Realization of Enhancement performance in Remote Sensing Data by Spatial Filtering Technique

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***Abstract* – The satellite data is the replica of our earth. The features on the earth can be delineated within fractions of time without any direct surveying investigations, which are thrown back as secondary access of gathering information. The advancement of surveying is the Satellite data which gives valuable assessment of features without any direct contact and especially time consuming. At particular area where field visit is necessary alone that can be done as per the requirement. And sometimes these raw data captured may be blurry with noises. This can be removed and enhanced using different algorithms. Working on to the Landsat satellite images for CMA boundary using Spatial Filtering techniques in Matlab helps to obtain the feature enhancement for the betterment of delineation. This method is to enhance the raw satellite information to a certain extent, reduces the misinterpretation.**

Keywords – Image Processing, Image Enhancement, Filtering Techniques, Landsat, Matlab

I. INTRODUCTION

By working on Satellite data using Image processing techniques, enhancing image data values, it is easy to demarcate features that are not visible to our human eyes and to locate geo-positions of features. The level of intensity, or reflectance of brightness from the surfaces in the satellite image can be helpful with the study of vegetation monitoring and flood analysis, identification of minerals, Geomorphological features, lakes, stream, Rivers, water bodies etc. thus enhancing the boundaries by Spatial Filtering. Numerous articles describe how to construct frequency filters (Al-Hinai et al.,1991; Pan and Chang, 1992; Khan, 1992). GIS and remote sensing tools are widely used for the management of various natural resources (Dar et al., 2010; Krishna kumar et al., 2011; Magesh et al., 2011). Remote Sensing not only provides a wide-range scale of the space-time distribution of observations but also saves time and money(Murthy,2000; Leblanc et al., 2003; Tweed et al., 2007).

II. STUDY AREA AND MATERIALS USED

A. Extracting Area of Interest

Selecting Area of Interest (AOI) is done based on the requirement and its the process of Image preprocessing which helps to reduce the image of our AOI spatially.

B. Study Area

Here, the Chennai Metropolitan Administration (CMA) boundary is taken as the Area of Interest (AOI) as study area for this project.

C. Data Collection

- Landsat TM 7 Bands
- Toposheet Data

III. METHODOLOGY

A. Visual Interpretation

An image analyst first understands the satellite information clearly and refers along with the available data such as Toposheet maps and field observations. Satellite images are interpreted based on the interpreter's knowledge, guidance and experience, depends on the nature of the topography and structural Geomorphological features, and the quality of the images. Most applications consider the following basic characteristics, or variations of them: shape, size, pattern, tone, texture, shadows, size, association, and resolution (Olson, 1960).

B. Digital Processing

Digital image processing involves correction of raw data by different enhancement methods to improve the visual understanding of images. Digital processing and analysis helps to identify features clearly and extract information from the satellite data without manual interference does automatically.

C. Image Enhancement

Image Enhancement is to create new images from the original image data in order to increase the quantity of information from the processed data to visualize and interpret easily from the data.

Filtering analyzes the variance of the pixel values in space, along with the spatial frequency of the satellite data. It is the sudden high difference in pixel values along the detachment of features like lineaments of faults, structural and Geomorphological features like pediment-pediplain, Rivers, Roads, Canals, Ponds, Drainages, settlement boundaries and small difference in pixel values in land area such as water

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bodies, agricultural fields, and crop vegetation so on. High pass filter will enhance features smaller than half the size of the kernel being used and smudge features larger than half the kernel window size.

D. Spatial Filtering

These are the following step by step basic procedure for working with satellite images to enhance the image.

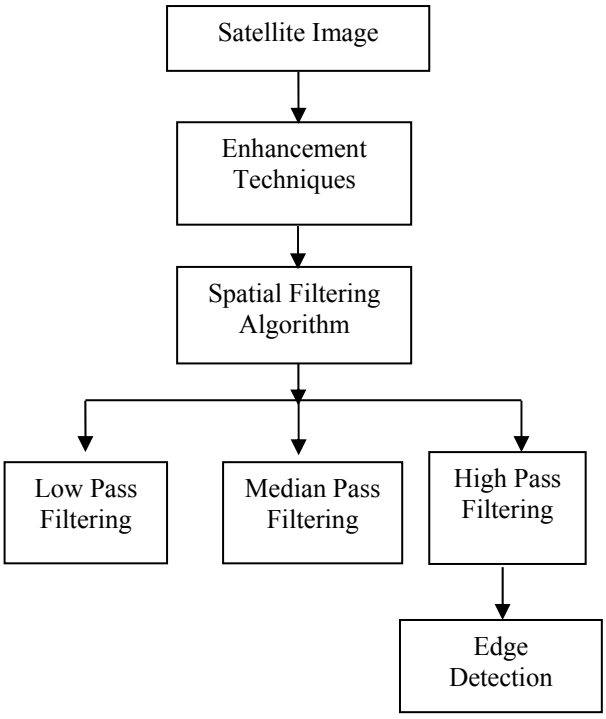

Fig.1. Flowchart of Spatial Filtering

Filtering includes set of digital processing functions used to enhance the manifestation of an image. Filters are intended to emphasize or suppress certain features in an image based on their spatial frequency criteria. Filters change a pixel's value taking into consideration the values of adjacent neighboring pixels and update as recorded images. Each pixel is taken into account and replaced by the average mean of pixel values in a 3x3 square, or window kernel centered on the particular pixel. The outcome is to decrease noise in the image, but also to smudge the area of equal importance and highlight the edges of the image. The spatial filtering is adopted using spatial masks. The spatial filtering helps to enhance the image by reducing noises. There are mainly three types of spatial filtering say, Low pass Filter, High pass Filter and Median Pass filter. Low pass filter does smoothening the images, whereas high pass filter sharpens the images and is used as spatial filtering technique for images. It emphasizes edges and sharp details in an image highlighting the boundary details of the objects. Median filter is suitable in noisy image for reducing noise patterns and also maintains sharp edges while low pass filter is not suitable for reducing the noises.

IV. SPATIAL FILTERING TECHNIQUE

A. High Pass Filter

Since there is no much noise to be removed, the high pass filter is used here to enhance the sharp detailed features such as edges that are poor in the original image.

$$I_{x+1,y} = 1/(2x+1)\ \Sigma f ky \qquad (1)$$

Where, k=1 to 2x+1

The mask (3x3) is taken such that the center of the mask has any positive value and all its neighboring coefficients are of negative value.

-1	-1	-1
-1	8	-1
-1	-1	-1

Fig.2. Mask

From the top to the right end till it reaches the last position of the image, each pixels are considered and the values are replaced. Pixels having equal values are assumed that all the pixel values have same grey level value say 10. Then the calculation of the mask area is as

$$R_a = 1/9[\ (-1*10)+(-1*10)+(-1*10) + (-\ 1*10) + (8*10) + (-1*10) + (-1*10) + (-1*10) + (-1*10)] = 0$$

Thus the center pixel of the mask is replaced by 0 and the background other pixels correspond to low frequencies are weakened. When the Pixel is high say 200 value, and all its neighbors have same gray level 10, then the corresponding calculation of the mask is given as,

$$R_a = 1/9\ [(-1*10) + (-1*10) + (-1*10) + (-1*10) + (8*200) + (-1*10) + (-1*10) + (-1*10) + (-1*10)]$$

$$= 1600\text{-}80/9 \quad =168.$$

Thus the center pixel of that mask area is replaced by 168. This means the pixels emphasizes the present feature details corresponding to the edges and sharp details.

The sharpened image is thus obtained by the inverse Fourier transform, and the noises enhanced that can be reduced. This problem may be avoided to some extent by using suitable high emphasis filters like *trapezoidal filter, exponential filter, Butterworth filter* etc., where the rate of transition of response of the filter from 0 to 1 is slowed down [Gonzalez and Wintz (1977)].

Filter=padarray(2,[2 2])-special('gaussian',[5 5],2);
sharpened = imfilter(image,Filter)

V. RESULTS

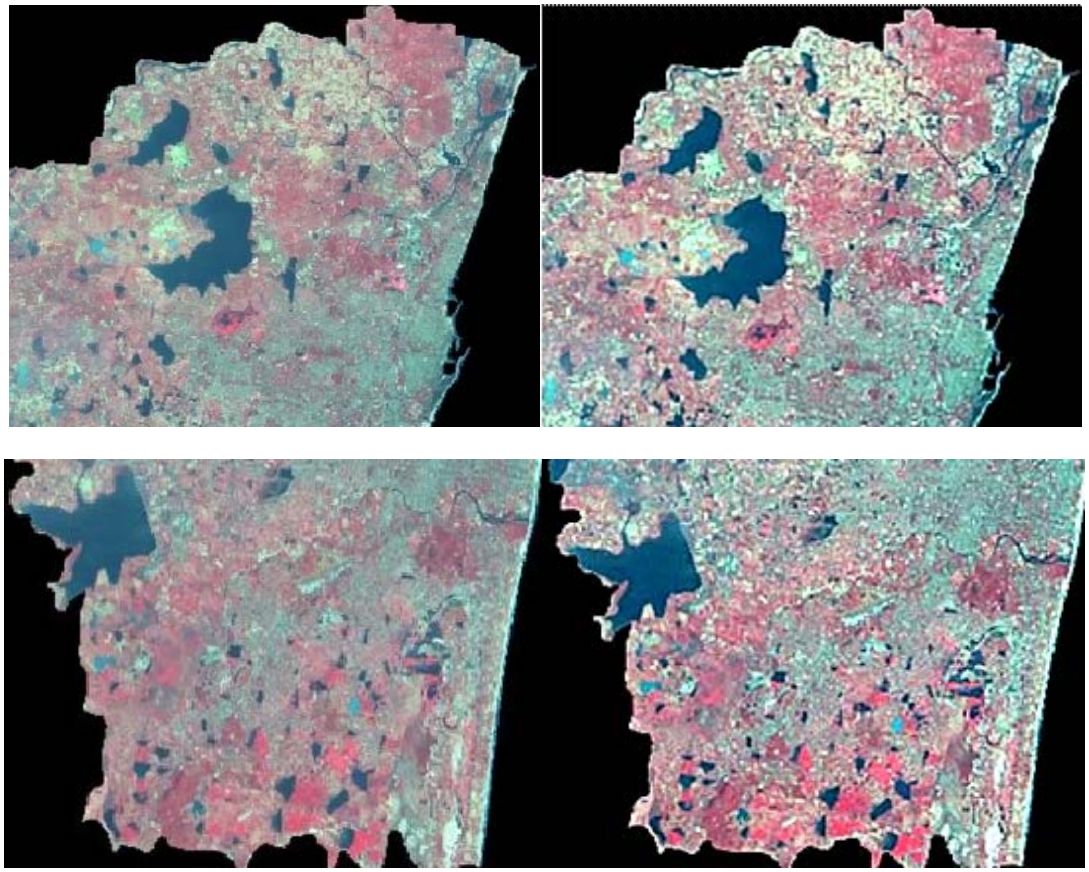

Fig.3. Few zoomed images showing the Landsat FCC Image and Sharpening of AOI image

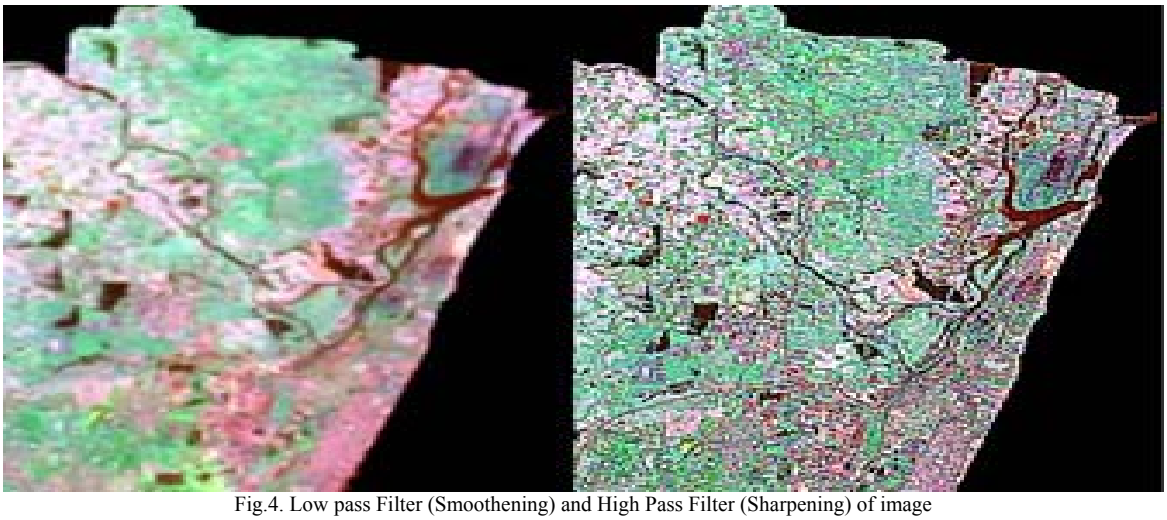

Fig.4. Low pass Filter (Smoothening) and High Pass Filter (Sharpening) of image

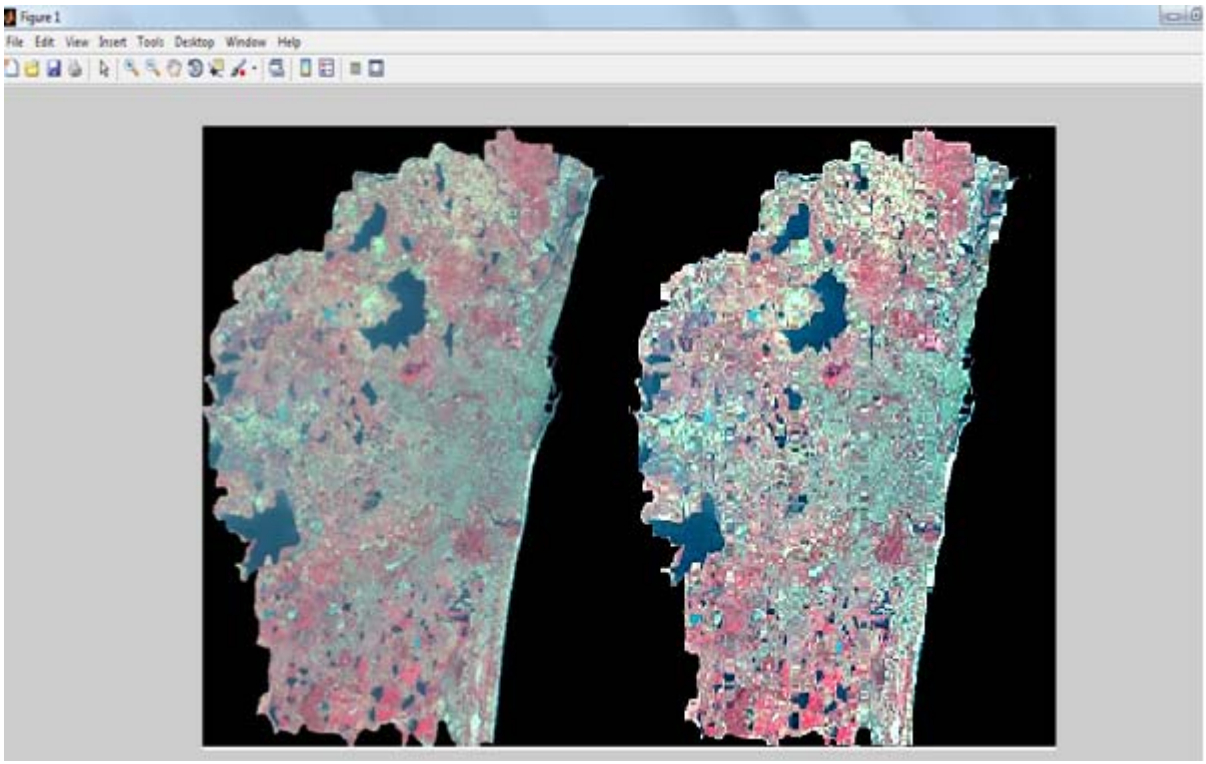

Fig.5. Enhancing the Chennai Metropolitan Area Boundary of Landsat Image Spatial Filtering Technique

VI. CONCLUSION

Image processing is the key for Remote sensing raw data. Using these methods of implementation helps to analyze the data in an effective way. It smoothens and gives clear cut boundaries of all the sharp portions, so delineation makes easy and accurate. In general, the features on the ground in current status can be studied, analyzed and examined with this enhancement of satellite images goes on easy for planning, designing infrastructure and style. Enhancement techniques help the interpreters in a drastic way giving definite precise representation. This is performed only by using the image processing techniques. This paper refers the implementation of spatial filtering technique in remote sensing data for the enhancement of data. Filtering techniques helps to enhance the image with few lines of algorithm by enhancing the boundaries, thus this technique promotes for delineation of roads, canals, channels, streams, Rivers, Drainage, Water Bodies etc. In the future many techniques combined with soft computing methods may give definite accurate results.

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