



**ORIGINAL RESEARCH PAPER**

**Engineering**

**RECOVERING THE ORIGINAL BANDS FROM THE SATELLITE COLORED IMAGES**

**KEY WORDS:** Image processing, satellite image, BMP image file structure.

**Emad Ali Al-helaly**

Kufa University, College of Engineering

**Noor Ali Al-Helaly\***

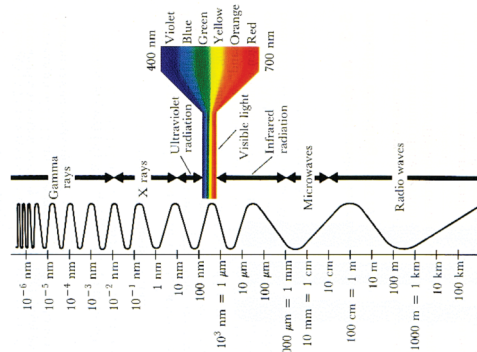
Imam Al-Kadhum University, College of Islamic Sciences, Computer Techniques Engineering \*Corresponding Author

**ABSTRACT**

In this paper, we take the colored satellite images which are displayed in BMP file format, and were originally formed by merging three bands, and then recover the initial bands and save them in separated image files. We have design a package (Band Recovery) to achieve this work, and compare the resulted band images with the original bands merged in ERDAS IMAGINE 8.4. The satellite images are available in the web pages, GIS software, and other computer media, but they are in formats suitable for non scientific or remote sensing purposes, so the researcher who need to view every band alone can not benefit from these images, by our designed software, he can split any image into it's original bands with some care. It is too expensive to buy a satellite image from the space stations, also it is limited only to the region you asked them firstly, and if you want to view any near or related regions, you should re-ask them and pay again. So our package may be suitable to get the original bands from the available satellite images easily for the scientific research.

**1. INTRODUCTION:**

The sensors, which is carried by the remote sensing satellites, are using some bands of the Electro Magnetic Spectrum (EMS). Figure (1)

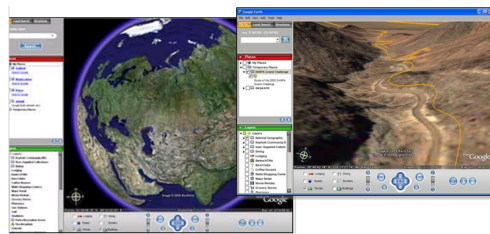


**Electro-magnetic Spectrum [1].**

These limits of every sensor to receive special electromagnetic are according to the type of the response from the observed regions. The remote sensors today are able to observe different ray frequencies wider than the visible range according to the land activities we want to sense and record.

**Table (1) Characteristic of the Landsat imaging devices (sensors) [2].**

Instrument	Spectral bands (μm)	IFOV (m)
MSS	4. 0.5 - 0.6 (green)	79 * 79
	5. 0.6 - 0.7 (red)	79 * 79
	6. 0.7 - 0.8 (near IR)	79 * 79
	7. 0.8 - 1.1 (near IR)	79 * 79
TM	8.. 10.4 - 12.6 (thermal)	79 * 79
	1. 0.45 - 0.52 (blue)	30 * 30
	2. 0.52 - 0.60 (green)	30 * 30
	3. 0.63 - 0.69 (red)	30 * 30
	4. 0.76 - 0.90 (near IR)	30 * 30
	5. 1.55 - 1.75 (mid IR)	30 * 30
	6. 10.4 - 12.5 (thermal)	120 * 120
ETM+	Largely as for TM Plus	60 * 60
	0.52 - 0.90 (panchromatic)	15 * 15



**Figure (2): Google Earth window.**

The problem in the last case is happened when we want to store images in our computer, they will be saved in the available image file format only like (\*.BMP, \*.JPEG, \*.TIFF, etc.), which means that you can only preview it and take information by eye.

Some times the researcher needs to preview every band alone, make some statistical operation on certain band, or apply a filter on them separately. So he is unable to do that by the common image formats.

The studying of the used way to introduce the image in the web and image programs and explorers may be useful to make us recover the original bands which formed the shown image. So, the next speech is to pave the ground for this duty theoretically, design a package to apply the work practically, and at last discuss: the results, accuracy, reality, and finally the limits of our way.

**2. The storage of satellite imagery and bands**

Each band may be saved in computer media as a separate file in a special format (e.g. \*.IMG), also all bands may be saved in one file, then the specialist software (e.g. ERDAS) can split every band and recognized the digital values.

Every pixel in band imagery is represented by one byte (8-bits) on the hard, this gives a 256 gray levels (from 0 for black to 255 for white). So the imagery will be gray and it's size equal (height \* width \* 1 byte).

The (\*.IMG) file format is a simple digital data, and the file is without header or trial, and it is not common file format, so you can not insert \*.IMG file in any document or picture box or web page, only ERDAS and Arc View can treat it [3].

The satellite imagery may come in seven bands as layers like the Thematic Mapper (TM), four layers like Multi-Spectral

Scanner (MSS), or more.

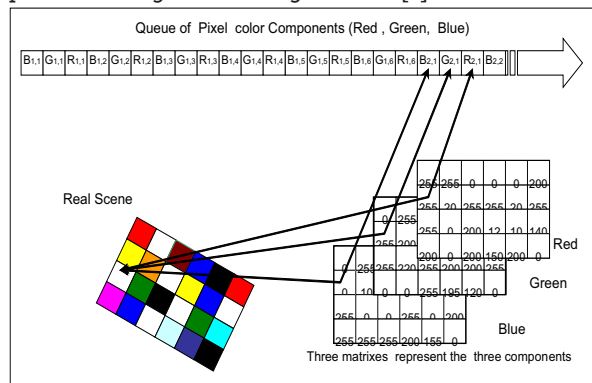
**3. Colors representation in the computer**

In the early computer system, every pixel in images was represented by one bit (0 or 1) so they were black and white images. With the hardware and software development of computer, pixels become represented in 4 bits to give (16) gray level (24), 8 bits (1 byte) to give (28 : 256) gray level, and then (224 bits) in an RGB color system, which mean (1 byte) for red component, (1 byte) for green component, and (1 byte) for blue one, so the RGB system gives (224 : 16777216) levels, which is very high color representation that is able to give an image with more real, describe any scene in the nature [9].

There are some other color systems like HIS or CMYK, but all of them have the same way to represent color of any real scene by merge the components of color, which are a certain limited region of the EMS.

The common file format of color images like BMP, JPEG, TIFF, GIF, .. are different in the way and location of the pixels value queue.

We have adopted a Bitmap (BMP) file format because it is a simple format, unencoded, and for it's community. The standard 24 bit BMP file contains a header of (54 bytes) include the height and width values, and then the region of pixel colors begins as in the figure below [6].



**Figure (3): Representation of colors in BMP file format [9].**

After understanding this format, we can solve the problem of splitting every component in separate files.

**4. How the colored images are produced initially from bands?**

When the user of the satellite image processing software wants to show an image for any reader to explain some idea, he can submit one band -if it is enough- to explain his idea, or merge three bands to show a colored image like the natural scene and to be more real, specially that the most features of the land can be recognized by eye, i.e. by the bands in visible range. For example if he want to show an image from a TM imagery, he will select band 1, band 2, and band 3, to give us a proper image. Band 1 lies in the blue region (0.45 – 0.52 μm), band 2 in the green (0.52 – 0.60 μm), and band 3 in red (0.63 – 0.69 μm) [2]. In this way the resulted image will be similar to the real scene and like the color in the nature as will as we see in our eyes. So any change in the arrangement of components may cause some oddity.

In addition to that, we can note and recognize some feature colors which are known like grass, shallow water, sands, etc. All these things help us to know the arrangement of bands.

Some times, image may be pseudo colored, stretched, or filtered. So we need in this case, some experience and practice. This may be limits our way somewhat.

**5.The Designed Package: Band Recovery**

This package is designed by visual Basic 6.0 Enterprise Edition. It is prepared for our purpose here, which is to split the three bands in separated files and to preview every one alone. Also it is provided by a Flex Grid to show component values of every pixel to correlate with the origin band.

The package also, can save the bands in an IMG file, and it is provided by facilities to help users in selecting a proper path for the new files. Some help tips are provided to explain our simple work.

We make it as a package to be installed in any computer with any Windows operation system version after Windows 95.

It is 28.8 Mega bytes on CD, and 46 kilo bytes after destination on PC. Some delay is not bad during processing of the images, especially in large ones.

The installation is standard and very easy, but it may ask to restart O.S.

The version which is provided in the attached CD is a limited version and restricted in dealing with images more than (height 590 pixels by width 590 pixels). There are an image (test.bmp) to test the software.

We will explain how to use the package in the practical part of this research.

**6.The Application**

In this part, we will make four steps:

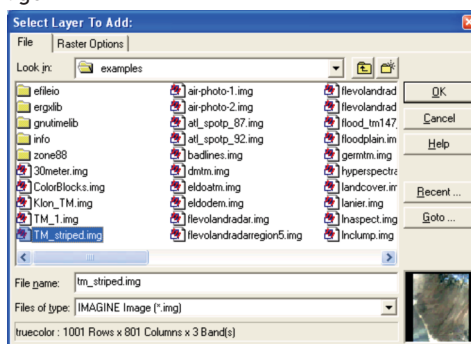
- 1- Using a ready package (ERDAS) to open TM imagery, and make a colored image from the bands.
- 2- Use our software (Band Recovery) to reproduce the original bands.
- 3- Compare the bands pixel values which are resulted by our software with the original bands pixel value which were used by ERDAS to produce the colored image.
- 4- Also we will make comparison by the histogram, because we are unable to examine all pixels in the previous step.

**6.1 Produce a colored image from three bands by using ERDAS**

Firstly, we open the ERDAS IMAGINE 8.4 which is one of the most common and depended tool in remote sensing world.

Open the Viewer windows, and from it's file menu select open, Raster Layers...

From the opened dialog box, select (TM-Stribed.img) file, which is one of the examples attached with the installed package



**Figure (4):Select an imagery.**

The imagery will appear in the viewer window, as in figure (5) below:

Then go to View menu and select (Arrange Layers..). A small form will appears (Figure 6), explaining the arrangement that

the viewer depend to merge the components (bands) to produce the colored image shown in the viewer windows.



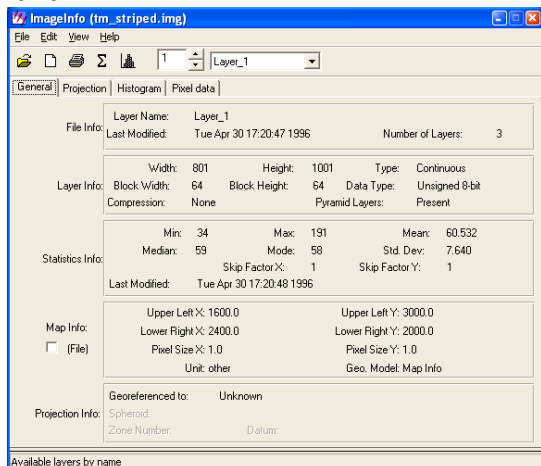
Figure (5): The satellite imagery.



Figure (6): Bands arrangements.

From the last shape, it is clear that the ERDAS Viewer take the third band (0.63 – 0.69 μm) as a red component (first layer), the second band (0.52 – 0.60 μm) as a green component, and the first band (0.45 – 0.52 μm) as blue (third layer), approximately as in the real view.

Close the (Arrangement Layers) form, and open the (Layers Info..) from (Utility) menu to see the information of image and every layer.



Convert this image as a BMP file by printing the scene on screen, then copying it in any image processing program like Adobe PhotoShop and trim it [7], to use it in our Software.

6.2. Use the Band Recovery to spilt band files

From [START> Programs> Recovery Version 1.0] open the package, it's windows will appear as below.

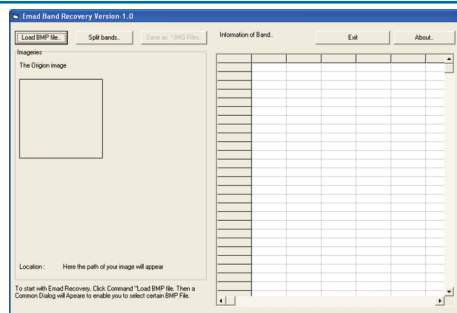


Figure (8): The windows of Band Recovery after installation.

At the left side an empty image box appears, this will take the colored images only for preview, which selected by clicking on the first command (Load Image..).

Note that, when we use an imagery more than (590\*590) pixels. The Flex Grid. can not show all values of bands more than (590\*590), because it is the maximum cells number [8].

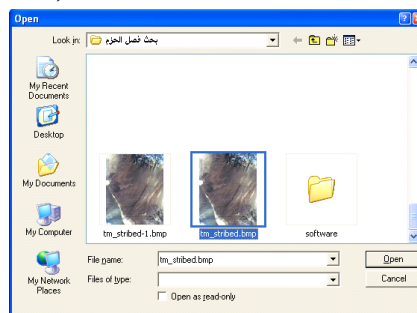


Figure (9): Open an imagery

After selecting this imagery, it will be appeared in the image box as in the figure (10) below.

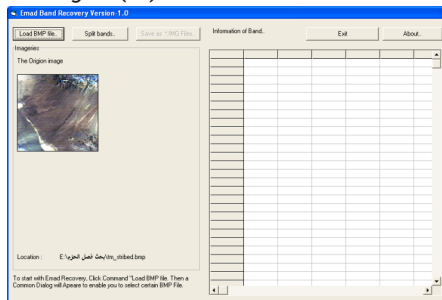


Figure (10): Only the colored image appears yet.

To split the imagery into it's bands, click on the second command button (Split bands..).The same (Open Dialog) will appear again to enable you to select path for the new files which include the separated bands. It suggests for you proper names (Band1.bmp, Band2.bmp, and Band3.bmp). After selecting paths, the three image boxes will appear to display image of the three bands as above.

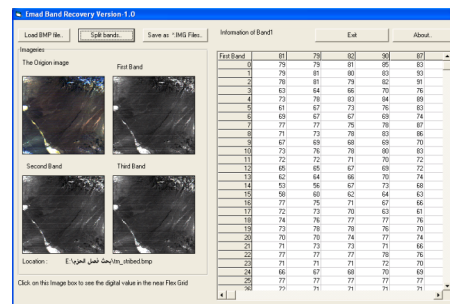


Figure (11): Every band separated in image box

On the right side, the flex grid shows the values of pixels of Band 1. By one click on the other image box, the flex grid will show the values of their bands.

These values very useful and depended in the next step.

The package can export an IMG files also. For this job, only click on the third command button (Save as \*.IMG file..). Then an open dialog will appear to enable the user to select a path for these new files.

**6.3. Correlation with the origin bands**

Return into EARDAS Viewer, and open the form of (Layer Info..) from (Utility) menu. Select the panel of pixel data for the first layer.

In the figure (12) below, a part of pixel data for the first band is shown, it is produced by our software, and in figure (13) it is for the origin band displayed by ERDAS.

First Band	0	1	2	3	4
0	79	79	81	85	83
1	79	81	80	83	93
2	76	81	79	82	91
3	63	64	66	70	76
4	73	78	83	84	89
5	61	67	73	76	83
6	69	67	67	69	74
7	77	77	75	78	87
8	71	73	78	83	86
9	67	69	68	69	70
10	73	76	78	80	83
11	72	72	71	70	72
12	65	65	67	69	72
13	62	64	66	70	74
14	53	56	67	73	68
15	58	60	62	64	63
16	77	75	71	67	66
17	72	73	70	63	61
18	74	76	77	77	76
19	73	78	78	76	70
20	70	70	74	77	74
21	71	73	73	71	65
22	77	77	77	78	76
23	71	71	71	72	70
24	66	67	68	70	69
25	77	77	77	77	77
26	73	71	71	71	71

Figure (12):The flex grid shows the values of band 1.

Row	1	2	3	4	5	6	7	8	9	10	11	12	13
1	78	78	77	78	75	75	80	82	81	77	76	74	
2	73	83	81	75	74	73	74	77	79	81	78	78	
3	75	76	77	76	79	84	79	76	81	83	78		
4	88	78	75	75	76	81	82	78	81	82	79	83	
5	80	76	72	73	73	77	80	77	79	79	77	82	
6	76	71	75	75	74	74	74	77	76	75	77	79	
7	75	73	84	87	82	78	75	71	71	75	78	78	
8	72	77	83	86	86	82	73	67	67	66	73	78	
9	76	80	78	82	86	81	73	67	67	66	74	78	
10	80	82	76	79	80	80	73	70	68	68	73	82	
11	81	82	78	75	73	78	74	73	76	81	83	80	
12	77	82	82	75	73	76	78	73	74	74	72	77	
13	75	84	80	76	77	75	77	76	78	77	78	83	
14	82	84	79	77	78	74	75	82	82	81	83	84	
15	79	76	72	71	75	74	72	77	79	75	77	81	
16	74	79	78	76	73	73	76	75	77	80	79	81	
17	78	76	76	74	79	76	76	80	79	78	78	79	
18	77	78	73	77	67	69	77	72	78	81	80	77	
19	81	76	83	75	80	77	70	73	80	78	78	80	
20	76	76	75	74	75	74	74	78	79	77	80	79	

Figure (13):Values of band 1 by the ERDAS.

We will use the Adobe PhotoShop to display histograms of the three files which contain band information. These histograms are compared with histograms that appear in (Layer Info.. > Histogram palette) in ERDAS, as in the figures below.

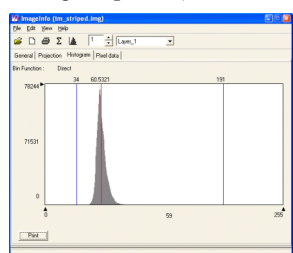


Figure (14): Histogram of Band 1

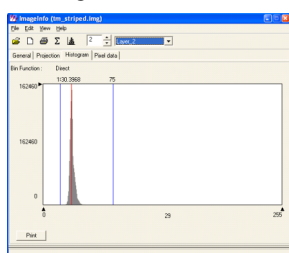


Figure (15): Histogram of Band 2

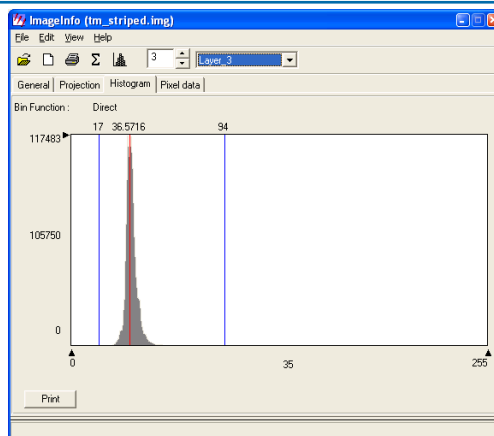


Figure (16): Histogram of Band 3.

The figures below are obtained from PhotoShop.

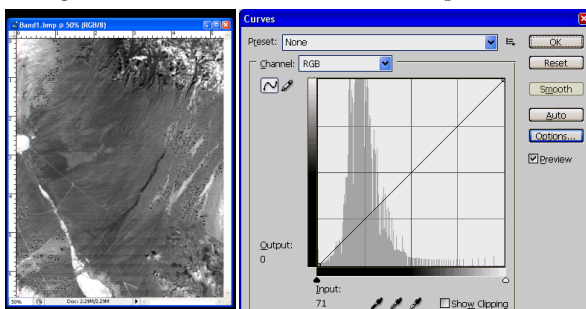


Figure (17): Histogram of Band 1 (reproduced).

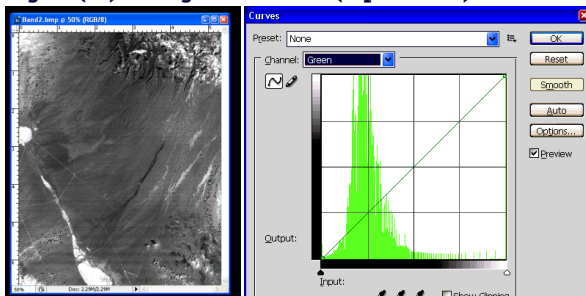


Figure (18): Histogram of Band 2 (reproduced).

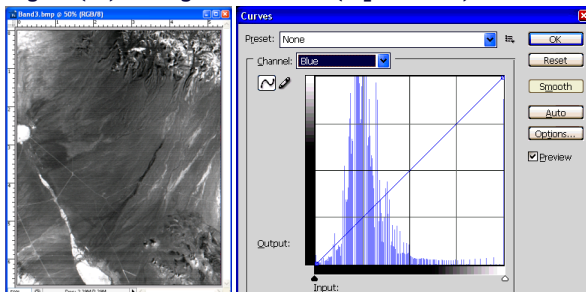


Figure (19): Histogram of Band 3 (reproduced).

Although, there are a small difference between the palette shapes of histograms between ERDAS and PhotoShop, we can note the similarity of pixel distribution between the histograms of the origin bands and the reproduced bands.

**7. Results and Discussion**

The resulted bands are very similar to the origin bands, so we can adopt this way to obtain the bands of any image that we see in the web or any software displaying satellite images.

The image which appears as a real color is more suitable to be treated by this way, but the images which are filtered or processed will be less reliable, and pseudo color image is not

applicable.

Processing", Prentice Hall PTR, London.

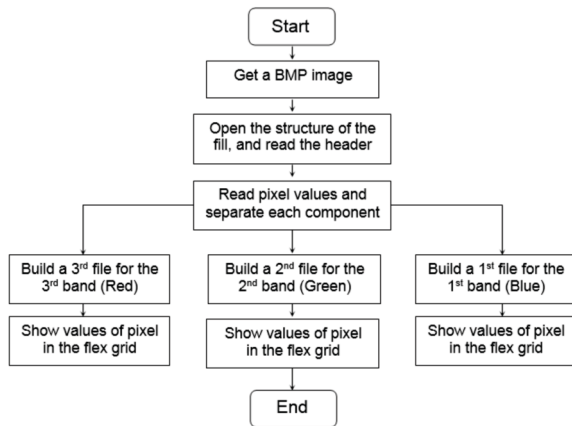
The software (Band Recovery) is a very active tool to do its job, but it needs to be developed to deal with other image file formats rather than BMP files.

We can use the Image of Google Earth because they are near to real image in the human eyes, which means that it is using the standard arrangement of color components (Red, Green, then Blue).

The Band Recovery may be good resources to get the first three bands of Thematic Mapper of Landsat satellite, and the first two bands in the MSS imaging devices.

Also it could be applied to SPOT imagery or any other satellite sensors, only we should know the arrangement of bands in the colored image, before.

**8. A flowchart for the Band Recovery**



**A part of the code:**

```

... 'read pixel values and distribute them on three files to each
component.
For i = 1 To height
For j = 1 To width ' a loop to read all pixel values
  Get #4, ,b 'Take from original file
  Put #1, ,b: Put #1, ,b: Put #1, ,b ' Put in the first built file
(Blue) (repeat 3 times)
  Get #4, ,g: Put #2, ,g: Put #2, ,g: Put #2, ,g ' Get & put for the
second file (Green)
  Get #4, ,r: Put #3, ,r: Put #3, ,r: Put #3, ,r ' Also for the third
one (Red)
  ' See Figure No 3 to know the structure of color palette in
BMP image file.
Next j
Next i
...
  
```

**REFERENCES:**

- [1] <http://www.abovetopsecret.com> , A scientific site deals with electro- magnetic phenomena.
- [2] Richards A. & Xiuping Jia, 1999, "Remote Sensing Digital Image Analysis", Springer – Verlag Berlin Heidelberg New York.
- [3] ERDAS IMAGINE Tour Guides, provided with the software, On-Line Help Copyright (c) 1982-1999 ERDAS, Inc..
- [4] <http://www.nasa.gov> , NORTH AMERICAN SEARCH AUTHORITY (NASA).
- [5] <http://earth.google.com>, The web site of Google Company.
- [6] [http://en.wikipedia.org/wiki/Windows\\_bitmap](http://en.wikipedia.org/wiki/Windows_bitmap) , The free encyclopedia Wikipedia.
- [7] On-Line Help of Adobe PhotoShop CS3, version 10.0, 2007.
- [8] "Using Visual Basic 6" , 2000, Macmillan Computer Publishing.
- [9] Scot E. Umbaugh, 1998, "Computer Vision and Image