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Analysis of Satellite Image Filter for RISAT: A Review

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Abstract

Satellites today are prime source of information capture and decision making for research organizations, corporate houses and government departments like weather forecasting, agricultural monitoring etc. Accurate and timely retrieval of data is key challenge for satellites today. The major issue with information capture is mixing of unwanted signals called noise with required vital data which leads to malfunctioning of decision making process. In order to overcome the issue, it becomes a mandate today to design and develop specific filters to different satellites which are problem specific and capable of tuning the captured information in various formats in robust manner. In this work, a review of Satellite image filter for RISAT is presented. These filters work on visible, infrared and water vapor images which are taken from satellites.

Index Terms*: Satellite Images, Filters-Sobel, Prewitt, Robert Cross, Canny*

1. Introduction

Image processing can be taken as the Manipulation of digital images by computer. Image processing focuses on two foremost tasks: enhancement of pictorial information for human interpretation and high level processing. Processing of image information for storage and transmission. Digital images are prone to the diversity of types of noise. Noise is the result of errors in the image gaining process that result in pixel values that do not reflect the true intensities of the original scene. There are several ways of introducing noise into an image, depending on how the image is created. For example if the image is scanned from a snap made on film, the film grain is a source of noise.

Noise can also be the outcome of damage to the film, or be introduced by the scanner itself.

With the advent of several filters for satellite image processing arena and their vitality, it requires critical emphasis on design and development of robust image filter application for different type of RISAT images. In this project work I am trying to design a filter for denoising the satellite images.

2. Literature Survey

To apply the concept of different filter, in this project, we have studied the three basic types of satellite image which are:

- Visible Image
- Infrared Image
- Water Vapor

Visible Imagery: Visible satellite images can be viewed during the day only, since clouds reflect the light from the sun. On these pictures, clouds show up of white colour, the ground is normally of grey colour, and water is dark. In winter season, snow-covered ground will be white, which will make distinguishing clouds more difficult. To help

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differentiate between clouds and snow, looping pictures can be helpful; clouds can move from one place to another while the snow cant. Snow-covered ground can also be recognized by looking for terrain features, such as rivers. Rivers will remain dark in the imagery till they are not frozen. If the rivers cannot be seen, they are probably covered with clouds.

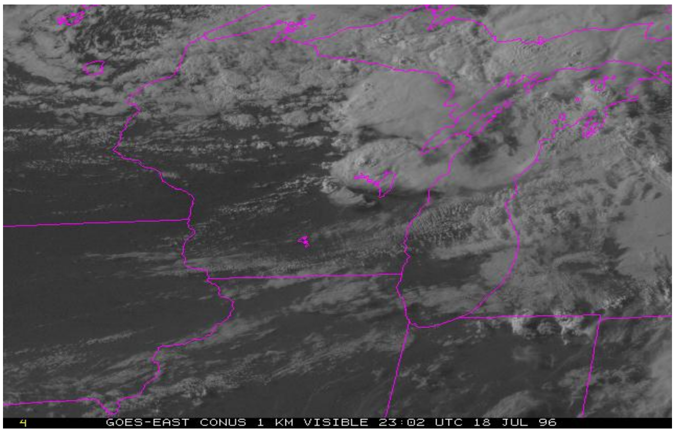

Figure. Visible Image

Infrared Imagery: Infrared satellite images show clouds in both day and night. Instead of using sunlight to reflect off from clouds, the clouds are recognized by satellite sensors that measures heat radiating off from them. The sensors also measures heat radiating off from the surface of the earth. Clouds will be colder than land and water, so they can be easily identified. Infrared images can also be used for identifying fog and low clouds.

-1	0	1
-2	0	2
-1	0	1

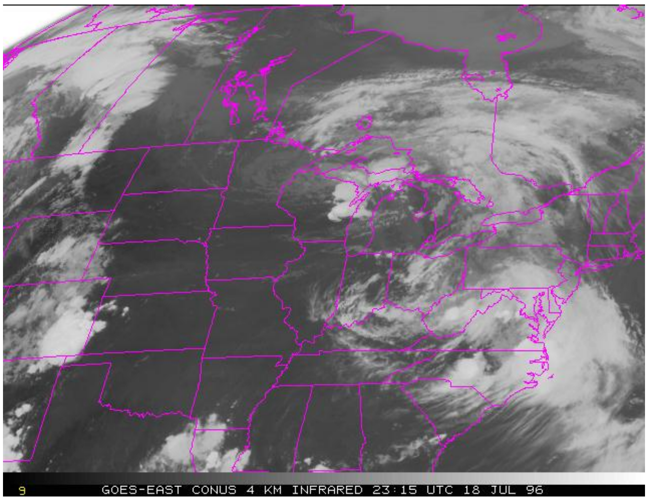

Figure. Infrared Image

1	2	1
0	0	0
-1	-2	-1

Water Vapour Imagery: Water vapour satellite images indicate how much moisture is present in the troposphere (approximately from 15,000 ft to 30,000 ft). The highest humidities will represent the whitest areas while dry regions will be dark in colour. Water vapor imagers are useful for indicating where heavy rain is possible.

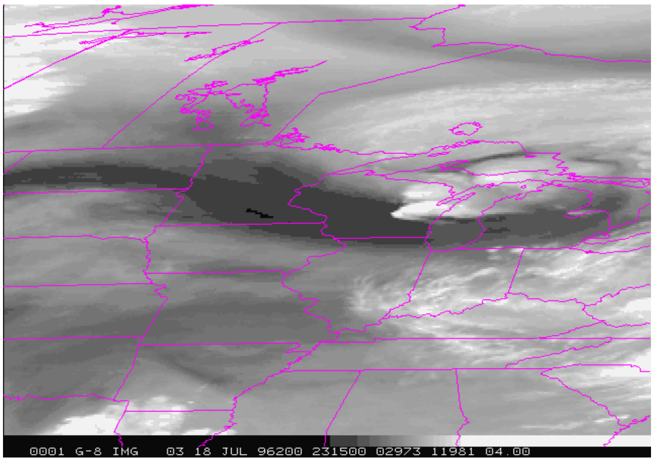

Figure. Water Vapor Imagery

To find out the edges of these images I have studied the following edge detection filters-

Sobel Operator:

Sobel is a discrete differential operator[1] which exploits the two 3×3 kernels[2]: among which one kernel estimates the gradients in the X-direction, while the other one estimates the gradients in the Y-direction say Gx and Gy respectively.

The image is convolved with both kernels to imprecise the derivates in horizontal and vertical change. At each given point, magnitude of the gradient can be estimated with –

$$G=\sqrt{Gx^2 + Gy^2}$$

However it is faster to calculate the gradient magnitude with-

$$|G|=|Gx|+|Gy|$$

Due to the Smoothing (Gaussian Smoothing) effect of sobel filter, it is less sensitive to noise present in an image. On the other hand Smoothing effects the correctness (accuracy) of edge detection.

In other words the image produced by sobel operator does not matches the high accuracy for edge detection. But its quality is enough satisfactory to be used in numerous applications.

Prewitt's Operator:

Prewitt's operator is also similar to sobel's operator used to find out the horizontal and vertical edges of images [3]. The Prewitt edge detector is suitable for an edge to calculate its magnitude and orientations, although most of the direct orientation calculations are not exactly accurate. The prewitt operator also uses the 3×3 neighbourhood kernels for eight directions [4]. To select the one with the largest module, the entire eight masks are calculated.

-1	+1	+1
-1	-2	+1
-1	+1	+1

Prewitt Operator

-1	+1	+1
-1	-2	+1
-1	+1	+1

Robert Cross Operator:

Robert operator is a partial differential operator [5]. The operator also performs a simple, quick to compute, 2-D spatial gradient measurement on an image. This operator consist of 2×2 kernels except the 3×3 as other operators, shown in fig-

0	+1
-1	0

+1	0
0	-1

The kernels are intended to respond maximally the edges running at 45° to the pixel grid, one kernel for each of the two perpendicular orientations.

To gain the separate measurement of gradient components in each orientations (say these Gx and Gy), the kernels can

Be applied separately to the original image.

Now to find out the absolute magnitude of the gradient at each point and the orientations of that gradient, these kernels than can be combined together.

The gradient magnitude are represented as follows-

$$|G| = \sqrt{Gx^2 + Gy^2}$$

Typically, an approximate magnitude is computed using-

$$|G| = |Gx| + |Gy|$$

Which is much faster to compute.

The angle of Orientation of the edge related to the pixel grid orientation is given by-

$$\theta = \arctan (Gx/Gy) - 3\prod / 4$$

Canny Operator:

Canny filter was developed by John F. Canny (JFC) in 1986 [6]. Canny filter is optimal with regards the following-

Canny is an edge detection operator, which uses a multi-stage algorithm to find out the wide range of edges in image. The algorithm follows the steps given below-

1) Smoothing: Smoothing refers to blur the image to remove the noise presented in the image.

2) Finding Gradients: When the gradients of the image have large magnitudes, the edge should be marked.

3) Non-Maximum Suppression: According to the Canny's algorithm, only local maxima should be marked as edge. And remove the pixels which are not the part of the edge.

4) Double Thresholding: The algorithm uses two thresholds **Upper threshold** and **Lower Threshold**. If the pixel gradient have the higher value than the upper threshold, then the pixel will be marked as an edge. And the pixel will be discarded, if the gradient value is below the lower threshold. And if the threshold value lies between the two thresholds then only that pixel is marked as an edge which is connected above the upper threshold.

5) Edge Tracking by Hysteresis: At the last step of algorithm, final edges are determined by suppressing all the edges that are not connected to very strong edges.

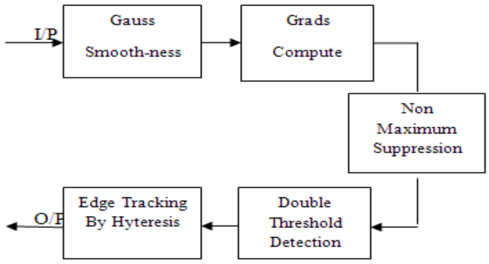

Figure. Procedure of Canny Operator [7]

Operator	Applications	Limitations
Sobel	Simple, Detects edges and their orientations	Inaccurate and sensitive to noise
Canny	Smoothing effects to remove the noise, Good localization and response, Enhances signal to noise ratio, Immune to noisy environment.	Difficult to implement to reach real time response, Time consuming

3. Purpose of Undertaking the Current Work

In today's scenario the application areas of **satellite image processing** are increasing day by day. Such as in weather forecasting, agricultural monitoring, tropical forest monitoring, natural resources exploitation, ship detection in coastal region etc.

Noise is very often to occur in an image. As the application areas of satellite image are increasing, the need of removing the noise is also increasing. Noise is unwanted electrical or electromagnetic energy that degrades the quality of signals and data. Noise occurs in digital and analog systems, and can affect files and communications of all types, including text, programs, images, audio, and telemetry.

For removing this unwanted energy called as **Noise,** we need some filters. So we conclude that **Filter**s plays a very important role in Digital Image Processing, as they helps in removing the noise and extracts the useful information from an image.

There are so many filters available for digital image processing to remove the noise from an image but there is not any particular filter available for any kind of satellite image. So in this project work, we are trying to design a filter which will helps in removing the noise from satellite images captured by Radar System.

4. Conclusion

We have concluded that satellite images are prime source of information retrieval system such as in medical science, weather forecasting, agricultural monitoring etc. For information retrieval these images need to be processed, while doing so there may be some unwanted signals called **Noise**, which may lead to the information loss.

To overcome this we need **Filters**. Among all the filters discussed above Canny filter have so many advantages such as its smoothing effect to remove the noise but have some limitations too, such as its difficult to reach the real time response and is time consuming. So in my project work I am trying to design one such filter which will be able to overcome these limitations.

References

[1] Z. Jin-Yu, C. Yan and H. Xian-Xiang, "Edge Detection of Images Based on Improved Sobel Operator and Genetic Algorithms".

[2] R. Maini and H. Aggarwal, "Study and Comparison of Various Image Edge Detection Techniques", "International Journal of Image processing (IJIP)", 2009 vol. 3, Issue 1, **(2009)** February 28, ISSN (Online) pp. 1985-2304.

[3] I. E. Igbinosa, "Comparison of Edge Detection Techniques in Image Processing Techniques", "International Journal of Information Technology and Electrical Engineering(ITEE)", vol. 2, Issue 1, **(2013)** February, ISSN pp. 2306-708.

[4] J. -T Shi, Y. Zhu, X. –L. Chu and X. Chen, "A Novel Approach of Edge Detection Based on Gray Weighted Absolute Correlation Degree and Prewitt Operator".

[5] J. Zhang, "Edge detection in glass fragmentation images based on One Order Differential operator", Second International Conference on Computer Engineering and Applications", **(2010)**.

[6] "Canny Edge Detection, 09gr820, **(2010)** March 23.

[7] S. Jain, S. Bagga, R. Hablani, N. S Chaudhari and S. Tanwani, "Facial Expression Recognition Using Local Binary Patterns with Different Distance Measures**"**, Intelligent Computing, Networking, and Informatics, Conference on **(2013)** December 18.

[8] M. Dixit and S. Silakari, "Face Recognition Using Approximated Bezier Curve and Supervised Learning Approach", IJMUE, vol. 8, no. 4, **(2015)**, pp. 311-324.

