values is an edge or a continuous progression .

Kernels of Laplacian filters usually contain negative values in a cross pattern (similar to a plus sign), which is centered within the array. The corners are either zero or positive values. The center value can be either negative or positive. The following array is an example of a 3 by 3 kernel for a Laplacian filter:

$$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

Note :

The above array is an example of one possible Kermel for a Laplacian filter . Other filters may include positive , non zero values in the corners and more weighting in the centered cross pattern

Original image

Low Pass Filtered

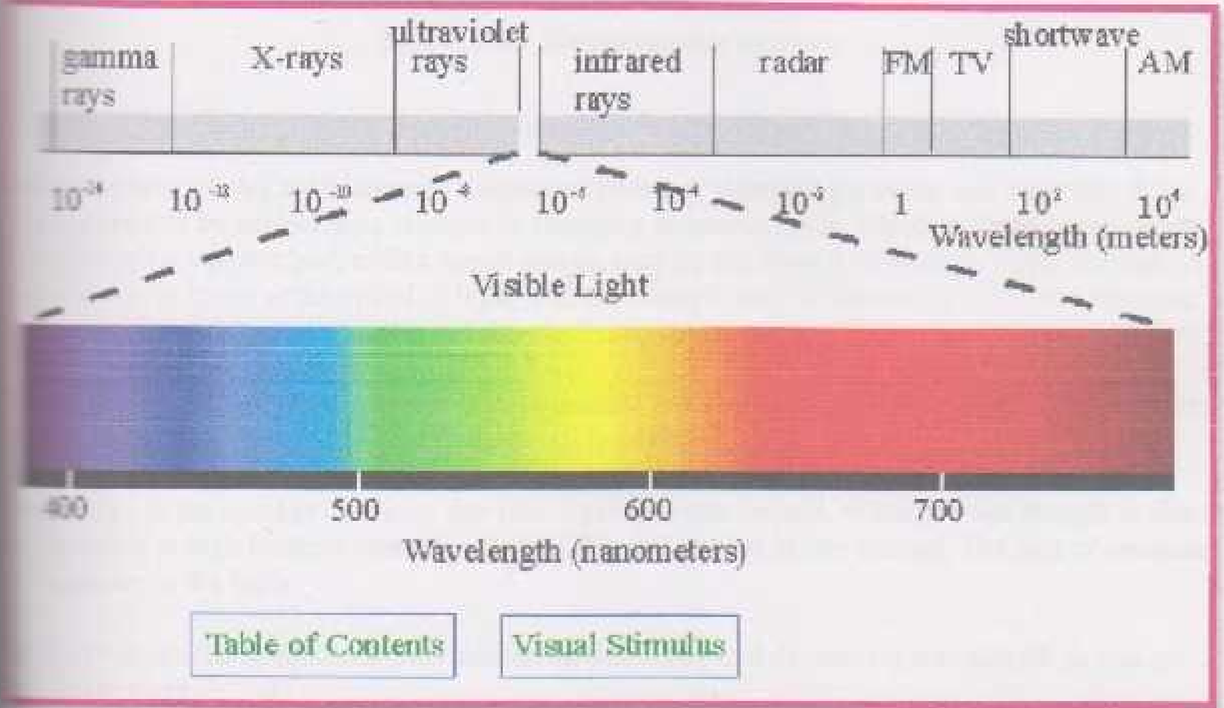
high Pass Filtered

Direction Pass Filtered

Laplacian Pass Filtered

Figure (5.11) Filters

The electromagnetic spectrum:



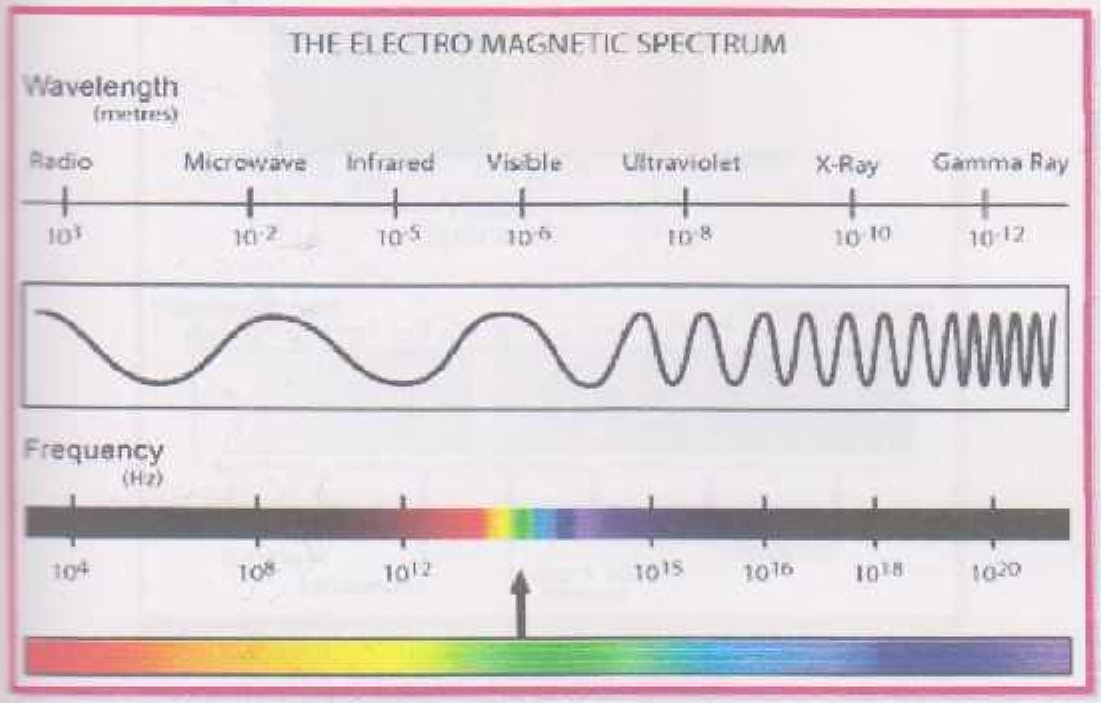


Figure (5.12) Electromagnetic spectrum

Electromagnetic waves are transverse waves composed of alternating electric and magnetic fields. They are created by accelerating charges or changing magnetic fields. Electromagnetic waves can travel through a vacuum and, unlike sound waves, they do not need a medium to travel through. All magnetic waves travel at the speed of light. The wavelength and the frequency of electromagnetic waves vary depending on the portion of the electromagnetic spectrum being investigated.

Wavelength : is the distance between two equivalent parts of the wave (two troughs or two crests). The unit of measure is the meter and the symbol is lambda .

Frequency : is the number of waves that pass a point in one second. When the wavelength is short, the frequency is high because more waves pass through a point in one second. The unit of measure of frequency is the hertz .

The electromagnetic spectrum shows increasing frequency and decreasing wavelength as you go from left to right .

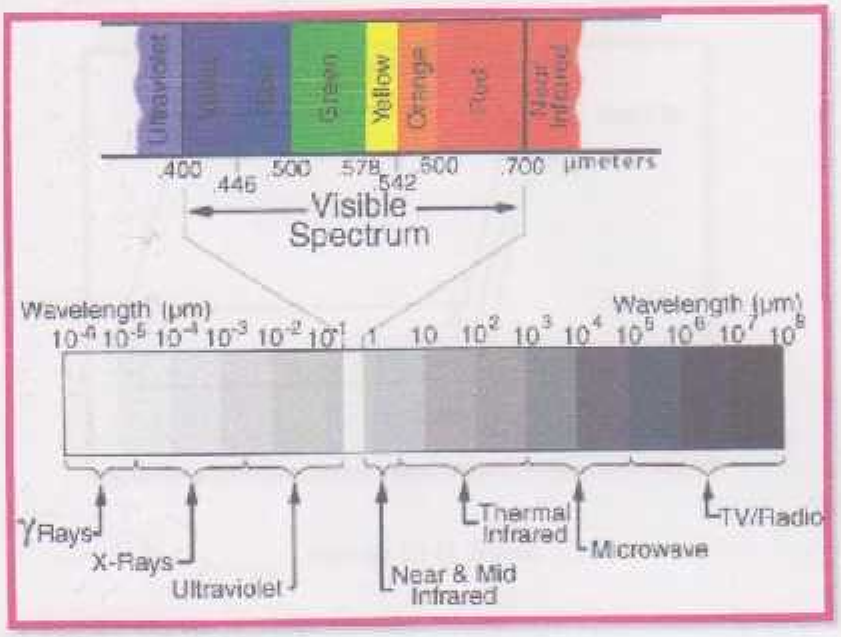


Figure (5.13) Visable spectrum

- Violet: 0.4-0.446 μm .
- Blue: 0.446-0.500 μm .
- Green: 0.500-0.578 μm .
- Yellow: 0.578-0.592 μm .
- Orange: 0.592-0.620 μm .
- Red: 0.620-0.7 μm .
- Color Infrared: 0.7-0.9 μm .

2 Bands :

Image data may include several bands of information. Each band is a set of data file values for a specific portion of the electromagnetic spectrum of reflected light or emitted heat (red, green, blue, near-infrared, infrared, thermal, etc.) or some other user-defined information created by combining or enhancing the original bands, or creating new bands from other sources.

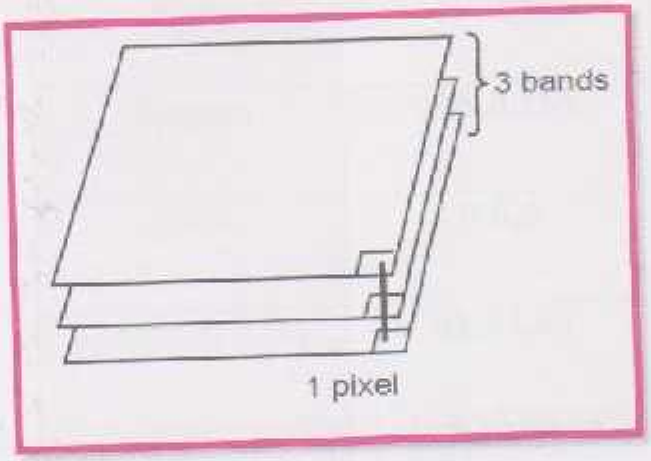


Figure (5.14) Bands

RGB (Red-Green-Blue) Color System:

RGB is perhaps the most widely used color system in image formats today. It is an additive system in which varying amounts of the colors red, green, and blue are added to black to produce new colors. Graphics files using the RGB color system represent each pixel as a color triplet--three numerical values in the form (R,G,B), each representing the amount of red, green, and blue in the pixel, respectively. For 24-bit color, the triplet (0,0,0) normally represents black, and the triplet (255,255,255) represents white. When the three RGB values are set to the same value--for example, (63,63,63) or (127,127,127), or (191,191,191)--the resulting color is a shade of gray.

None of these is widely used in graphics file

Color	RGB
Red	255,0,0
Yellow	255,255,0
Green	0,255,0
Cyan	0,255,255

Blue	0,0,255
Magenta	255,0,255
Black	0,0,0
Shades of Gray	63,63,63
of	127,127,127
Gray	191,191,191
White	255,255,255

Table (5.1) Equivalent RGB, CMY, and HSV values

Resampling Methods

- Nearest neighbor.
- Bilinear interpolation.
- Cubic convolution.
- Cubic spline interpolation.
- Radially symmetric kernels.

Nearest-neighbor Resampling

Nearest neighbor is the most basic and requires the least processing time of all the interpolation algorithms because it only considers one pixel – the closest one to the interpolated point . This has the effect of simply making each pixel bigger .

-Set the intensity at (the intensity at (X,Y X,Y)) to the intensity of the pixel to the intensity of the pixel closest to it: [round(X), round(Y)].

-This method is very fast, but it produces aliasing effects along edges.

5-2 Bilinear interpolation

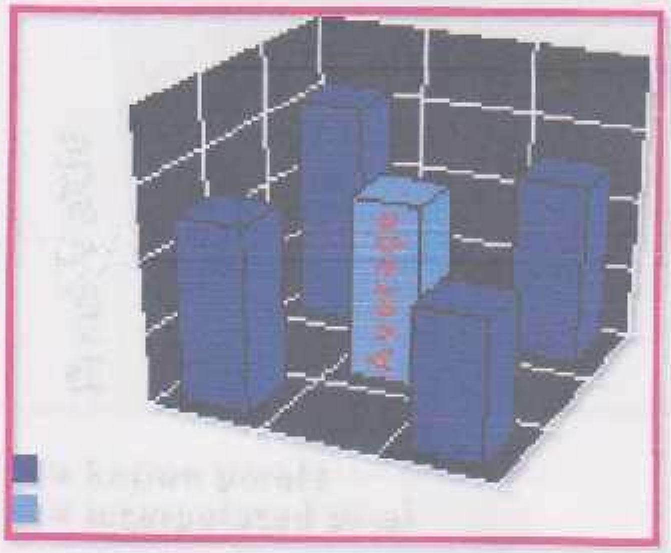


Figure (5.15) Bilinear interpolation

Bilinear interpolation considers the closest 2*2 neighborhood of known pixel values surrounding the unknown pixel . It then takes a weighted average of these 4 pixels to arrive at its final interpolated value. This results in much smoother looking images than nearest neighbor .

Mathematical model :

Assuming u and v are integer parts of X and Y, respectively, bilinear interpolation is defined by

$$I(X,Y)=W_{u,v}I(u,v)+W_{u+1,v}I(u+1,v)+W_{u,v+1}I(u,v+1)+W_{u+1,v+1}I(u+1,v+1)$$

where:

$$W_{u,v}=(u+1-X)(v+1-Y)$$

$$W_{u+1,v}=(X-u)(v+1-Y)$$

$$W_{u,v+1}=(u+1-X)(Y-v)$$

…-3 Bicubic interpolation :

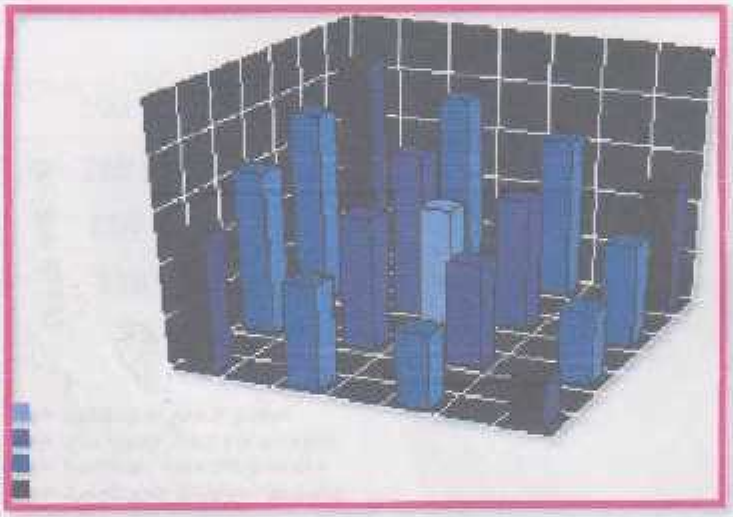


Figure (5.16) Bicubic interpolation

…ic goes one step beyond bilinear by considering the closest 4*4 neighborhood of known pixles … a total of 16 pixles . since these are at various distances from the unknown pixel , closer pixels … a higher weighting in the calculations . Bicubic produces noticeably sharper images than … previous two methods , and is perhaps the ideal combination of processing time and output … .

…matical model :

… convolution can be computed row convolution can be computed row-by-row and then …-by-column.

…ing intensities at u-1, , , , u, u+1, u+2 are I((u-1),), I(u), I(u+1), I(u+2), intensity at X is …ated from

…-1)f-1+I(u)f0+I(u+1)f1+I(u+2)f2

…

…-0.5*t^3 + t^2 -0.5t

…1.5*t^3 -2.5 t^2 +1

…-1.5*t^3 +2 t^2 +0.5t

Z = 0.5*t^3 -0. 5t^2

and t = X – u.

Image problems

1- Floors don't appear in 2006 image ,but in 2009 image they appear as shown below:

Figure (5.17) Sample of 2006 image

Figure (5.18) Sample of 2009 image

This problem did not enable us to make digitizing for modified buildings that have increased their number of floors , and therefore not being able to reveal the new floors are licensed or not.

2- The problems of shadows in the two images 2006 and 2009, as shown below:

Figure (5.19) Sample of 2009 image

Figure (5.20) Sample of 2006 image

This problem caused difficulty in digitizing work.

3- zooming problem as shown below in two images:

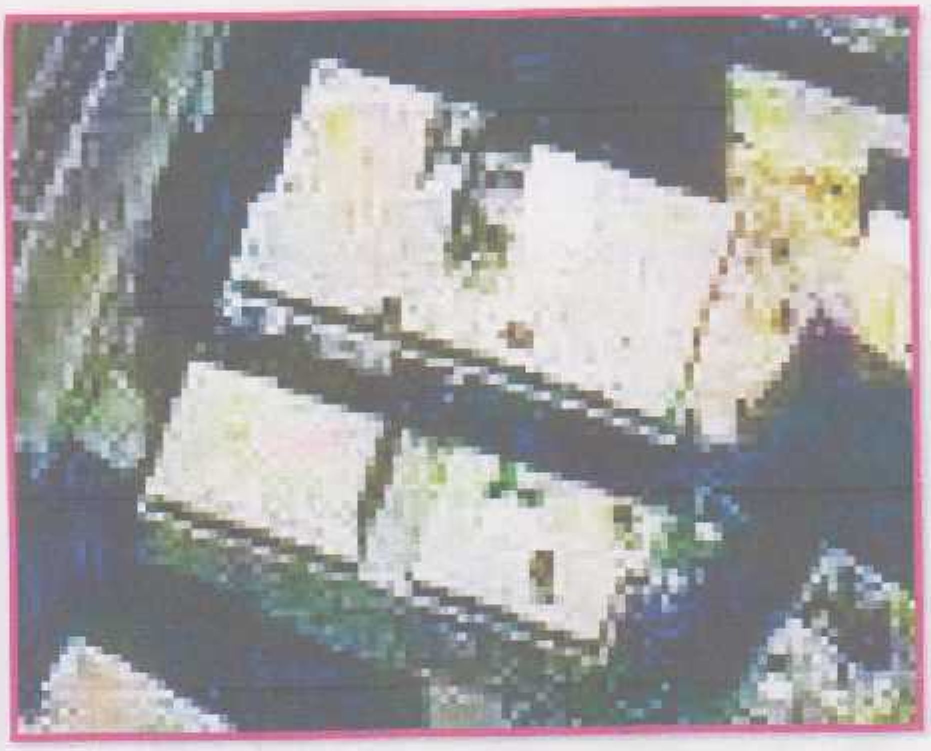


Figure (5.21) Sample of 2006 image

Figure (5.22) Sample of 2009 image

This problem caused difficulty in digitizing work. It was resolved by making resample pixel size in ERDAS by diffrent interpolation types such as bilinear interpolation and cubic convolution. (As shown later)

4- brightness problem.

5- Overlap in some building in some parts of image, as shown below:

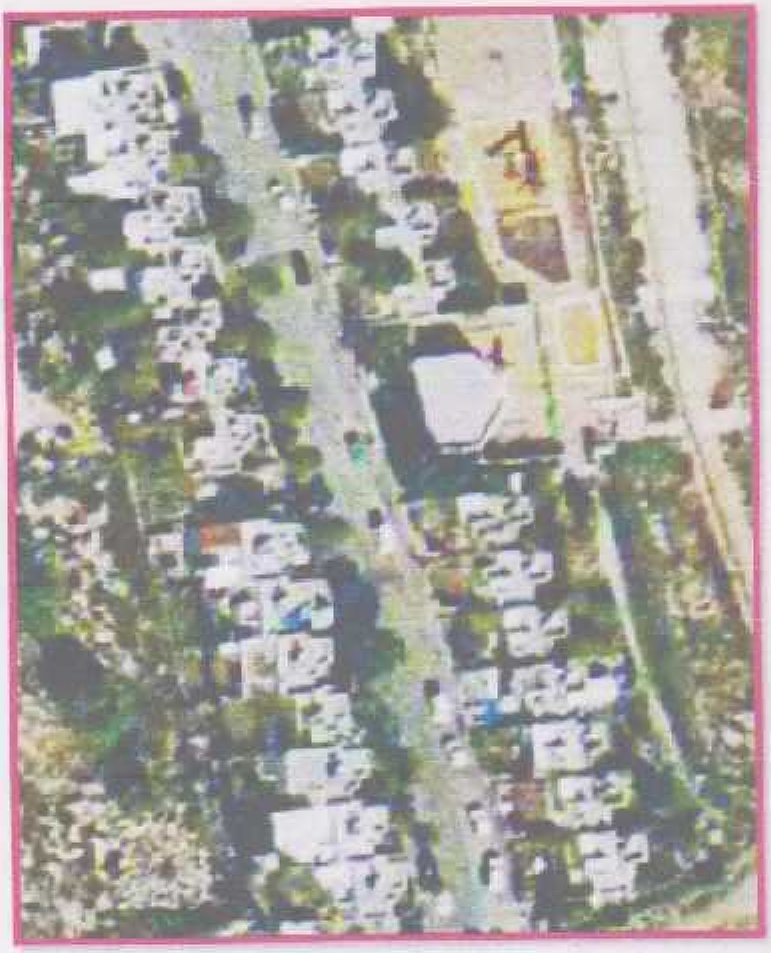


Figure (5.23) Overlap problem

6- Image 2008 is 0.5m pixel size but its appear 1m .
7- Image 2009 is satellite photo but 2006 image is Aerial photo and this make a problem in digitizing .

Working Procedure In Erdas

6-1 Multspectral Menu In Erdas

6-1-1 Enhancement :

General Contrast Menu Orders :

1. General contrast
2. Histogram Equalize
3. Standard Deviation stretch
4. Brightness/ Contrast
5. Photography Enhancements
6. Piecewise Contrast
7. Break points
8. Load Breakpoints
9. Save scaling
10. Data Scaling

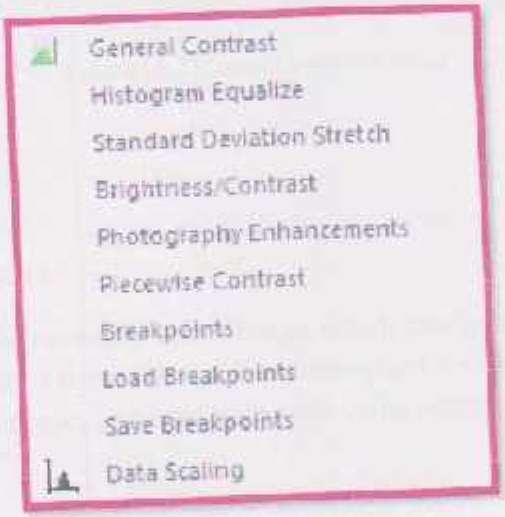


Figure (6.1) Genral contrast menu

6-1-1-1General contrast

Manipulate the brightness , contrast and color display parameters of the currently selected image for enhanced image display .

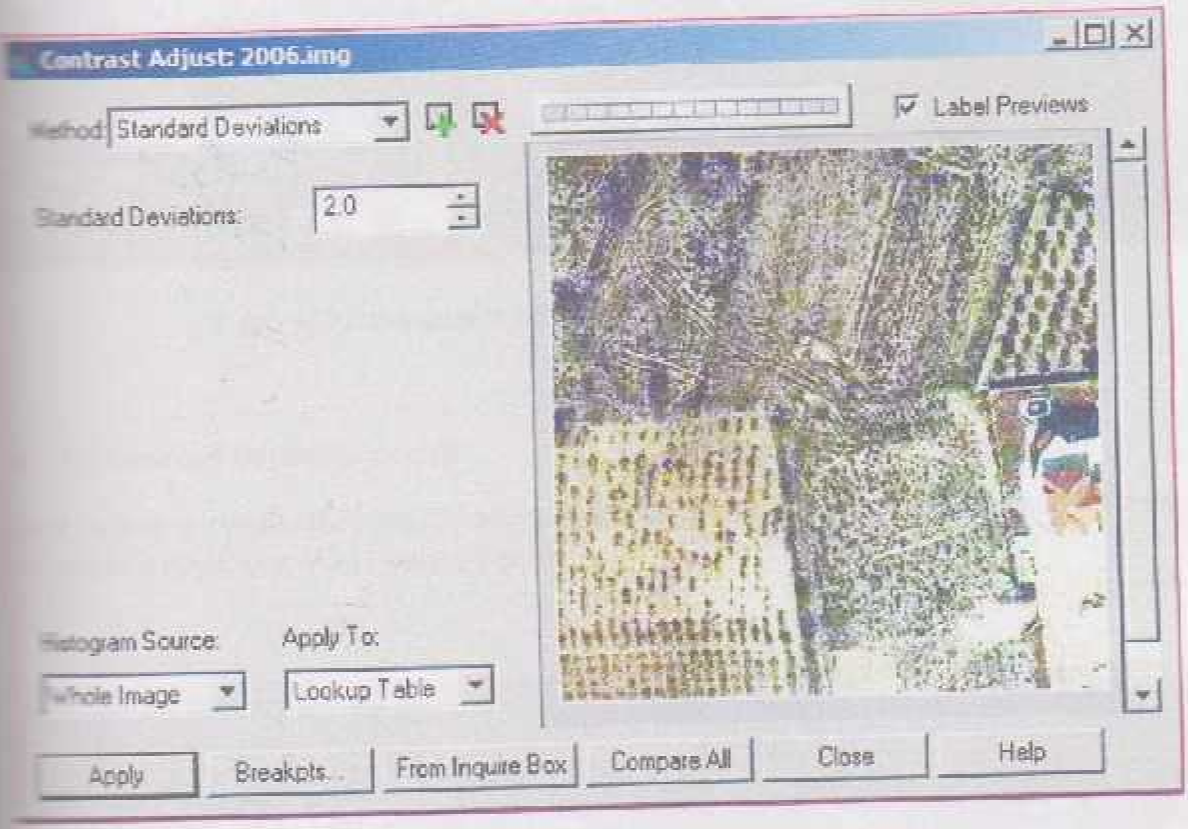


Figure (6.2) Genral contrast order

6-1-1-2 Histogram Equalize

Apply a lookup table to the currently active image which maximizes the contrast of the data by applying a nonlinear contrast stretch that redistributes pixel values so that there are approximately the same number of pixels with each value within a range .

Figure (6.3) Histogram Equalize order for sample of 2006 image

6-1-1-3Standard Deviation stretch

Apply a lookup table to the currently active image which stretches each band linearly between +2 standard deviations and -2 standard deviations .

Figure (6 4) Standard Deviation Strench order for sample of 2006 image

6-1-1-4 Brightness / Contrast

Starts a simple Brightness / Contrast Adjustment tool to adjust the brightness and contrast of the selected image .

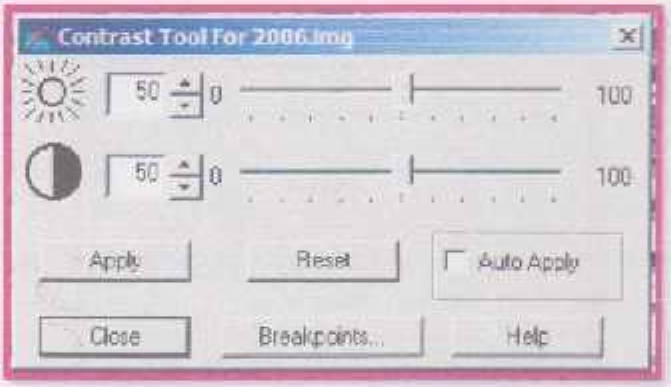


Figure (6.5) Brightness /Contrast order

Figure (6.6) Brightness /Contrast order for sample of 2006 image

6-1-1-5 Photography Enhancements

Starts the Photography Enhancements tool for adjusting the display parameters of the active image..

Figure (6.7) Photography Enhancements order

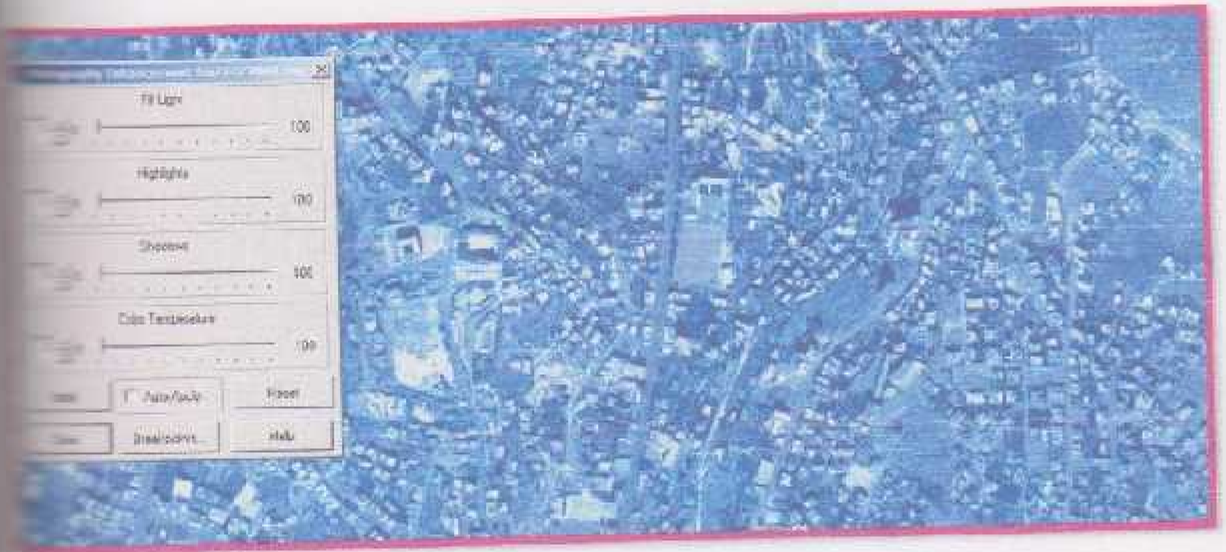


Figure (6.8) Photography Enhancements order for sample of 2006 image

-1-6 Piecewise Contrast

rts a tool to adjust the brightness and contrast of a specified range of the active image .

ee linear ranges can be adjusted per color gun .

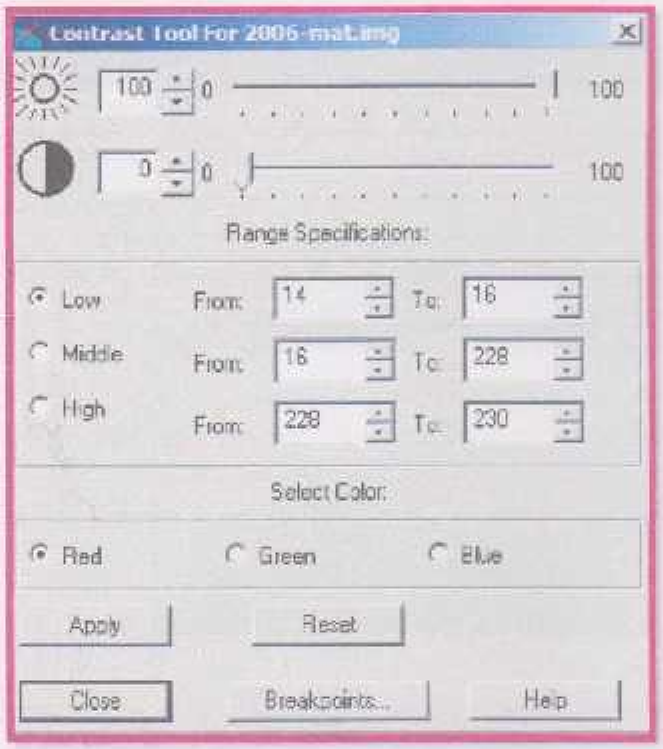


Figure (6.9) Piecewise Contrast order

Figure (6.10) Piecewise Contrast order for sample of 2006 image

6-1-1-7 Break points

Starts the Breakpoints Editor to enable viewing of the active image's histograms and current lookup table and for manual editing of custom lookup table curves .

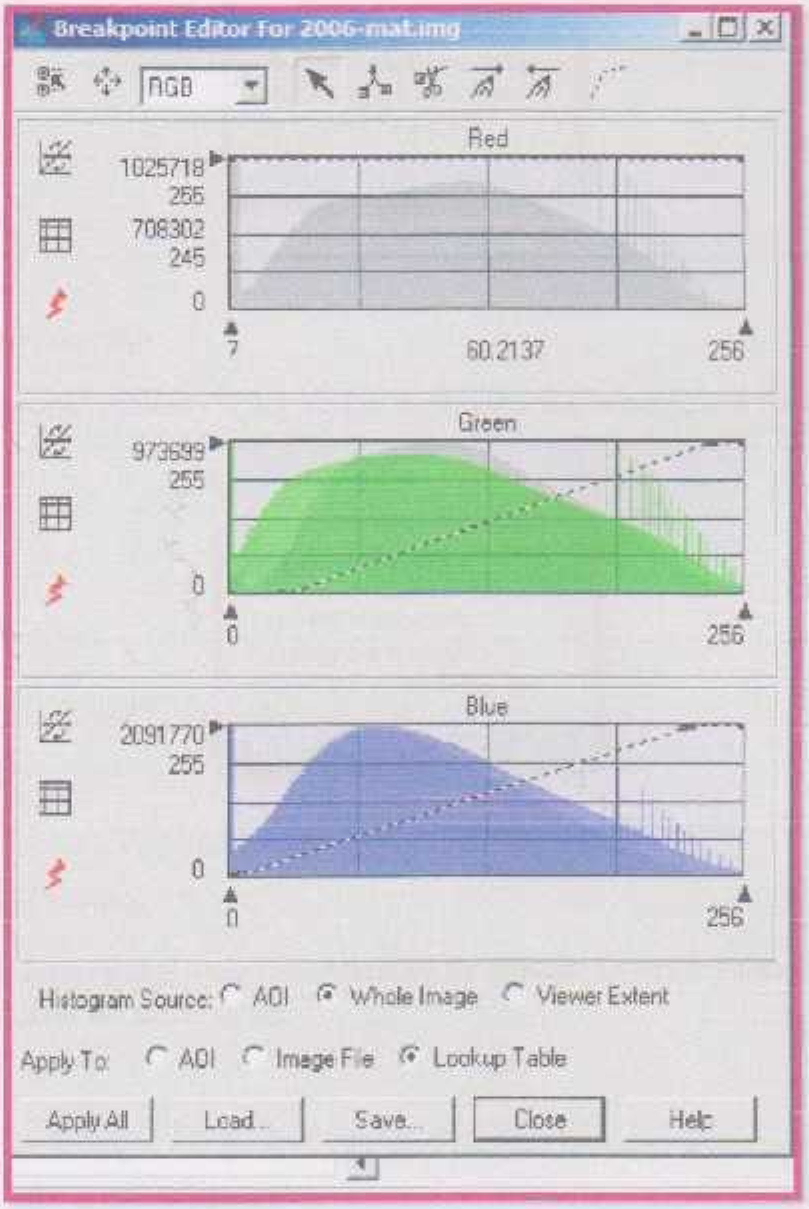
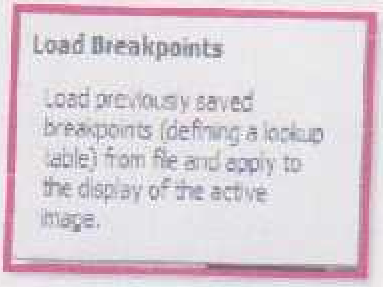


Figure (6.11) Break Point Order

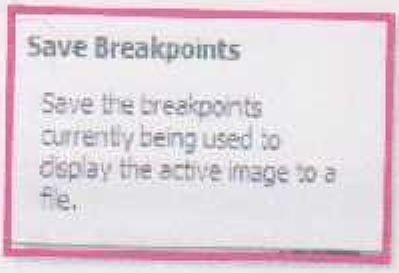
6-1-1-8 Load Breakpoints

Load previously saved breakpoints (defining a lookup table) from file and apply to the display of the active image .



6-1-1-9Save Breakpoints

Save the breakpoints currently being used to display the active image to a file .



6-1-1-10 Data Scaling

Starts the Data Scaling tool . only recommended for advanced users to set the binning type and statistics scaling for the active image .

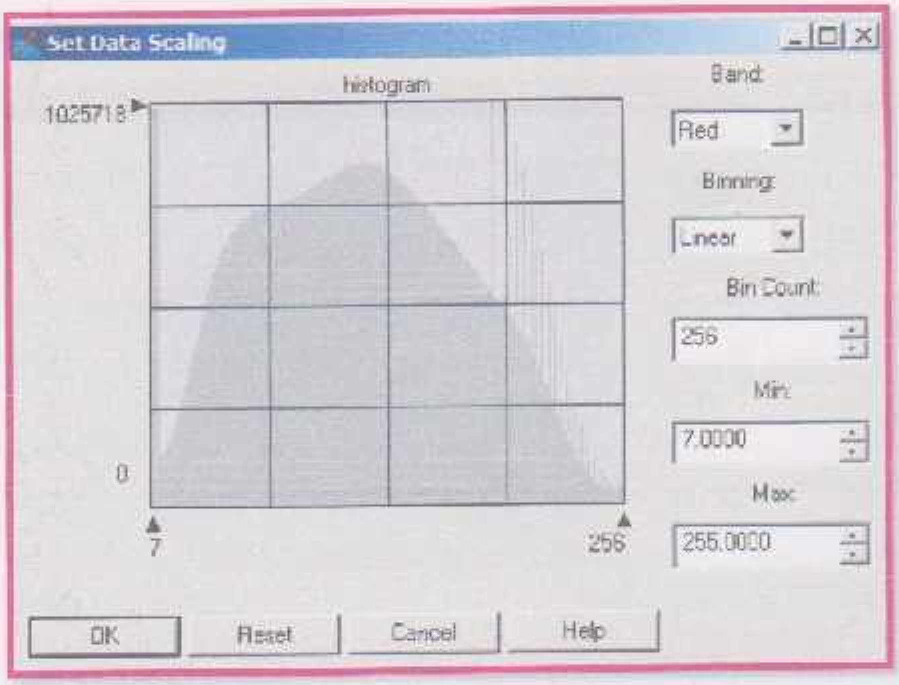


Figure (6.12) Data Scalind for Red Band Order

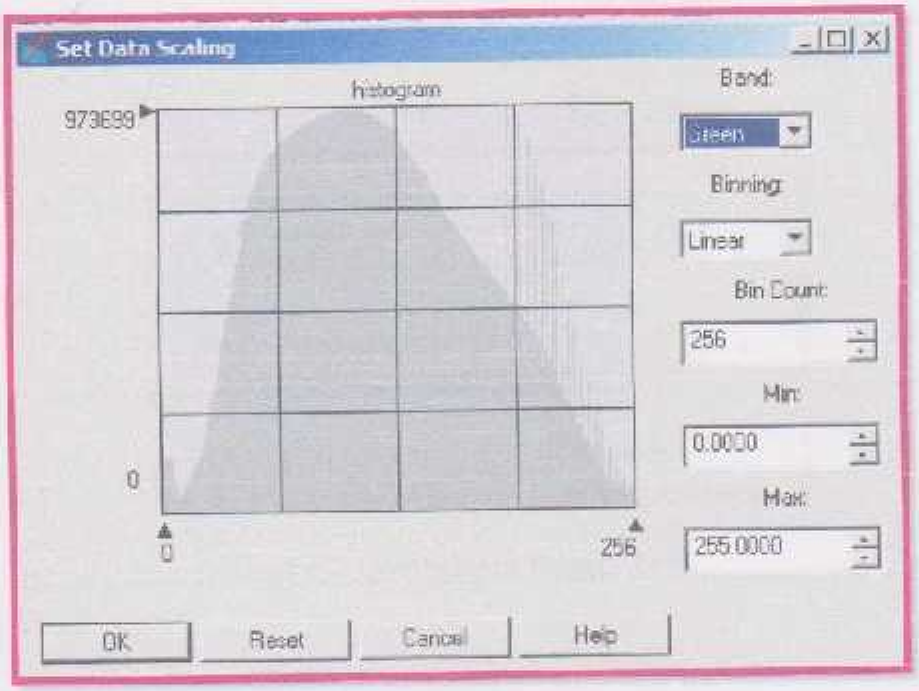


Figure (6.13) Data Scalind for Green Band Order

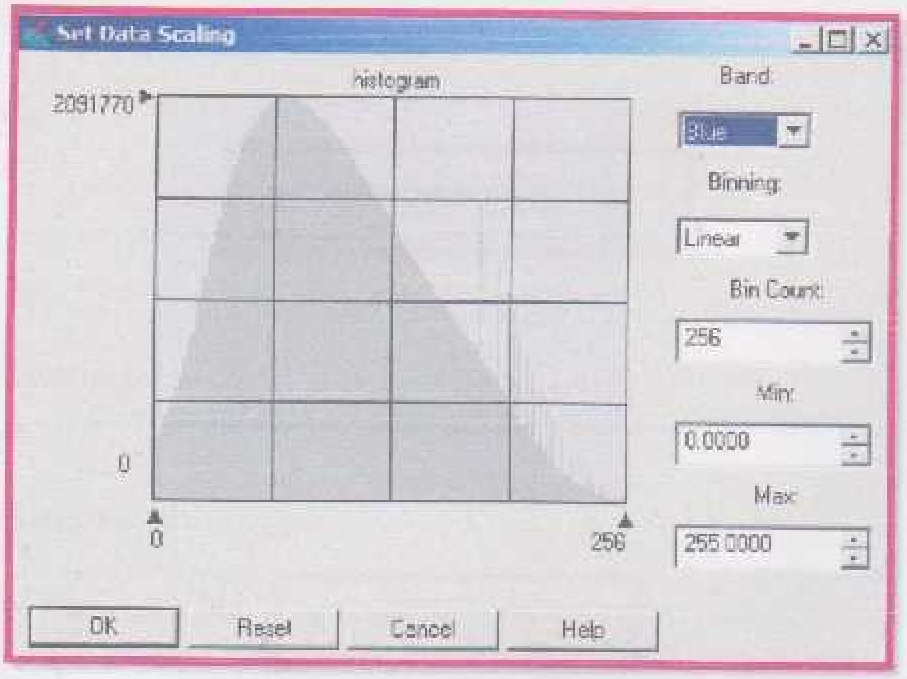


Figure (6.14) Data Scalind for Blue Band Order

6-1-2 Brightness Contrast

Figure (6.15) Brightness Contrast Order

6-1-2-1 CONTARST UP

Increase and decrease the contrast of currently active image.

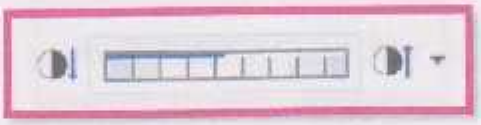


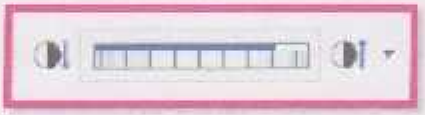
Figure (6.16) Contrast Up

Example of changing contrast:

1- Decreasing contrast :

Figure (6.17) Decrease Contrast Order

2- Increasing contrast :



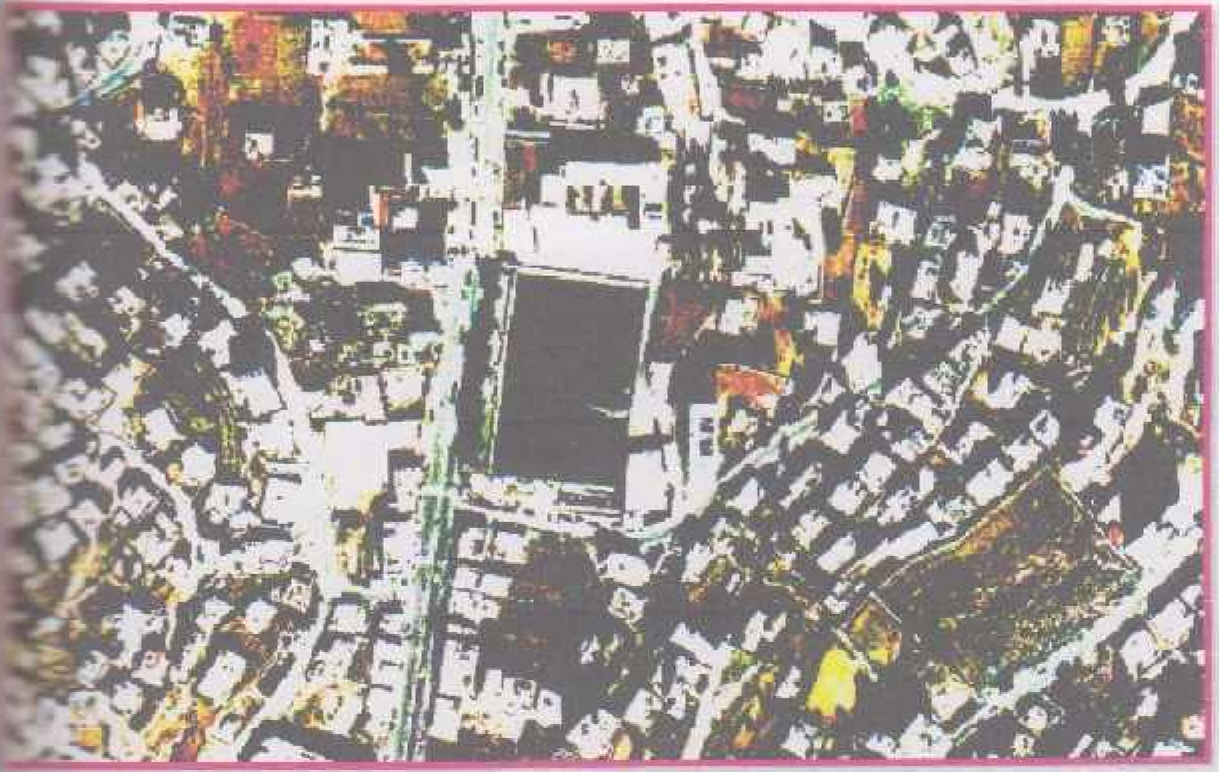


Figure (6.18) Increase Contrast Order

6-1-2-2 Brightness Up

Increase and decrease the brightness of currently active image.

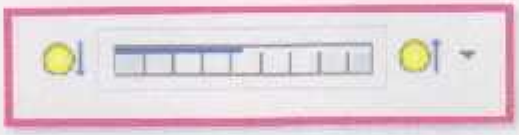


Figure (6.19) Brightness Up

Example of changing Brightness:

1- Decrease brightness:

Figure (6.20) Decrease Brightness Order

2- Increasing brightness :

Figure (6.21) Increase Brightness Order

6-1-3 Sharpness

Figure (6.22) Sharpness Menu

6-1-3-1 Sharpness Up

Used to increase and decrease the sharpen of the activity image.

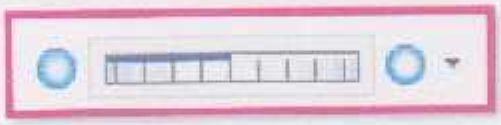


Figure (6.23) Sharpness

Example of changing sharpen :

1- Decrease sharpen :

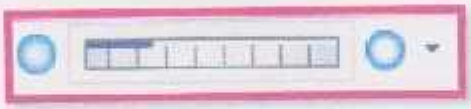
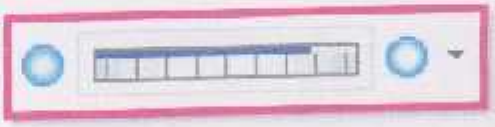


Figure (6.24) Decrease Sharpen Order

2- Increasing sharpen :



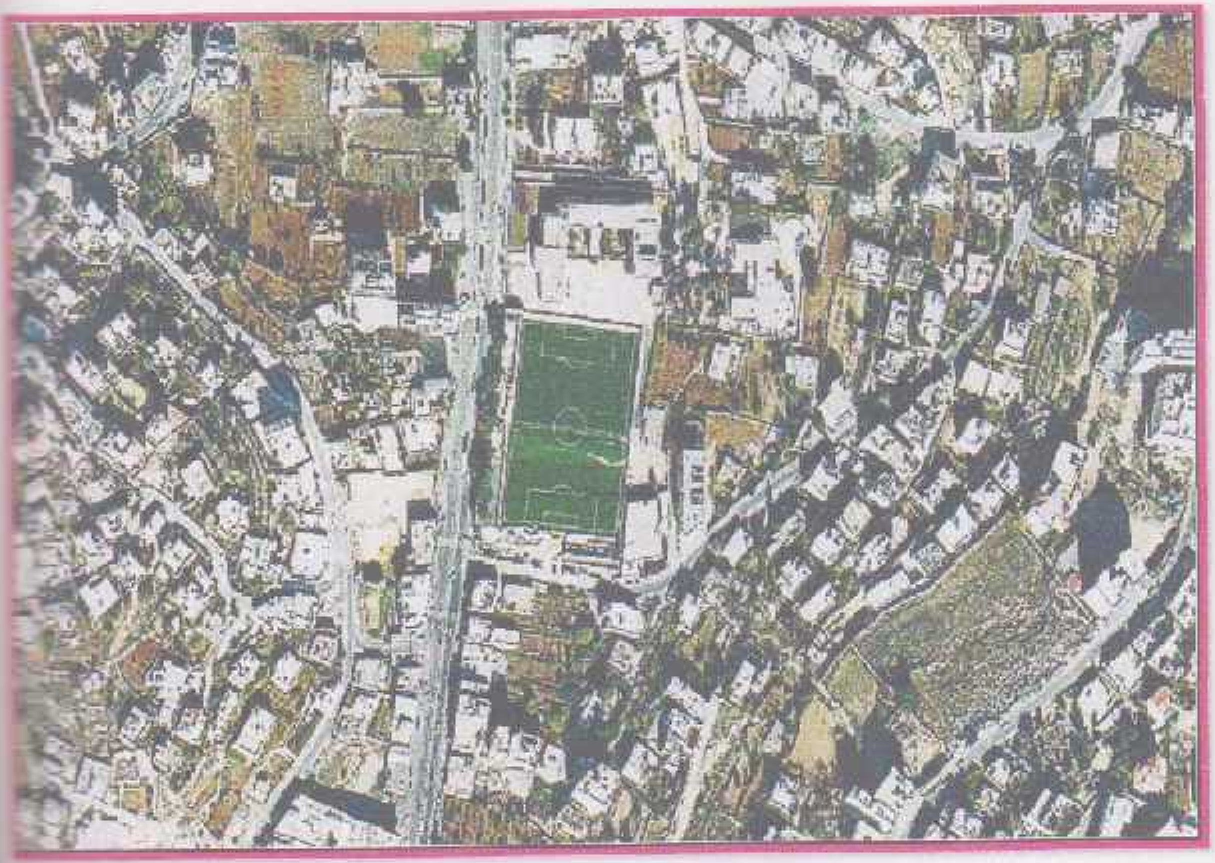


Figure (6.25) Increase Sharpen Order

6-1-3-2 Filtering

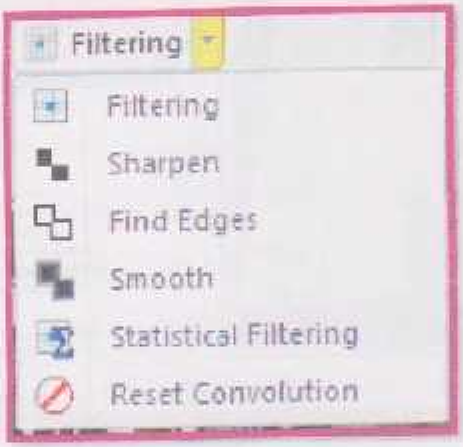


Figure (6.26) Filtering Orders

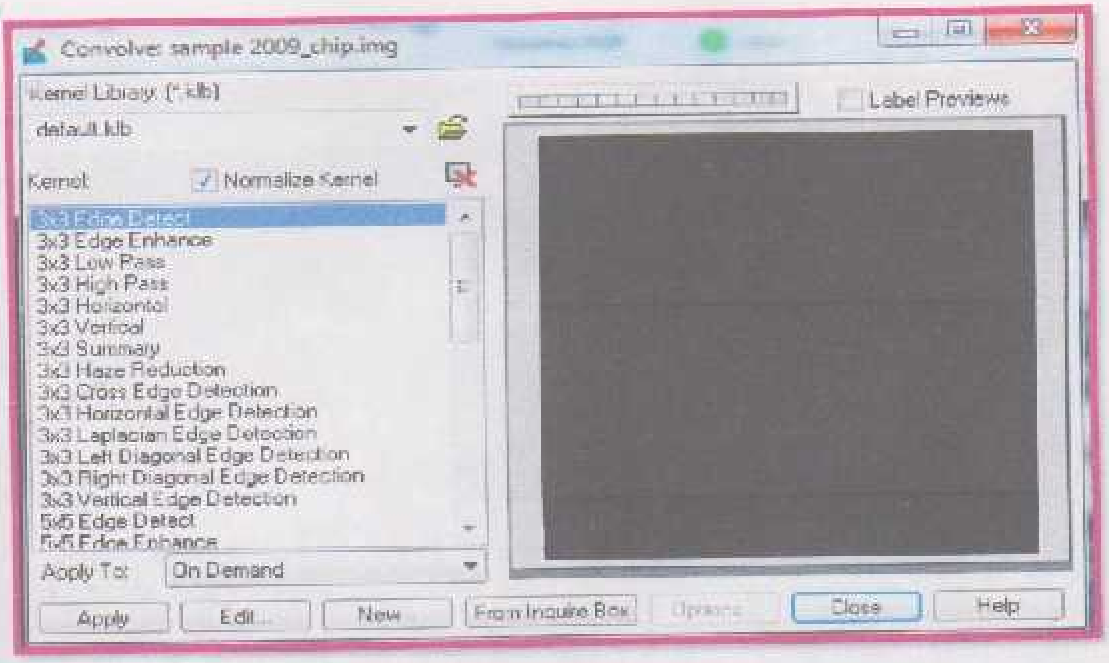


Figure (6.27) Filtering Window

this window many filiters , and we choose the type of filitering to be used .

mples of Filters :

1- 3*3 Low pass

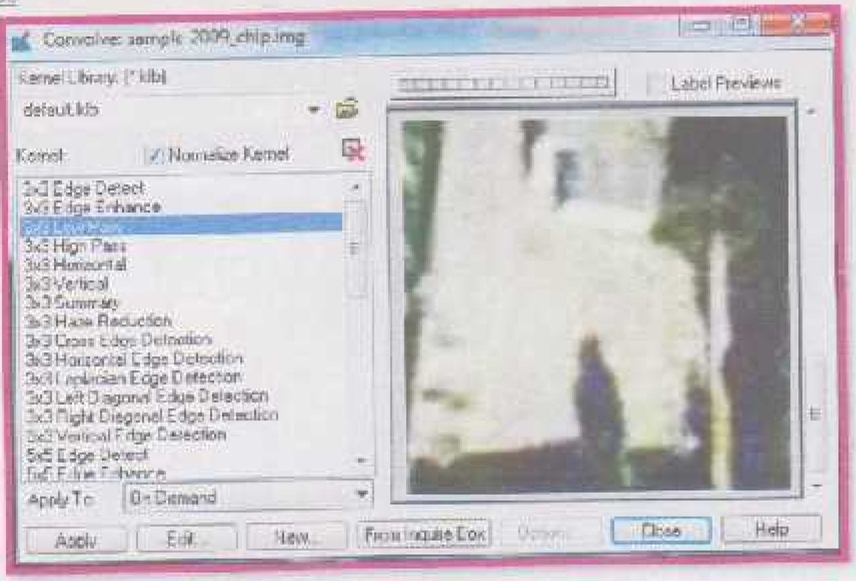


Figure (6.28) Chosen 3*3 low pass filter from Filtering Window

Figure (6.29) Sample of 2006 image after applying 3*3 low pass filter

2- 3*3 High pass

Figure (6.30) Sample of 2006 image after applying 3*3 high pass filter

3- 3*3 Vertical

Figure (6.31) Sample of 2006 image after applying 3*3 vertical filter

4- 7*7 Edge Enhancement

Figure (6.32) Sample of 2006 image after applying 7*7 edge enhancement filter

5- 3*3 Sharpen 5

Figure (6.33) Sample of 2006 image after applying 3*3 sharpen 5 filter

6- Haze reduction

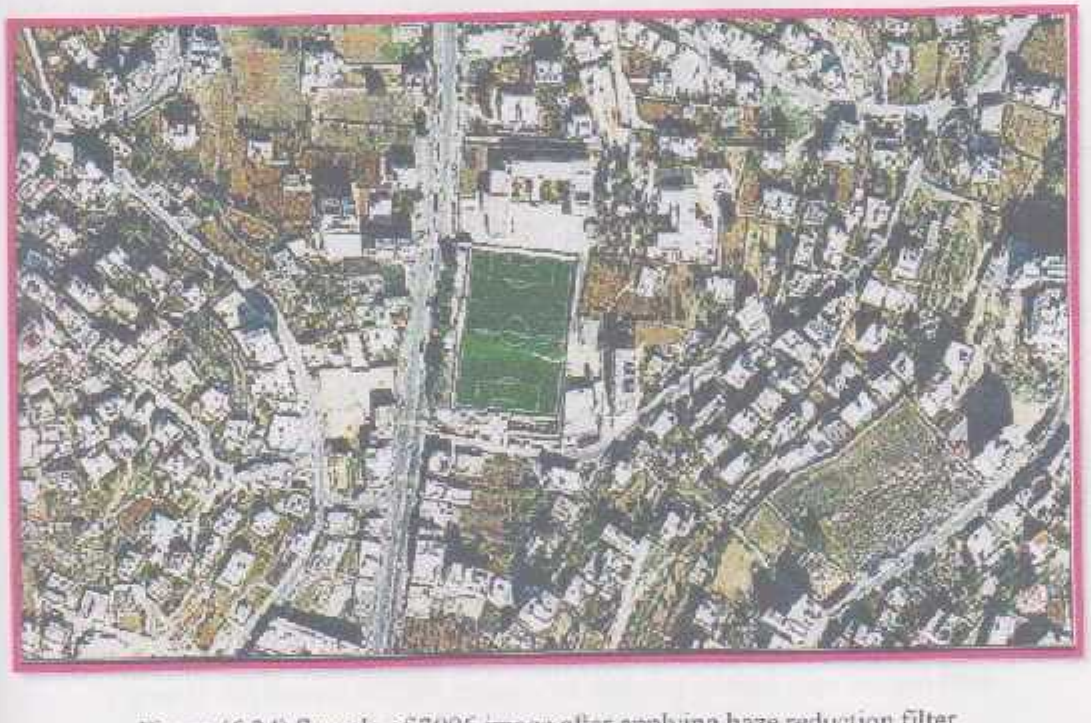


Figure (6.34) Sample of 2006 image after applying haze reduction filter

7- Smooth

Figure (6.35) Sample of 2006 image after applying smooth filter

8- Vertical edge dection

Figure (6.36) Sample of 2006 image after applying vertical edge dection filter

9- <u>Laplacin edge dection</u>

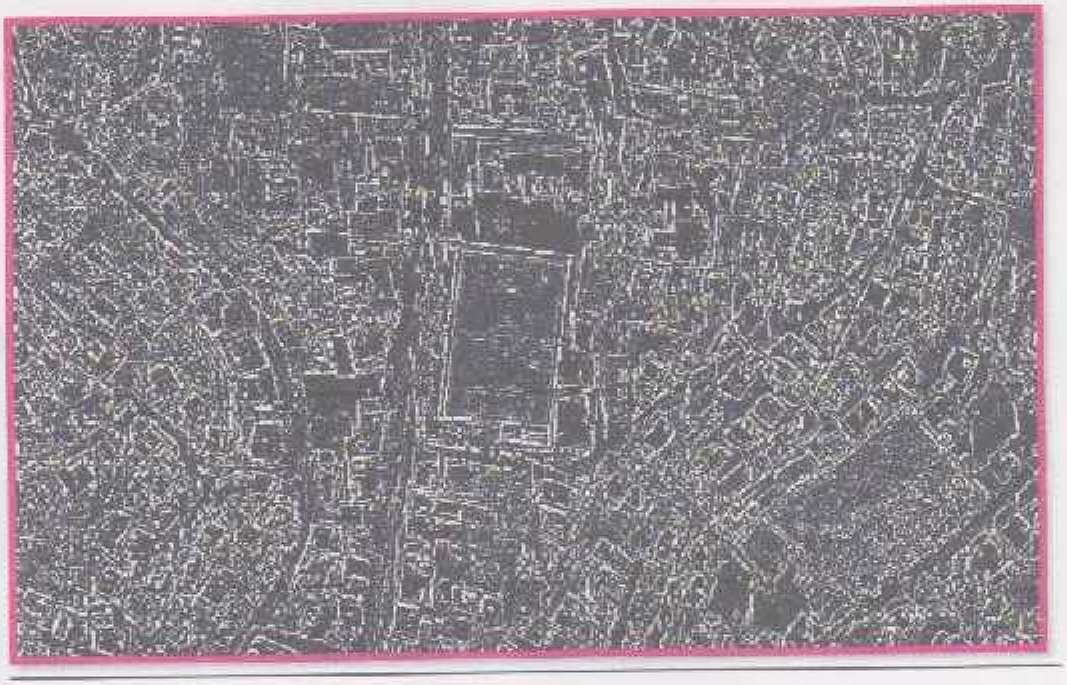


Figure (6.37) Sample of 2006 image after applying laplacin edge dection filter

6-1-4 Bands

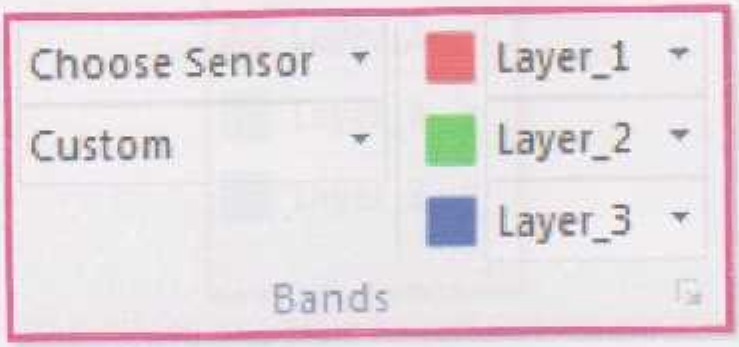


Figure (6.38) Bands Menu

6-1-4-1 Layer Combination

To make greater control over which files and layers are displayed.

Figure (6.39) Layer Combination

Colors arrangement on the screen :

Gun 1 → Red

Gun 2 → Green

Gun 3 → Blue

If the arrangement of colors is changed as below:

Figure (6.40) Sample of 2006 image after changing arrangement of colors

6-1-4-2 Sensor Type

Choose the sensor type of the active image to define wavelength to band associations.

Figure (6.41) Sensor type list

6-1-4-3Common Band Combination

Chosing from this list combinations used to display the chosen sensor type to set the band to RGB-colorgun assignment .

Figure (6.42) Common band combiniation list

Examples of Common band combiniation :

1- True color :

Figure (6.43) True color

2- False color IR :

Figure (6.44) False color IR

3- Desktop RGB:

Figure (6.45) Desktop RBG

4- Desktop BGR :

Figure (6,46) Desktop BGR

6-2 Resample pixel size

To solve zooming problem in images we make resample for pixel size as shown below :

Raster menu

↓

Spatial

↓

Resample pixel size

This window will appear:

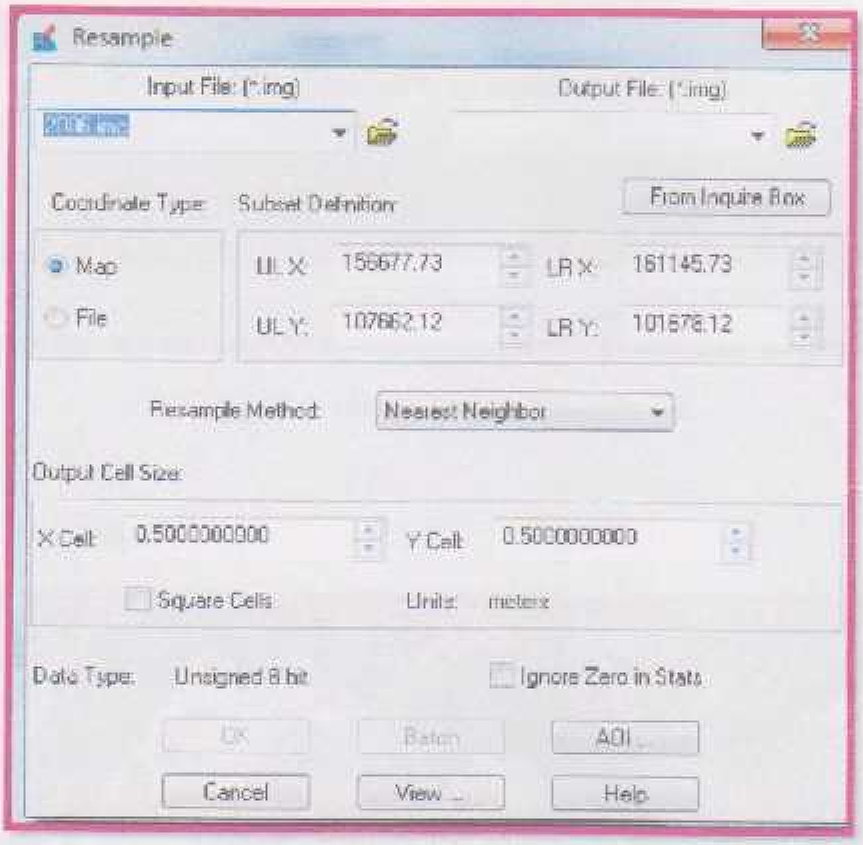


Figure (6.47) Resample window

Name the output file and save it.

Choose the type of Resampled method: 1- Nearest neighbor

2- bilinear interpolation

3- cubic convolution

Click ok.

This window will appear:

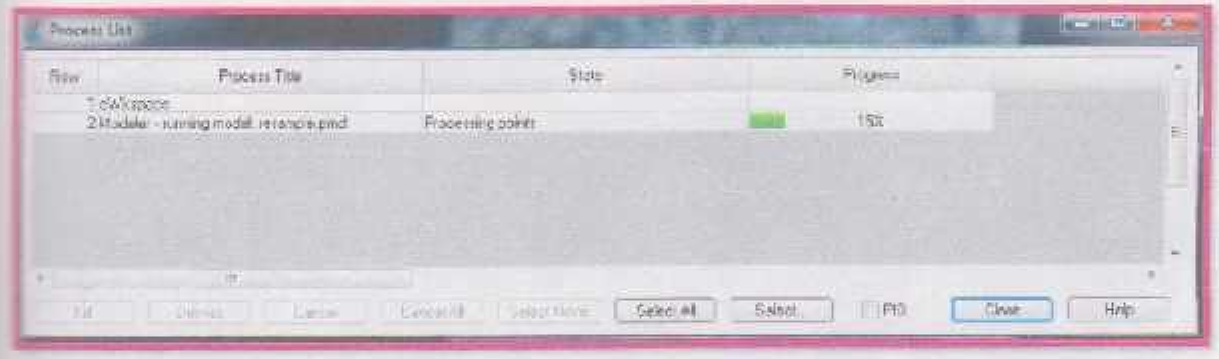


Figure (6.48) Process list of resample order

And the results are as below :

Figure (6.49) Sample of original 2006 image

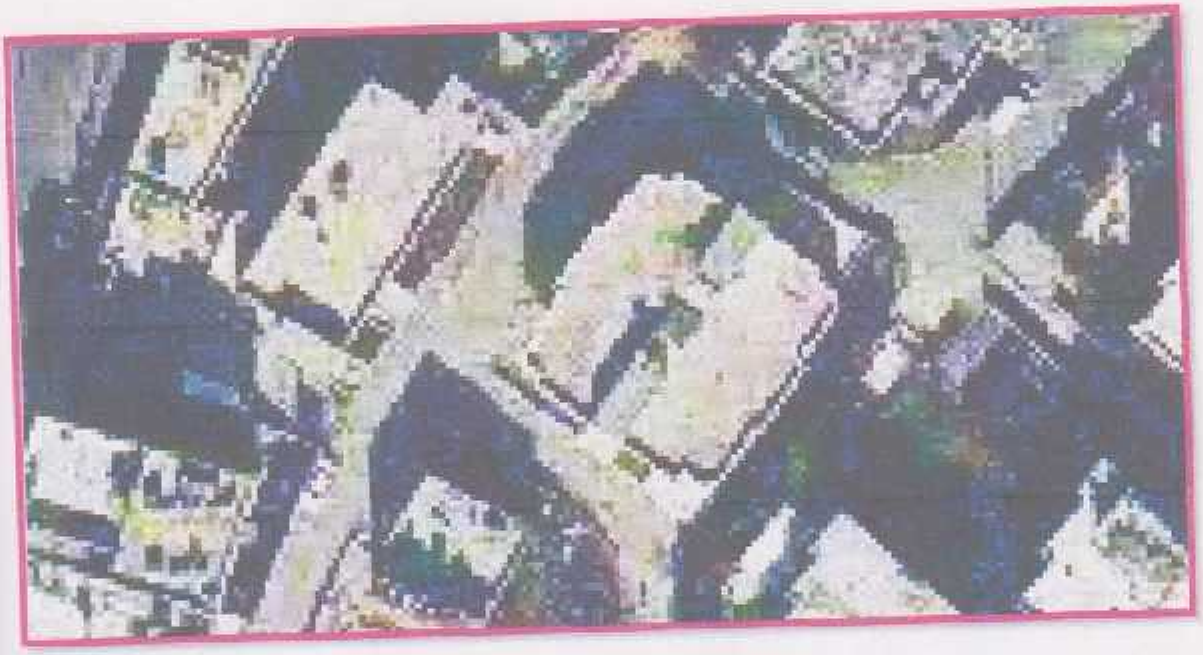


Figure (6.50) Bilinear Interpolation 2006 image

Figure (6.51) Cubic Convolution 2006 image

Note : In cubic convolution the borders of building are the most obvious when making zooming.

6-3 Statistical filter

To suppress very high frequency variations (noise) in the image we make statistical filter as shown below :

Raster menu

↓

Spatial

↓

Statistical filter

This window will appear:

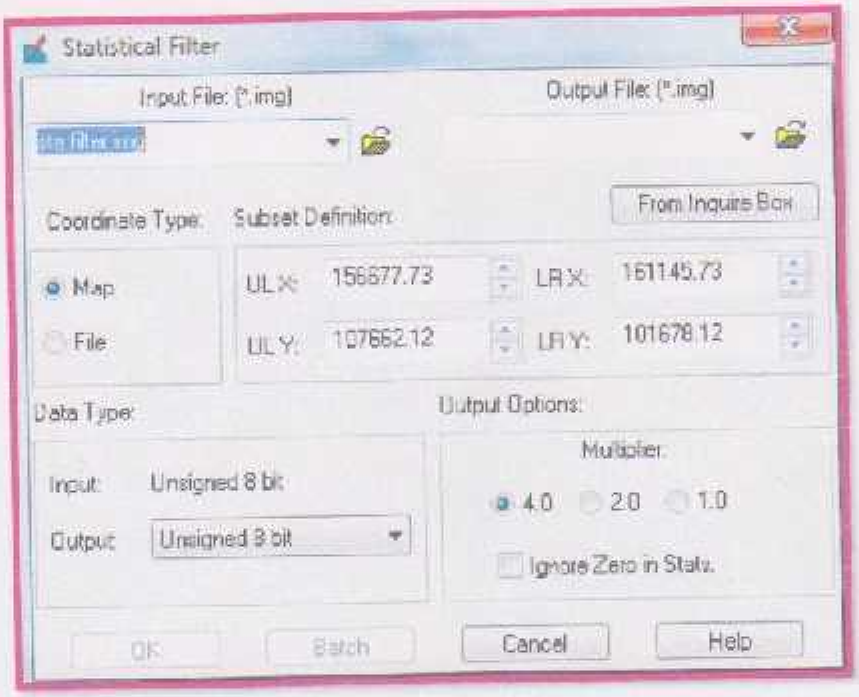


Figure (6.52) Statistical filter window

*Name the output file and save it.

Figure (6.55) Statistical filter 2006 image

* click ok.

This window will appear:

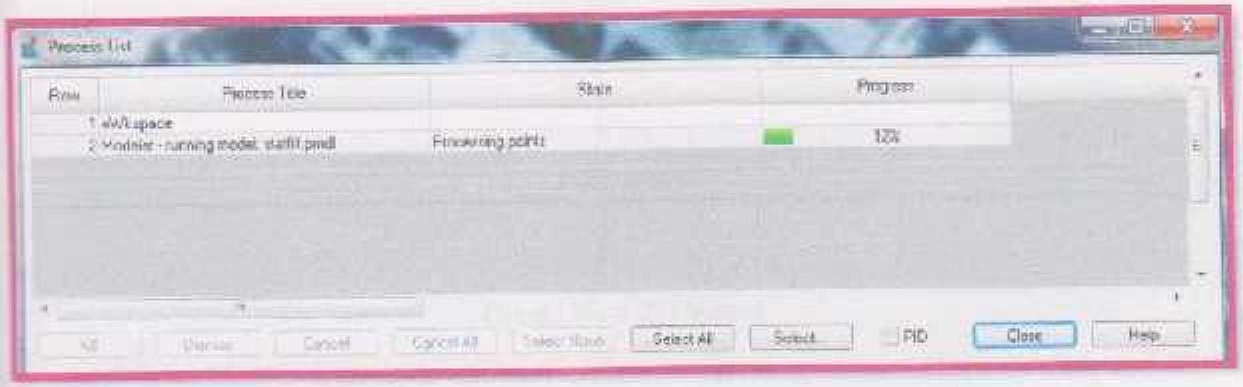


Figure (6.53) Process list for statistical filter order

And the results are as below :

Figure (6.54) Sample of original 2006 image

7-1 Digitizing Procedure

7-1-1 Create 2D View And Add Images

Home menu

↓

Add views

↓

Create New 2D Views

This window will appear:

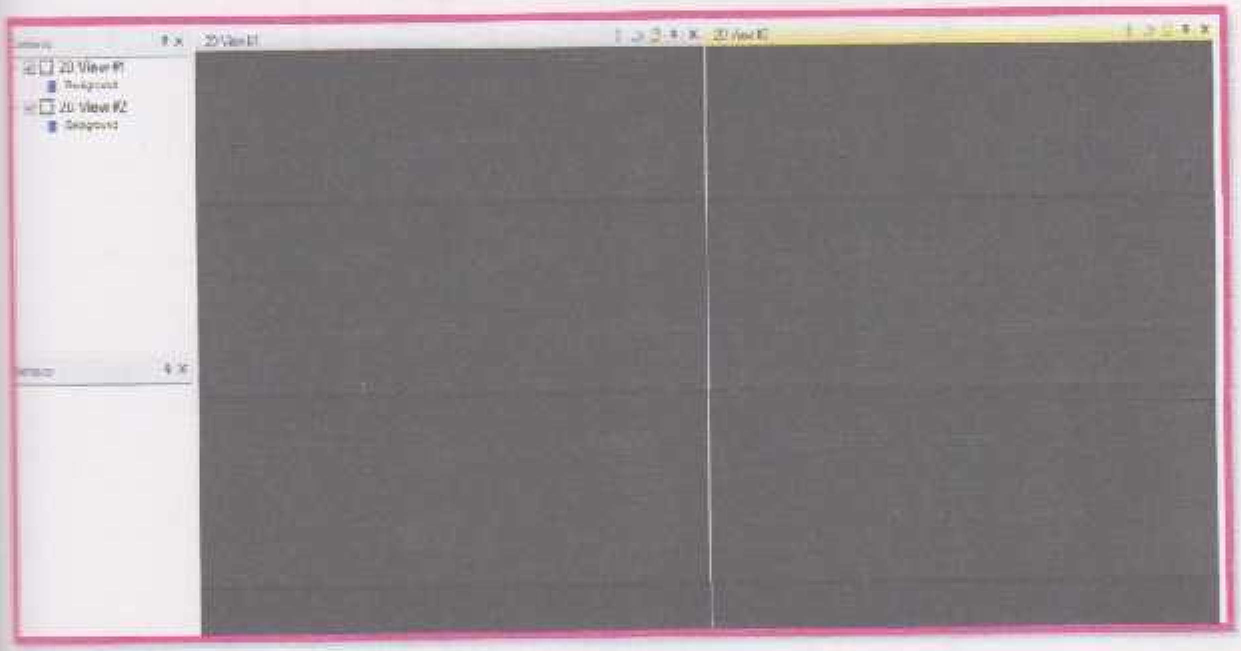


Figure (7.1) 2D view

- Add the first image in window 1 (2D view #1), and the second image in the second window.

- Window 1 (2D view #1) add two raster image: 1- 2006 image.
  2- Hight light (50) (from change dection).

- Window 2 (2D view #2) add one raster image: 2009 image.

To add image in two window :

Right mouse click on 2D view on table content

↓

Open Raster Layer

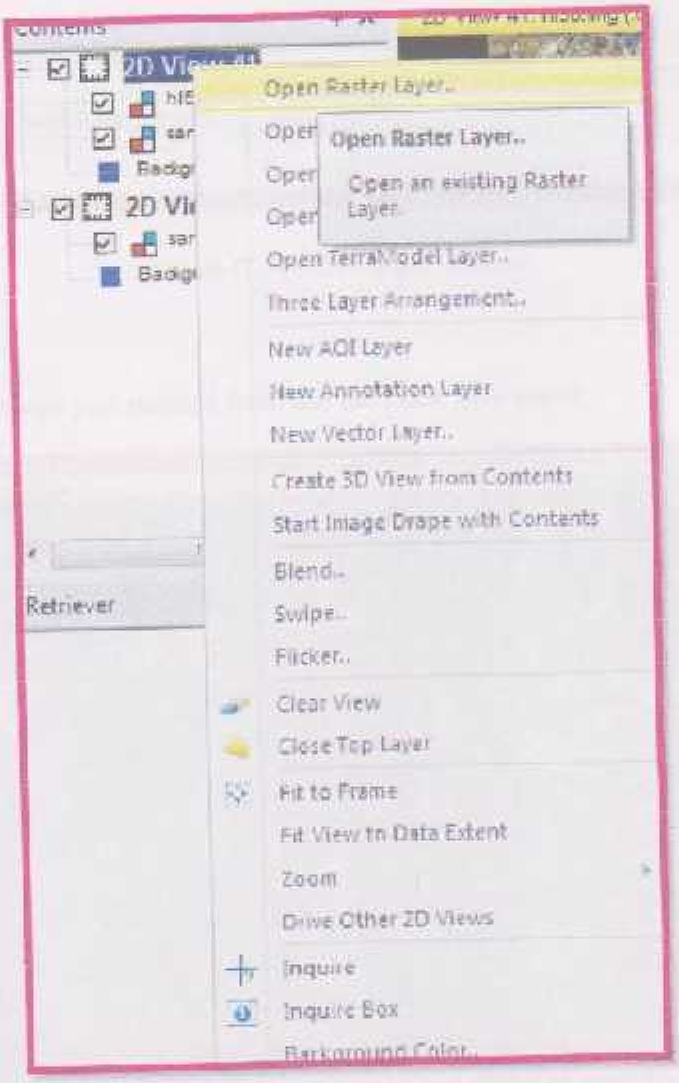


Figure (7.2) Add raster image in window

This window will appear:

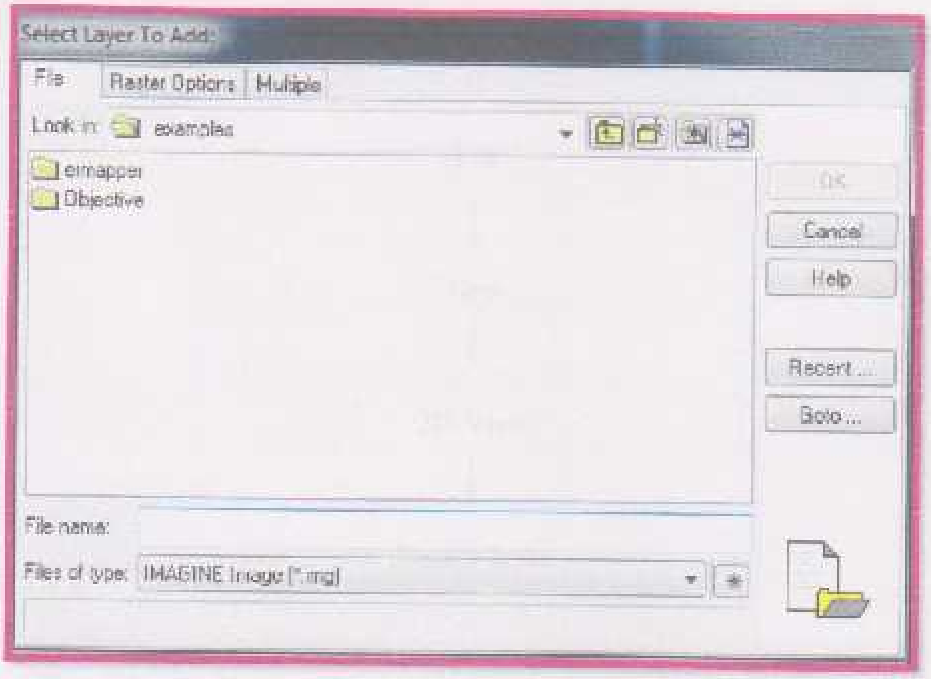


Figure (7.3) Add images window

Then select the raster image you wanted from the the place you saved.

Figure (7.4) Images in 2D view window

7-1-2 Make Shape files

File

↓

New

↓

2D View

↓

Vector layer

This window will appear:

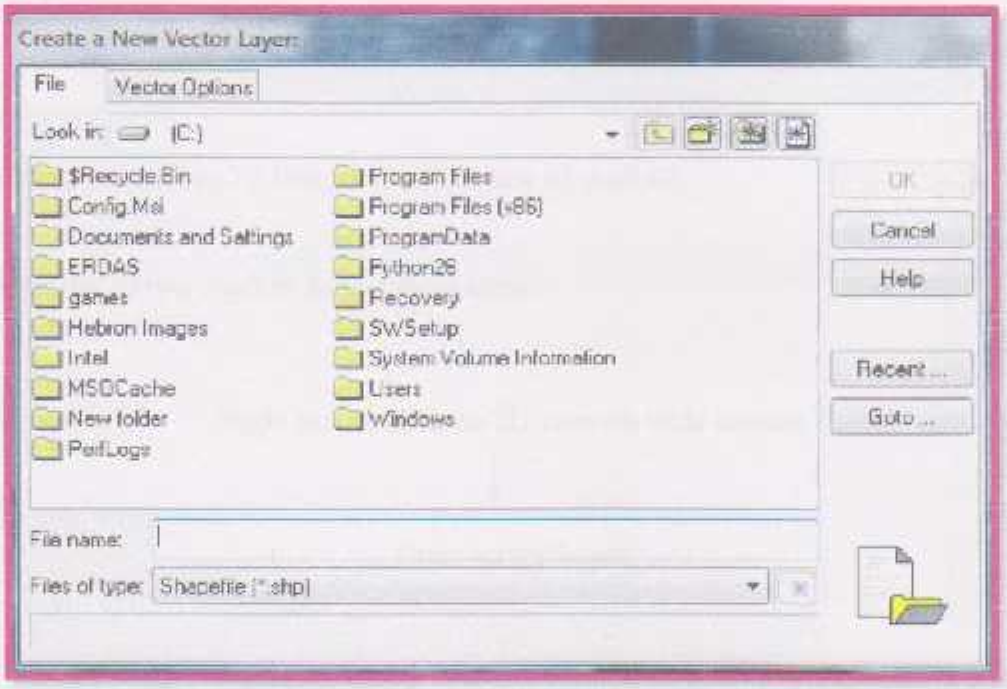


Figure (7.5) Create a New vector layer window

* Name the shapefile and save it.

This window will appear:

Figure (7.6) New Shapefile Layer Option

* Select Polygon Shape.

* click ok.

* Finally the shapefile will be added to the chosen 2D window.

7-1-3 Adding Shapefiles To Images On 2D View #1 And #2

To add shapefiles in two window follow these steps :

Right mouse click on 2D view on table content

↓

Open vector Layer

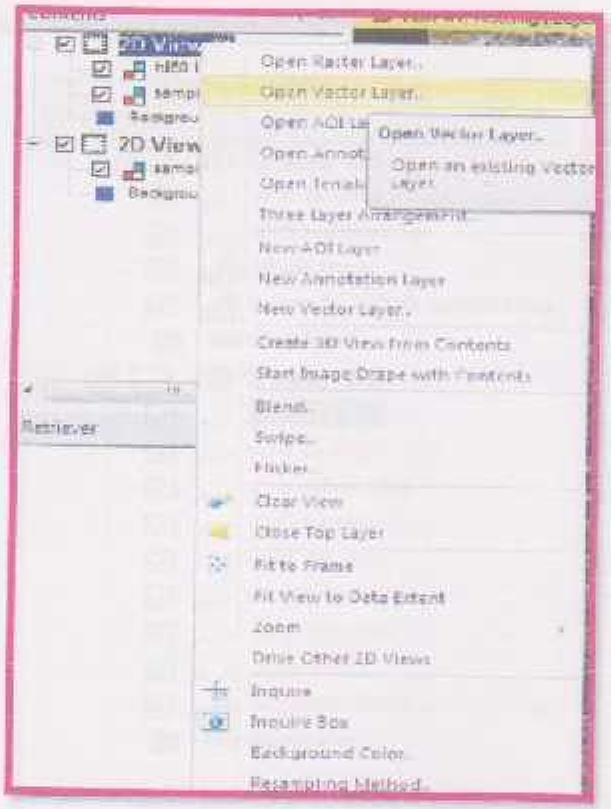


Figure (7.7) Add vector layer to images in 2D windows

This window will appear:

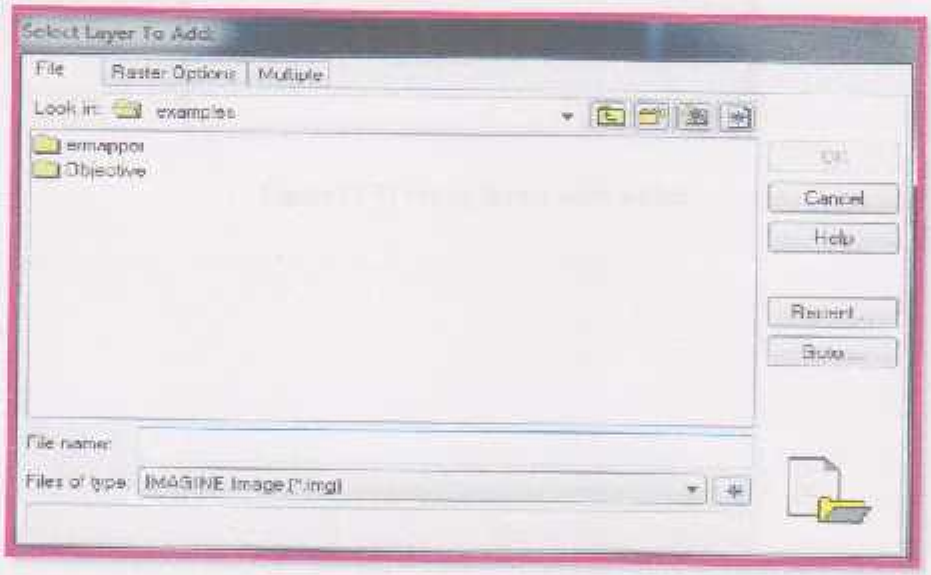


Figure (7.8) Adding vector layer window

Then select the vector shapefiles you wanted from the the place you saved.

Figure (7.9) vector layers were added

7-1-4 The Classifications Used In The Project

1- The classification used in 2006 image are :

- Removed Buliding (rb)
- Removed another things (R).

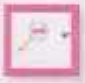
2- The classification used in 2009 image are :

- New Buliding (nb).
- Modified buliding (mb).
- New road (nr).
- Modified road (mr).
- Paved road (pr).
- Other things (other).
- Playgrounds (pg).

7-1-5 Start Digitizing

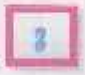
1) Make zooming at part of image 2009 by using these icons :

zoom in



zoom out

pan : to change the location and to make movements.

2) Click at this icon  in 2D view window of 2006 image , then it will come the same part in image 2006.

3) Compare the change between the two images with the assistance of highlight image that comes from change detection.

4) Areas where have high highlight (pink color or blue color) means that there are changes such as , new building , paved road , new road, removed building … etc.

2006 2009

Figure (7.10) Example of new building in 2009 image

2006 2009

Figure (7.11) Example of paved road in 2009 image

5) To start digitizing click at the wanted shapefile .

6) From Drawing menu select this icon  to make digitizing.

7) By this icon  making digitizing on the building or road borders in 2009 image.

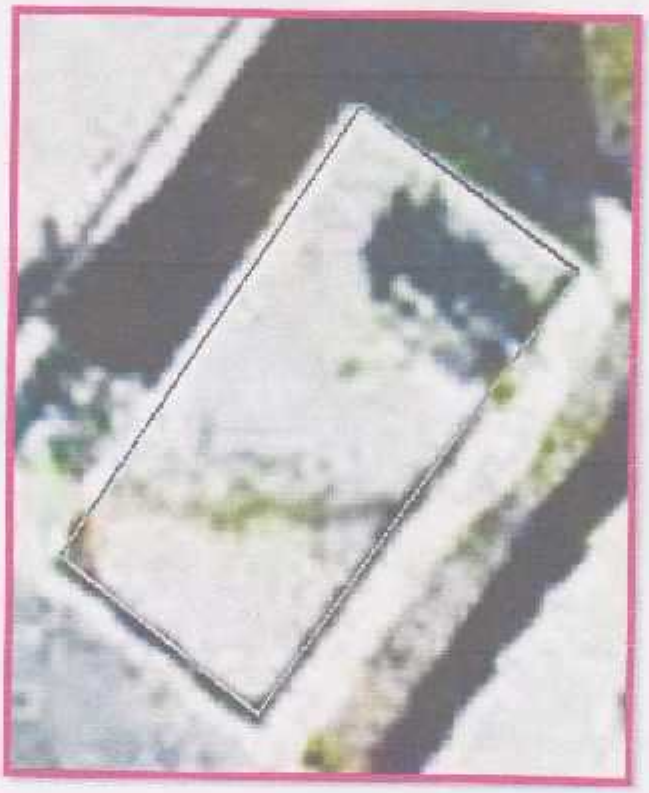


Figure (7.12) The way of making digitizing of building

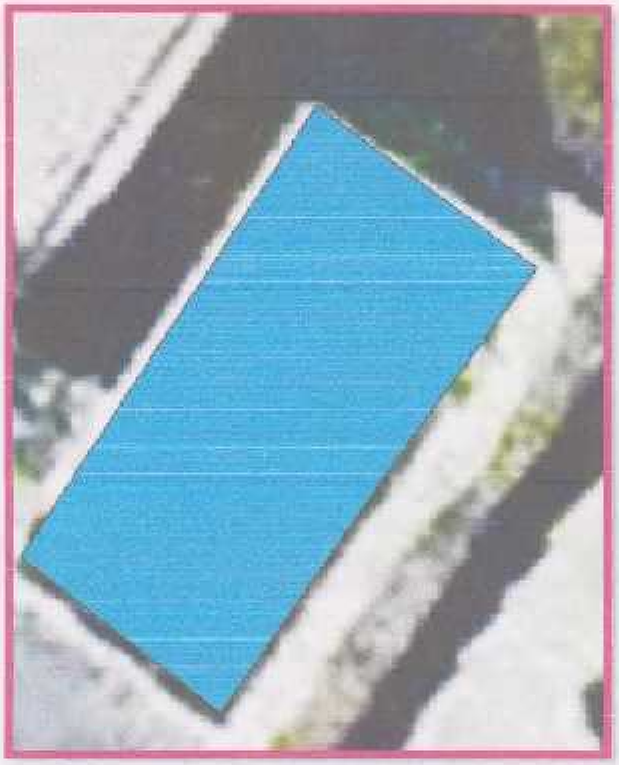


Figure (7.13) Digitized building

In this way we are working and making digitizing for all new building and roads between 2006 and 2009 years .

7-2 Mapping procedure

7-2-1 Arc map program

After making digitizing using Erdas program we using Arc Map 10 to produce the maps:

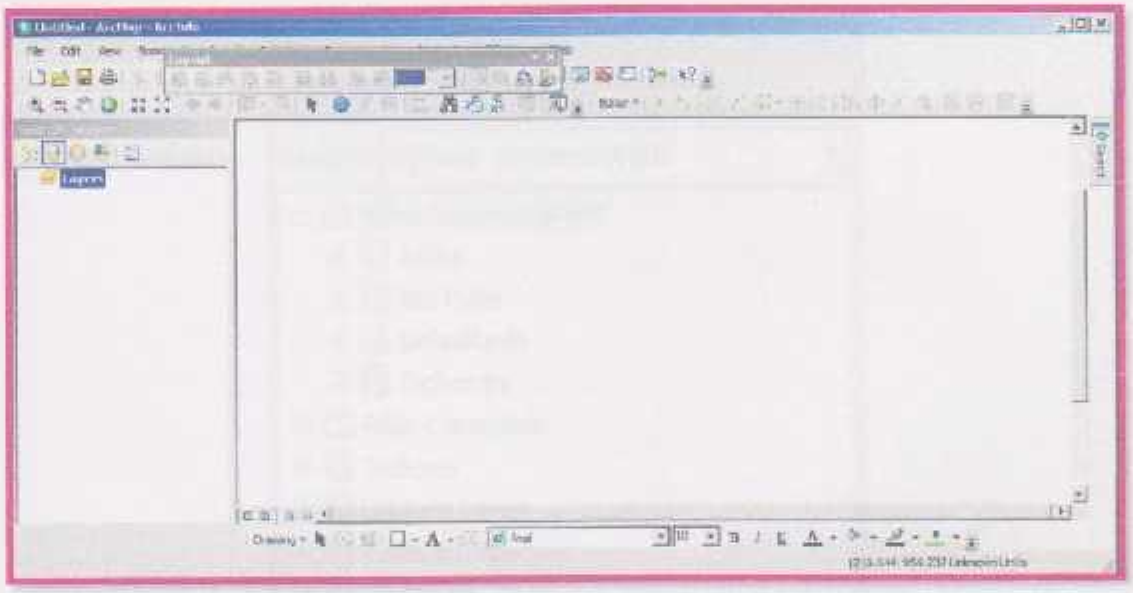
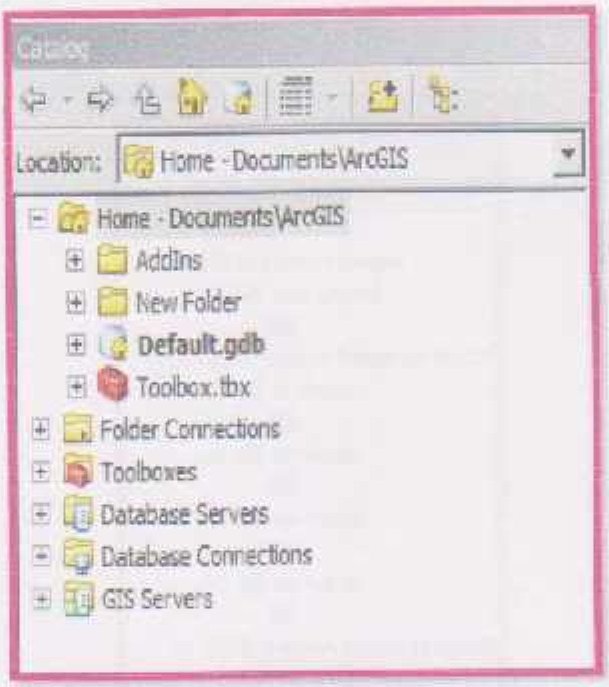


Figure (7.14) Arc map window

7-2-2 Start and stop editing

To start working on Arc map we have to start editing .

7-2-3 Add Geodatabase



Right click ,new personal Geodatabase

Figure (7.15) Adding Geodatabase

7-2-4 Add shape files

From 

right click on 

click on 

Then Add the shape files (New Building ,Modified Building , paved road , New road , Playground and 2009 photo).

Figure (7.16) Adding Shapfiles

7-2-5 Merge shape files

From Merge data management , enter the inputs file and the output file.

7-2-6Change shape files color

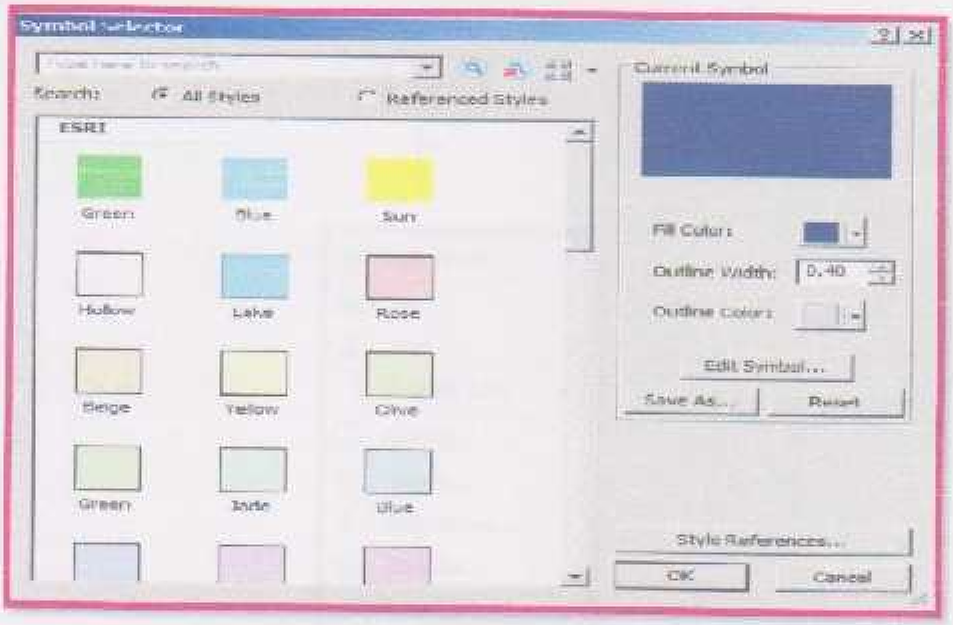


Figure (7.17) Changing shapefile Color

7-2-7 Add layout

From the icon layout veiw 

↓

Figure (7.18) Adding Layout

7-2-8 Insert Menu

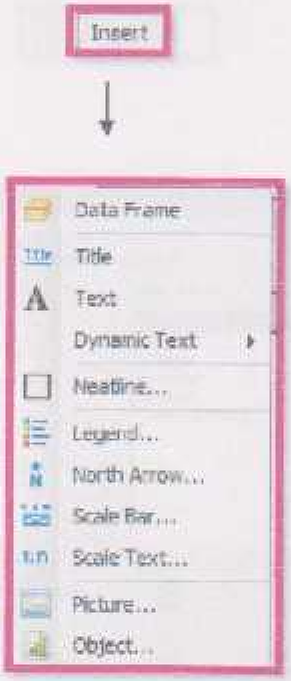


Figure (7.19) Insert Menu

7-2-8-1 Insert Title

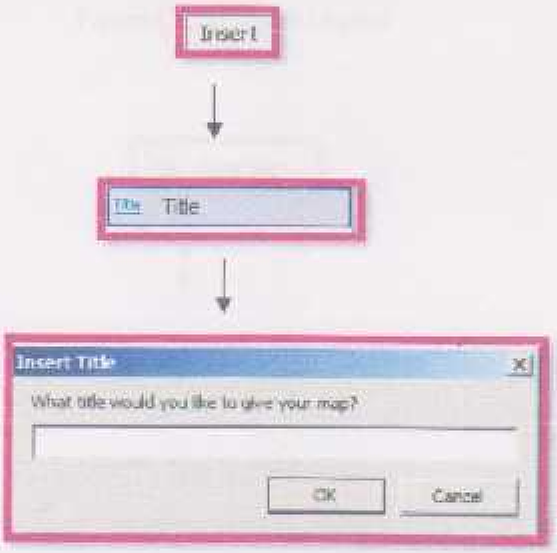


Figure (7.20) Insert Title

7-2-8-2 Insert legend

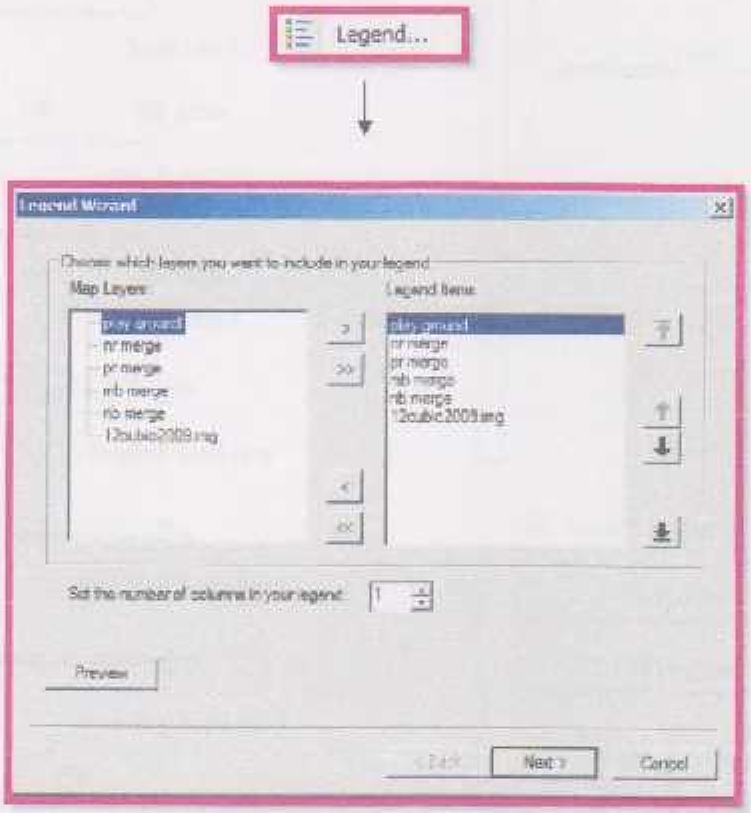
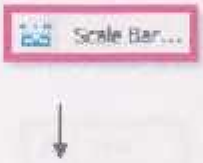


Figure (7.21) Insert Legend

7-2-8-3 Insert Scale bar



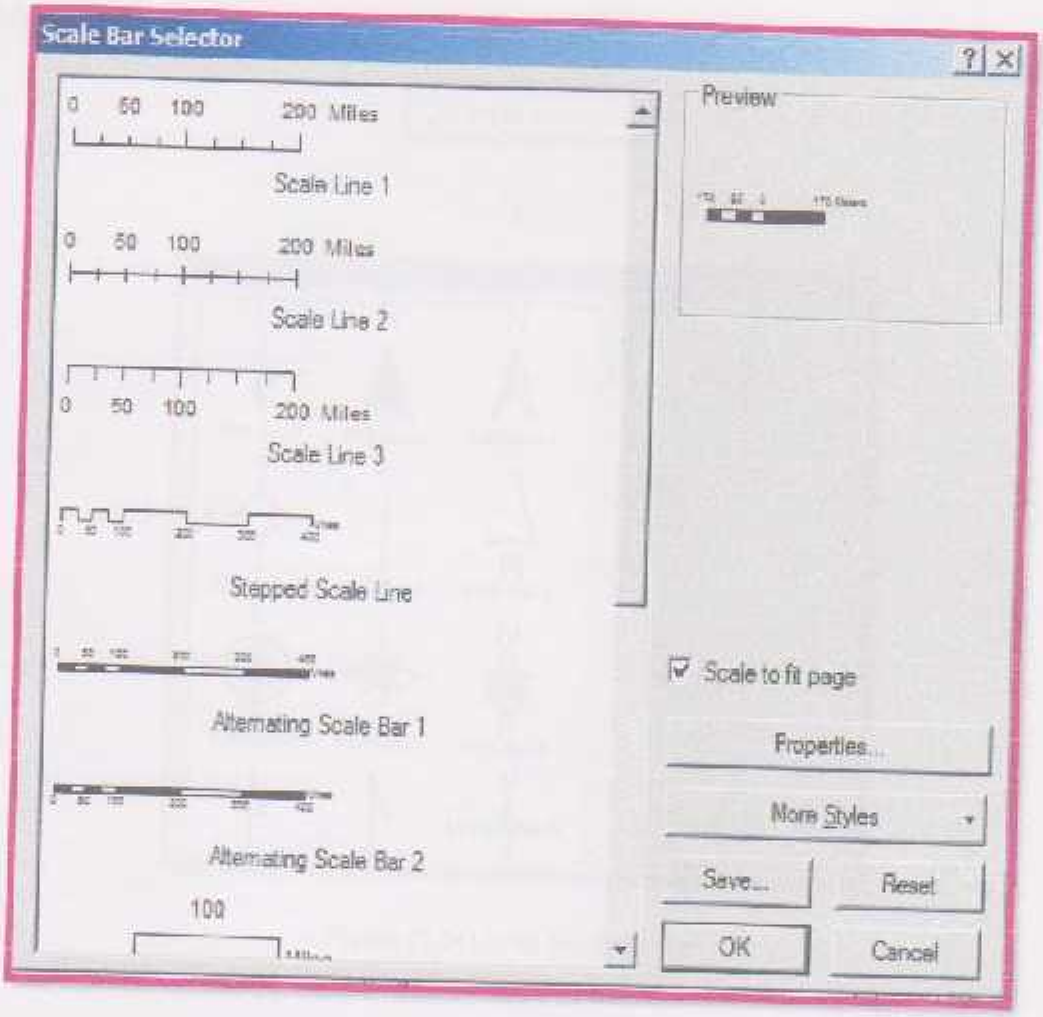


Figure (7.22) Insert Scale Bar

7-2-8-4 Insert text

Figure (7.23) Inset text

7-2-8-5 North Arrow

↓

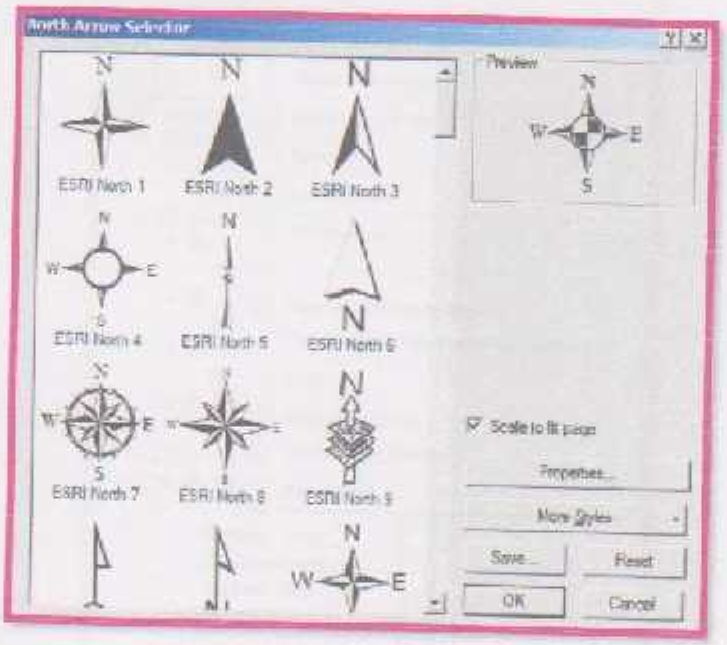


Figure (7.24) Inset North Arrow

7-2-8-5 Grid

Right click on the map then press on Grid

7-2-9 Project Results

7-2-9-1 Result Procedure

Right click on the Layer

↓

Open Attribute Table

↓

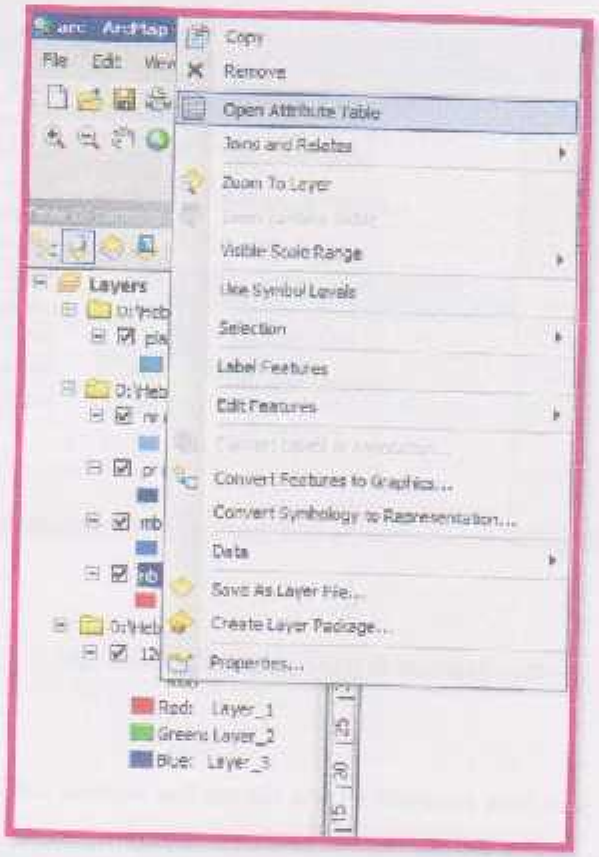
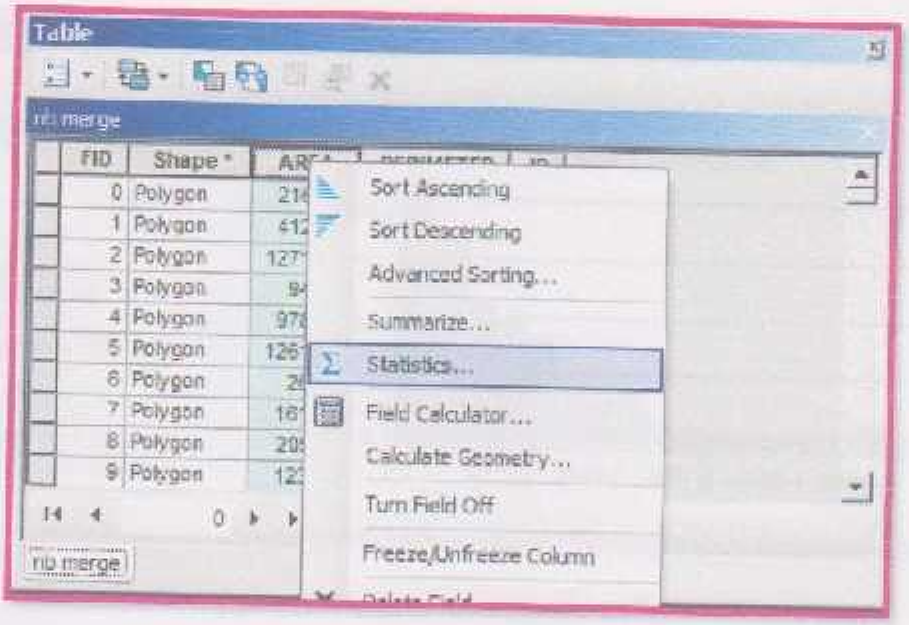


Figure (7.25) Open Attribute Table

↓

This window will appear



Right click on area cell and select statistics

This window will appear and its compute area sum

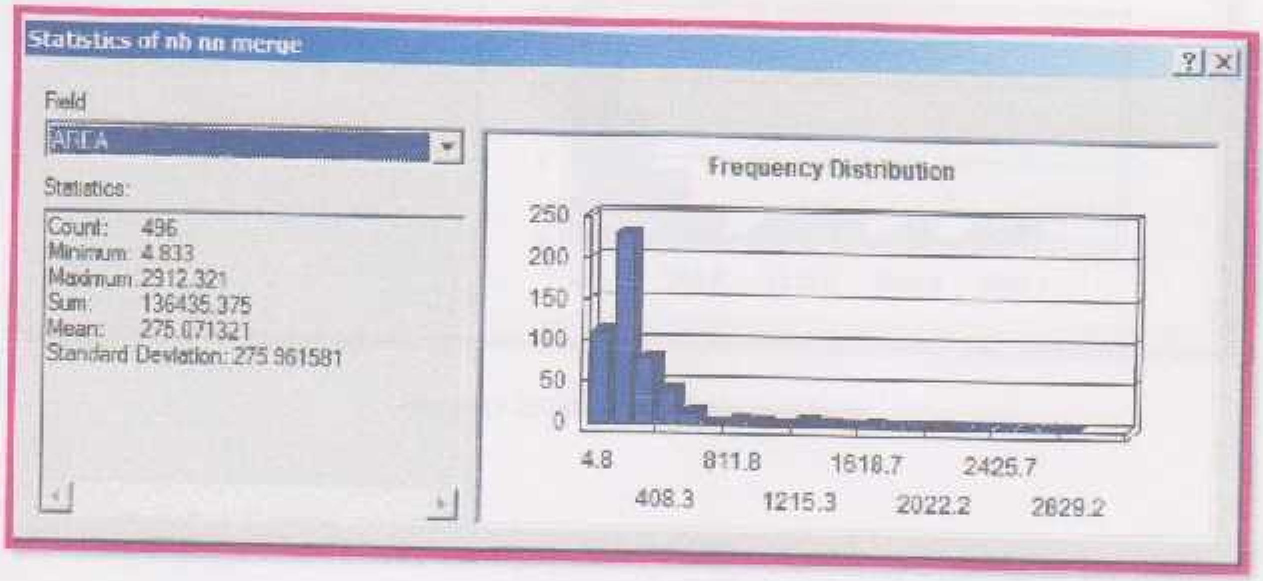


Figure (7.26) statistics of new building layer

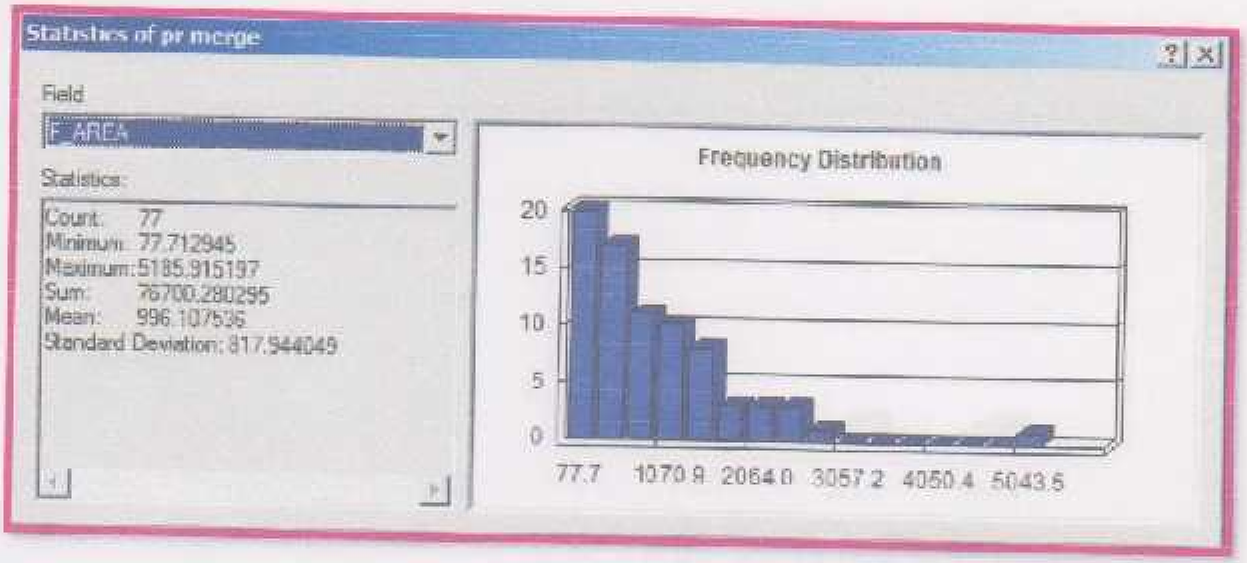


Figure (7.27) statistics of paved road layer

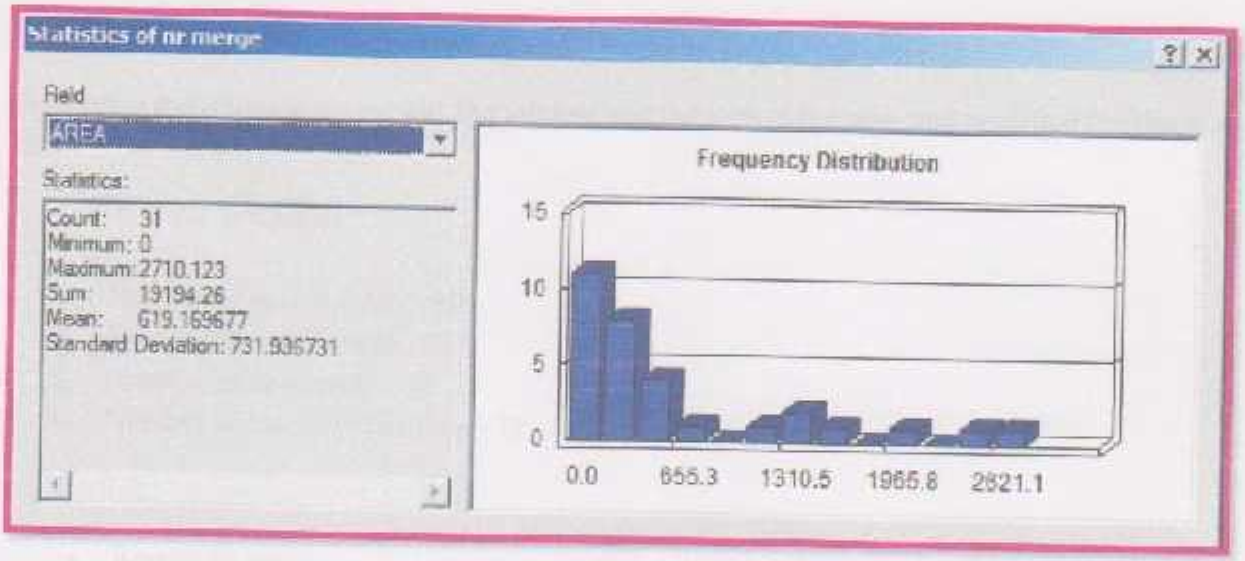


Figure (7.28) statistics of new road layer

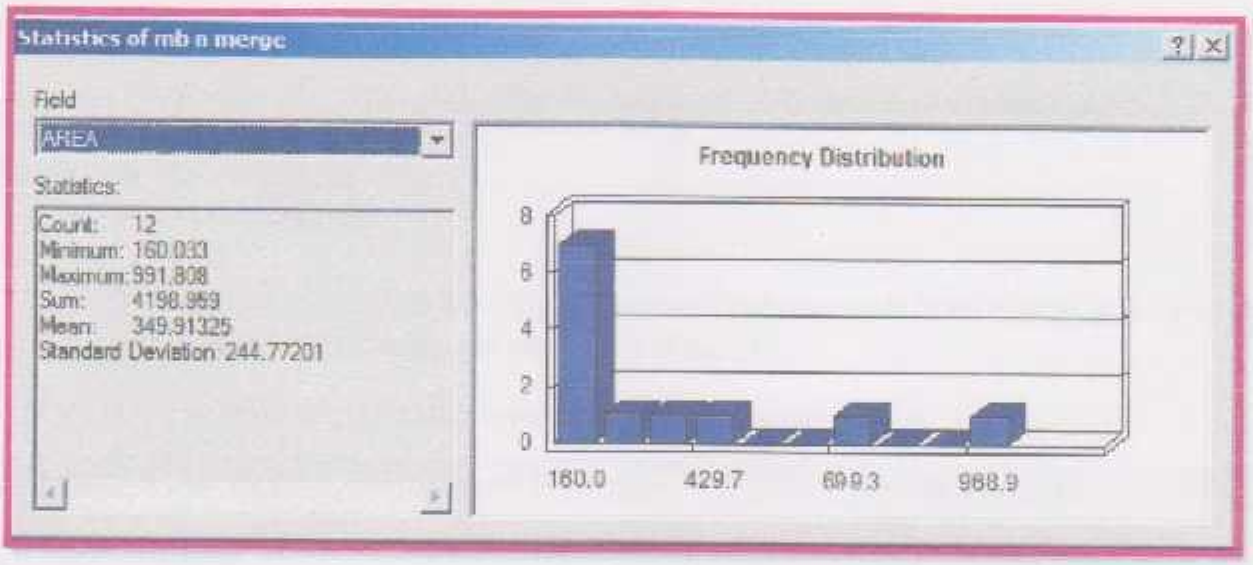


Figure (7.29) statistics of modified building layer

7-3 Results

According to GIS program we got the number and the area of the new and modified Buildings and roads as shown below.

- Results as number :

1. Number of new building :496
2. Number of paved roads : 77
3. Number of new roads : 31
4. Number of modified building : 12

- Results as area :

1. Area of new building: 136435
2. Area of modified building : 4198
3. Area of paved road : 76700
4. Area of new road :

7-4 Notes

- To facilitate the results study from the map we divided Hebron city to three parts:
  - The North part .
  - The South part .
  - The Middle part .

- Number and areas of new building , paved road and new roads in the middle of Hebron city is less than those for south and north parts of the city.

Table of the number of detected categories :

Categories Detected	South Part (no.)	North Part (no.)
New building	261	235
Modified building	9	3
New road	3	28
Paved road	44	33
Circular	0	2
Playground	0	1

Table (7-1) Number of detected categories

Table of the area of detected categories :

Categories Detected	South Part (m^2)	North Part (m^2)
New building	73029	63406
Modified building	3590	608
New road		19194
Paved road	50551	26149
Circular	0	315
Playground	0	858

Table (7-2) Area of detected categories

From theses tables :

- Number and area of new buildings in south part is larger than its in the north part.
- Number and area of modified building in south part is larger than its in the north part.
- Number and area of new roads in south part is less than its in the north part
- Number and area of paved road in South part is larger than its in the north part.
- The North part contain new circulars and playground.

From these results we noted that construction trend in north part is larger than south part.

And interest in the development of the northern part more than the southern like construct new road ,circular and play ground.

Modified Building & road

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