Detection of Edges Using Mathematical Morphology for X-Ray Images

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Abstract: *Detection of edge is a terminology in image processing and computer vision particularly in the areas of feature detection and extraction to refer to the algorithms which aims at identifying points in a digital image at which the image brightness changes sharply or more formally has discontinuities. The need of edge detection is to find the discontinuities in depth, discontinuities in surface orientation, changes in material properties and variations in scene illumination. Mathematical morphology is a new technique for edge detection .It is a theory and technique for analysis and processing of geometrical structures, based on set theory. In this paper square type structuring element of different size is implemented on different image. The noise can also be suppressed by mathematical morphology. So by using mathematical morphology the image can be enhanced and the edges can be detected.*

Keywords: *Mathematical morphology, edge detection, x-ray images, erosion, dilation.*

1. Introduction

Edge detection is a fundamental tool, which is commonly used in many image processing applications to obtain information from images and frames [11].The separation of the image into object and background is a critical step in image interpretation [2]. An edge may be regarded as boundary

between two dissimilar regions in an image .edge detection is a terminology in image processing and computer vision. Particularly in areas of feature detection and feature extraction.

Mathematical morphology is a tool for extracting image components that are useful in representation and description of region shape, such as boundaries, skeletons and convex hull. The technique was originally developed by Matheron and Serra at Ecoledes mines in Paris .The language of mathematical morphology is set theory and sets in mathematical morphology represent objects in an image .Mathematical morphology is a theory of image transformations and image functional .Morphological operations are based on simple expanding and shrinking operations. Mathematical morphology examines the geometrical structure of an image by probing it with small patterns ,called 'structuring element', of varying sizes and shapes .This procedure results in non-linear image operators which are well suited to exploring geometrical and topological structures. They do provide the strong visual clues that can help the recognition process .

2. Traditional methods of edge detection

2.1 Sobel operator

Sobel edge detection is used in image processing techniques .The Sobel kernels are more suitable to detect edges along the horizontal (180 degree) and vertical axis (90 degree)[2]. The Sobel operator is based on convolving the image with a small, separable, and integer valued filter .

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

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

2.2 Canny Edge Detector

Canny edge detection is a multistage algorithm to detect a wide range of edges in images. It was presented in 1986 by Canny. The problem with this type of traditional edge detection approach is that a low threshold produces false edges ,but a high threshold misses important edges.

2.3 Prewitt edge detection

Prewitt operator edge detection masks are the one of the oldest and best understood methods of detecting edges in images. The strength of the edge at given location is then the square rote of the sum of the squares of two derivatives.

2.4 Robert edge detection

In Robert edge detection, the vertical and horizontal edges bring out individually and then put together for resulting edge detection.

+1	0
0	-1

Gx

0	+1
-1	0

Gy

The two individual images Gx and Gy will be combined to get result. The Robert cross kernels are relatively small .Therefore they are highly susceptible to noise.

2.5 Laplician of Gaussian (LOG)

This method of edge detection was invented by Marr and Hildreth in 1980.In this method, the Gaussian filtering is combined with Laplician to break down the image where the intensity varies to detect the edges effectively. It finds the correct place of edges and testing wider area around the pixel .The disadvantage of LOG operator is that it can not find orientation of edge because of laplician filter[17].

3. Mathematical morphological operators

Mathematical Morphology is one of the most productive areas in image processing [18].The content of mathematical morphology is based on set theory. A structuring element is a special mask filter that enhances an input images. It can be of different sizes and of different shapes (square, diamond,circle).Following are the main mathematical morphological operators:

1. Dilation
2. Erosion
3. Opening
4. Closing

3.1 Dilation

Dilation is defined as the maximum value in the window. Hence the image after dilation will be brighter or increased in intensity. It also expand the image and mainly used to fill the spaces. Dilation process expanding image objects by changing pixels with value of “0” to “1”.

3.2 Erosion

Erosion is just opposite to dilation. It is defined as the minimum value in the window .The image after dilation will be darker than the original image .It shrinks or thins the image. Erosion process shrinking objects or images by changing pixels with a value of “1” to “0”.

3.3 Opening and closing

Both parameters are formed by using dilation and erosion. In opening, firstly image will be eroded and then it will be followed by dilation. And in case of closing, firstly image will be dilated and then followed by erosion.

4. Different steps involved for implementation is as follows:

1) First step is to take the x-ray image .2)Then apply the different structuring elements which are as follows:

1st method:

Se1= 1 1 1 1 1 1 1
1 1 1 1 1 1 1
0 0 0 0 0 0 0
1 1 1 1 1 1 1
1 1 1 1 1 1 1
1 1 1 1 1 1 1
(180 degree)

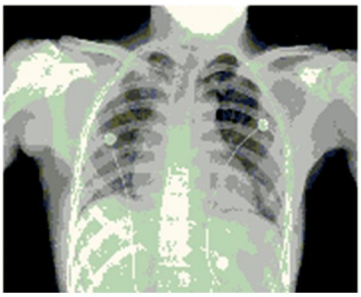
Se2=1 1 1 0 1 1 1
1 1 1 0 1 1 1
1 1 1 0 1 1 1
1 1 1 0 1 1 1
1 1 1 0 1 1 1
1 1 1 0 1 1 1
(90 degree)

Se3= 0 1 1 1 1 1 1
1 0 1 1 1 1 1
1 1 0 1 1 1 1
1 1 1 0 1 1 1
1 1 1 1 0 1 1
1 1 1 1 1 0 1
1 1 1 1 1 1 0
(135 degree)

Se4=1 1 1 1 1 1 0
1 1 1 1 1 0 1
1 1 1 1 0 1 1
1 1 1 0 1 1 1
1 1 0 1 1 1 1
1 0 1 1 1 1 1
0 1 1 1 1 1 1
(45 degree)

2) Erode the image and dilate the image .
3) Take the difference between eroded and dilated image. Finally we will get the edges.
4) Increase the intensity of image as per requirement.
5) Dilate the image if any line spacing exist in image.

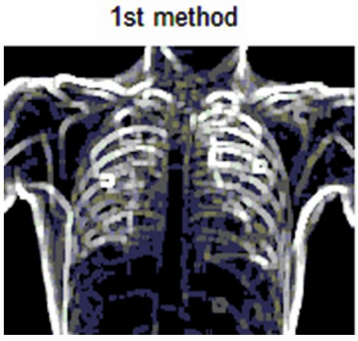
5. Results



90 degree edge detection

180 degree edge detection

45 degree edge detection



Final result.

6. Conclusion

From the results, it is concluded that the edge detection using mathematical morphology is more efficient than the traditional methods. From the results and comparison of the different methods of edge detection, it is concluded that the mathematical morphological edge detection is better than the traditional method

The main advantages of mathematical morphology are direct geometric interpretation, simplicity and efficiency in hardware implementation.

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