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Satellite images edge detection based on morphology models fusion

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Abstract

One of the first steps of feature extraction is edge detection. There are various methods for edge detection such as sobel operator, log method and canny operator but with disadvantages (create noise, image smoothing and discontinuous edge detected). We present an improved method for edge detection. In this method, edge detected by morphology's operator and their combination and with the use of various structure elements of images in satellite and remote sensing.

Keywords: Satellite, Image processing, Edge detection, Multi spectral images.

Introduction

One of the arts that have been presented for collecting information from the earth's surface is through satellite images. Processing satellite images helps geography information. One of the uses of processing the satellite images is extracting for purposes and different objects and these purposes and objects can be natural (mountain, desert, lake, etc.) artificial or man-made (roads, places, electricity lines, etc). Processing and interpret these images on specific features are in great demand to achieve our purposes (CANTY, 2002). In this article the problems about the method have been solved and better algorithmic on the basis of morphology operators is presented (Christian Hergarten, 2004).

Methods of feature extracting in satellite images

Two general method that can be used for explaining images are: Spectral method and Place method. In spectral method reflex ion electromagnetic wave that have been shined on objects and difference of the waves latitudes signal reflexes information about the kind of quality, situation and sources situation and different objects on earth have been extracted. But second method, the information about the necessity on the based on the object features has been extracted that the most important are shape, color , theme ,contextual, size, that each of them are used in their specific methods and have classic steps is description satellite images is object recognition.

In this article the primary steps of shape recognition that is edge detection is discussed. If we use the shape feature for achieving information, it should be achieved based on dimensions and peripheral of shape. Extracting shapes is usually on the basis of borders-areas-geometric changes and the initial step for image analyzing and extracting is classifying. With its combined image it is divided into combined parts. The size of classifying depends on the topic it means that when the favorite object is departed the classifying should be stopped. Generally classifying is the hardest works in processing pictures. In this step, the probable success and failure is defined. Algorithms of classifying single colored images are usually based on one of the two main property of gray-scale that is discontinuous and similarity. In the first group, the image is classified on fast gray changes. Main topics in this group are making detection of single points and edge's image and the purpose method.

The main technique in the second group is threshold, the area growth and dividing. In this article the first step is discussed. The basic theory in the most making edge detection methods is by calculating a local derivative operator we can use the magnitude of the first derivative for defining whether the pixel is on the edge or not and the second derivative for defining whether the pixel on the edge is on the dark or bright side. Several methods are in this field (Foody, 2002) and briefly discussed here.

Sobel operator is one of the edge detection methods as observed in Fig. 1; both do the influence of deriving and smoothing but the in fact observe a lot of discontinuous in the figure. The Laplacian operator is very sensitive to noise and produces double edges and is not able to appear the direction of the edge to show that a pixel is on the dark or bright side (Christian Hergarten, 2004). Another method is using operator Canny. This method the necessary steps for smoothing and edge detecting are done together. Although this method includes better results for edge continues and but we observe noise in parts of images. On the other hand it has more calculating than the former methods (Fig.1). In fact, for reasons like noise, break borders (because of heterogeneous bright and other factors) that make unnatural not allied seldom, these methods show a complete border. Hence there is a need for obvious algorithmic edges detection and other edge linking algorithm (Rafael *et al.,* 2002).

Edge detecting of the satellite images

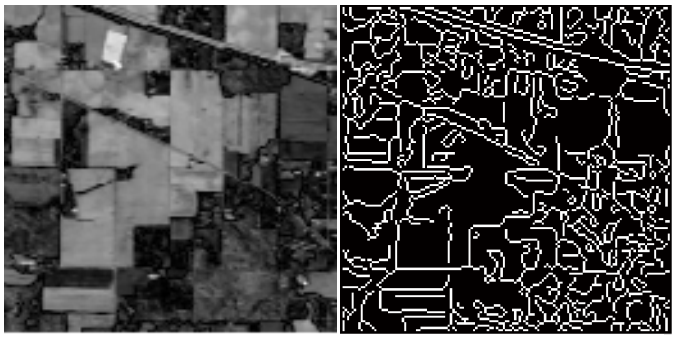
In satellite images because of the existence of many features and objects with different shapes and sizes it is necessary that the extracted edges to be connected completely; otherwise if these edges and borders to be broken very much it may be considered an object in which this problem is included in the mentioned methods. On the other hand, the amount of noise should be considered too, because noise can omit a part of the shape or add a part to it. For edge detection of multi spectral images, Cumani method was used. This method use PCA algorithm for decreased number of spectra (Aldo Cumani, 1991). This method provides better result

Indian Journal of Science and Technology Vol. 5 No. 7 (July 2012) ISSN: 0974- 6846

but defective of noise environments with complex computation Fig. 1.

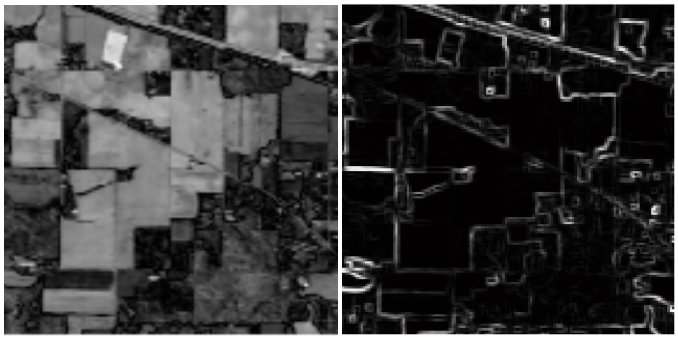
Other method for edge detection is criterion Educlidean. Bakker and Schmidt (2002) followed a method for measurement smoothness of images beneficial of Gradian operators and Euclidean criterion. By this method the cost of computation becomes large and an edge detected is not continuous. This method is noise sensitive as well Fig. 2.

Fig.1. Use of Cumani method.



Original image Cumani method

Fig. 2. Use of euclidean criterion



Original image Euclidean criterion

Edge detection on the based morphology operators

In this part we consider the descriptions of morphology operator's dilation and erosion which are two Basic morphology operators and other morphology operators are often derived from their combination. If A is a white and black picture and B is a structure element, the dilation of the base of B on the image of A is shown (Beucher, 1990) by:

$$(A \oplus B)(x,y) = \max\{A(x-s, y-t) + B(s,t)\} \quad (1)$$

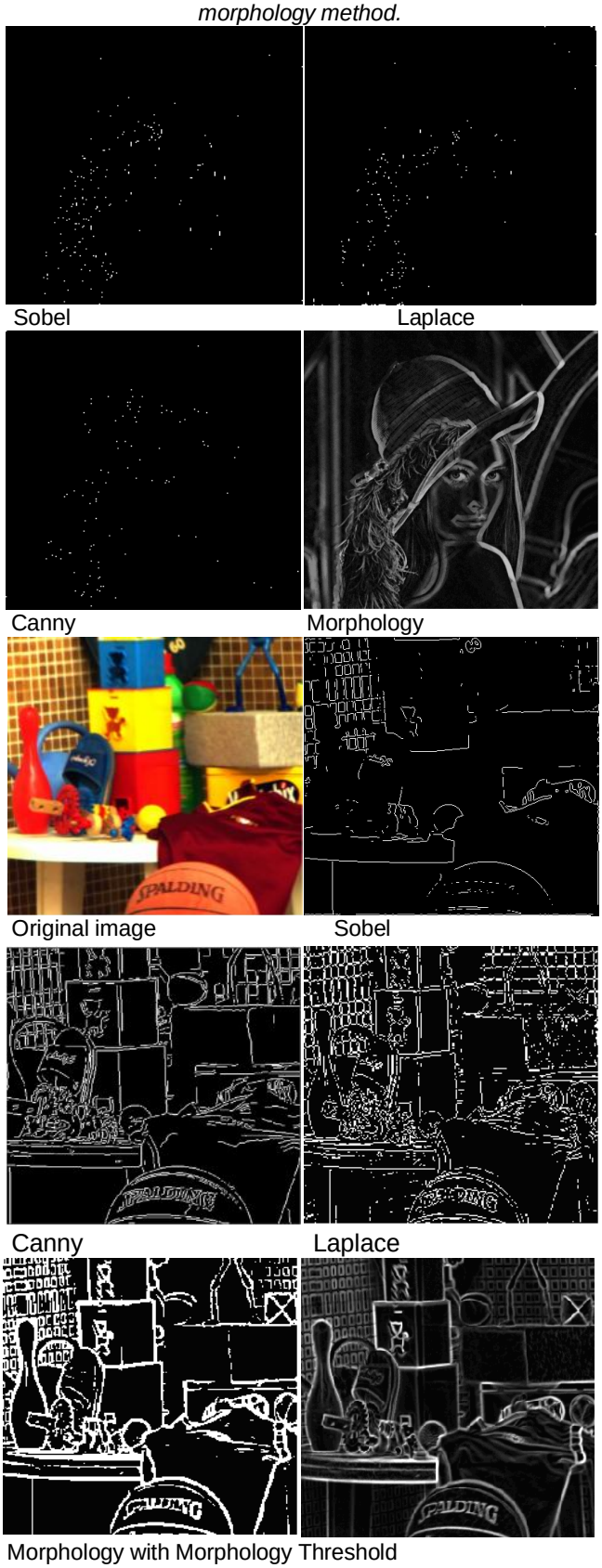
Dilation is an operator that grows and thickens the objects in a binary image. Erosion operator is explained below for A, B sets:

$$(A \Theta B)(x,y) = \min\{A(x+s, y+t) - B(s,t)\} \quad (2)$$

Erosion makes small or makes the around of an image thin. Like dilation operator the method and the amount of the erosion is controlled by the structure elements. Opening operator on A set by means of structure elements B with the relation of $A \circ B$ is describe as:

$$A \circ B = (A \oplus B) \oplus B \quad (3)$$

Fig.3. Comparison of traditional technique and morphology method.



Indian Journal of Science and Technology Vol. 5 No. 7 (July 2012) ISSN: 0974- 6846

Closing operator that makes smooth some parts of the periphery; on the contrary the Opening operator usually mixes the broken hybrids and omits the small details and fills the spaces of objects periphery classing operator on A and B sets as described below:

$$A\Theta B \subseteq A \subseteq A \oplus B$$

$$A \circ B \subseteq A \subseteq A \bullet B \quad (4)$$

Morphology edge detection algorithmic uses basic operator such as closing, opening, dilation, erosion as described below:

$$E_d(A) = (A \oplus B) - A$$

$$E_e(A) = A - (A\Theta B) \quad (5)$$

$E_d(A)$ is an image edge which is an achieved by using the subtract of dilation image from the main image and Ee(A) is the subtraction of the main image from erosion image (Zhao *et al.,* 2005).

We observe that dilation and closing make the shape of the image big whereas erosion and opening makes the shape of the image small. It enables us to use these exclusivity for finding the edges (rnauMir *et al.,* 2009). Morphology gradient of the image is given by:

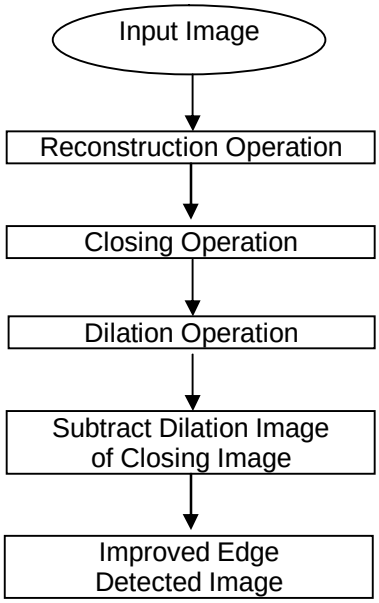
$$G(A) = (A \oplus B) - (A\Theta B) \quad (6)$$

We have shown the result of the comparison of this method and other methods for Lena image (Fig.3a) and one sample of multi spectral image (Fig.3b).

The purposed method for satellite and multispectral images edge detection

In this method, morphology reconstruction operator for processing and omitting noise is used and followed by operator closing and dilation of the images is smoothened. With the notice of using structure elements and achieved experimental results on this method, we observed that the bigger the sizes of structure elements become the thicker and the achieved borders. With this point in mind that if the size of structure element is much bigger, it causes standard and elongation of the borders which will not have a favorite result. In this purpose method in comparison of the mentioned methods the results have become better, the structure elements in the shape of a circle and square will have better results than other structure elements in satellite images. In satellite images which have more details getting good edges, the smooth image is subtracted from the above processing before the dilation operation. Fig. 4 shows the Algorithm's flowchart (Image Processing Toolbox User's Guide, 2004).

Fig.4. Proposed algorithm

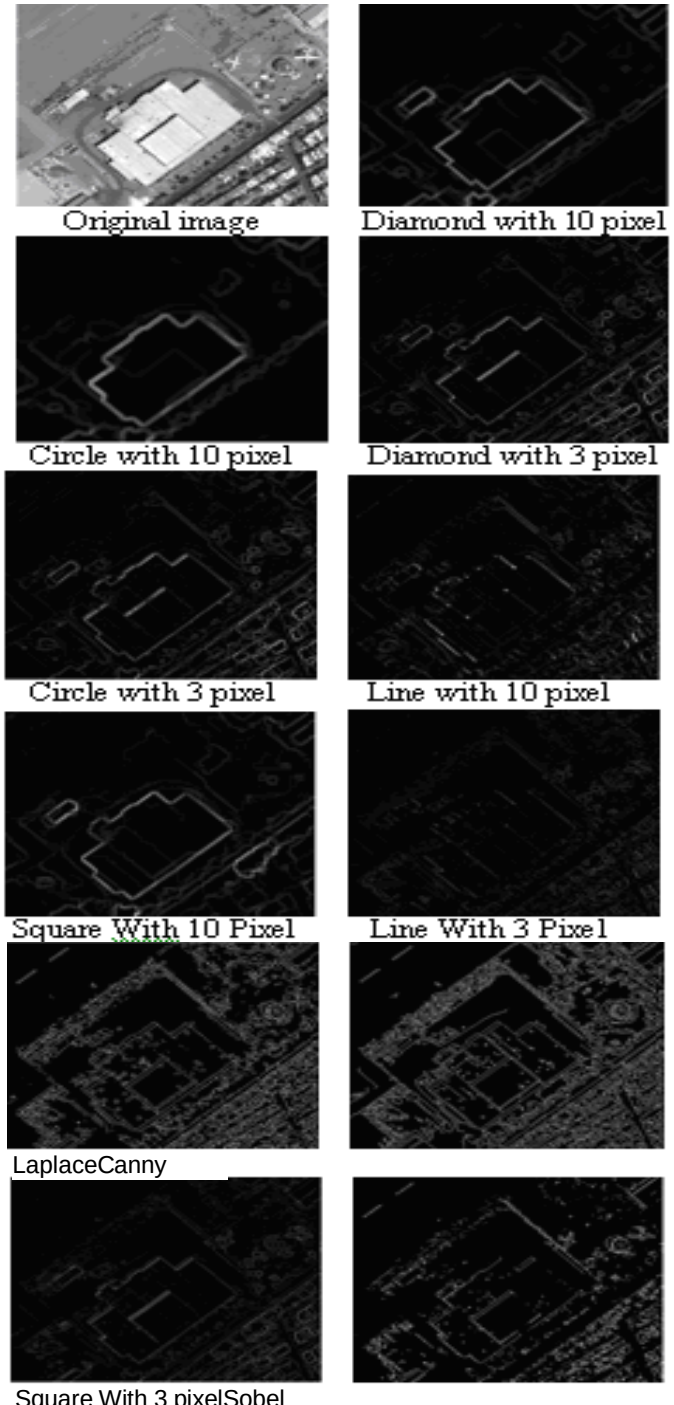


Given below is for A and B set achieve purpose method (Santhaiah *et al.,* 2009):

$A_1 = (A \oplus B)$ (7)

$A_2 = R_A(A_1)$ (8)

Fig. 5. Purpose algorithm result and comparison various structure elements with various pixel number and sobel, laplace , canny operators



Indian Journal of Science and Technology Vol. 5 No. 7 (July 2012) ISSN: 0974- 6846

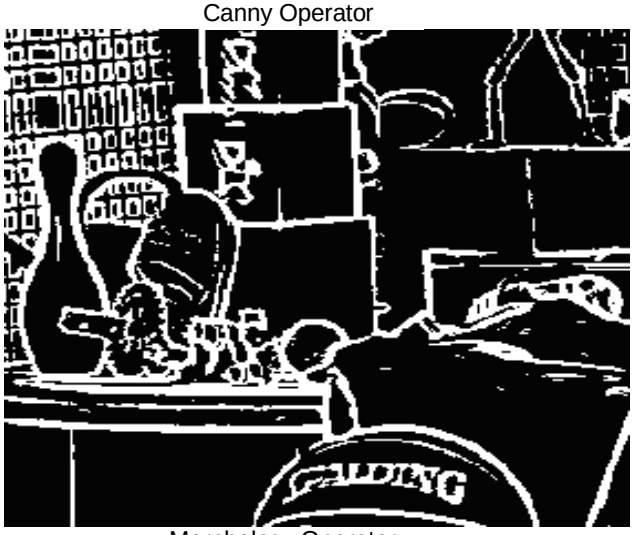
$A_3 = (A_2 \oplus B)$ (9)

$A_4 = R_{A_2}(A_3)$ (10)

Fig. 6. Comparison of purpose method and canny operator (Canny operator presented better result of general methods)

Original Image

Canny Operator



Morphology Operator

in the relation of RA (8) is Reconstruction.

Implement results

Fig. 5 presents the use of different structure element. In this article, the two categories given are used: Lena image from the existing software and satellite Quickbirde carefully 60 * 70 cm for a town zone next to the airport and objects such as buildings in different dimensions, air plane, automobile, etc.

Done tests

The tests done on multi spectral images which accompanied by the main image and image operation of the canny operator is shown in Fig. 6. The derived edges in the purpose edges method have better quality images which have minute details and more by choosing suitable structure elements and even combining these we can receive better edges of higher quality.

Conclusion

We have shown a method that can decrease the noise in images and provide improvement in edge detection.

Acknowledgment

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