Study And Analysis Of Enhancement And Edge Detection Method For Human Bone Fracture X-Ray Image

Prof. D. N. Satange
Asstt.Professor (Department Of Computer Science)
Arts, Commerce & Science College,
Kiran Nagar Amravati

Miss. Karuna K. Chaudhari
PG Student (Department Of Computer Science)
Arts, Commerce & Science College,
Kiran Nagar Amravati

Miss. Priya D. Kale
PG Student (Department Of Computer Science)
Arts, Commerce & Science College,
Kiran Nagar Amravati

Abstract

Recent developments in medical imaging techniques have brought a new research field in image processing which comprises medical image enhancement and edge detection. The principal aim is to improve medical diagnosis to obtain image-based information, such as the detection and localization of pathological deformations. X-ray digital real-time imaging detection technology has been widely used with its quick speed, high sensitivity, low cost characteristics and so on. Using various types of filters we can remove the noise from degraded image. The edge function is used to detect edges, which are those places in an image that correspond to object boundaries.

1. Introduction

Image enhancement refers to sharpening, of image features such as edge boundaries or contrast to make graphic display more useful for display and analysis. Image enhancement is among the simplest and most appealing areas of digital image processing. Improvement in quality of these degraded images can be achieved by using application of enhancement techniques.[1] Image Edge detection significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. Evaluation of the images showed that under noisy conditions Canny, LoG (Laplacian of Gaussian), Robert, Prewitt, Sobel exhibit better performance, respectively. Edge detection is difficult in noisy images, since both the noise and the edges contain high frequency content. Attempts to reduce the noise result in blurred and distorted edges. The software Matlab R2010a version is used for the experimental work. [11]

2. Image Enhancement

Image enhancement refers to sharpening of image features such as edge boundaries or contrast to make graphic display more useful for display and analysis. Image enhancement includes gray level and sharpening, filtering, noise removal and so on. [1]

2.1 Histogram Equalization

Histogram is the basis for numerous spatial domain processing techniques. Histogram manipulation can be used for image enhancement. The intensity level in an image may be viewed as variable in the interval. [15] Using the fundamental histogram equalization descriptor of a random variable is its probability density function. Fig.1(c)

2.2 Adjust an RGB image.

An image lacks contrast when there are no sharp differences between black and white. Brightness refers to the overall lightness or darkness of an image. To change the contrast or brightness of an image, the Adjust Contrast tool performs contrast

stretching. In this process, pixel values below a specified value are displayed as black, pixel values above a specified value are displayed as white, and pixel values in between these two values are displayed as shades of gray. Fig 2 (d).

2.3 Filtering

In image processing, filters are mainly used to suppress either the high frequencies in the image, i.e. smoothing the image, or the low frequencies, i.e. enhancing or detecting edges in the image. Noise removal is easier in the spatial domain as compared to the frequency domain as the spatial domain noise removal requires very less processing time.The two types of filters are the linear and non-linear filters. The linear filters have the advantage of faster processing but the disadvantage of not preserving edges. Conversely the non-linear filters have the advantage of preserving edges and the disadvantage of slower processing. [3][4]

2.3.1 Fspecial Filters

Fspecial (type) creates a two-dimensional filter h of the specified type like disk filter, guassian filter, log filter, prewitt filter, sobel filter, laplacian filter, motion filter.

- **Fspecial with disk**

A disk filter is a type of water filter used primarily in irrigation, similar to a screen_filter, except that the filter cartridge is made of a number of disks stacked on top of each other like a pile of poker chips. Some types of disk filters can be backflushed in such a way that the disks are able to separate and spin during the cleaning cycle.Fig.2 (e).

- **Fspecial With Gaussian Filter**

Gaussian filter is a filter whose impulse response is a Gaussian function. [5][6][7] Gaussian filters are designed to give no overshoot to a step function input while minimizing the rise and fall time. Fig.2(f).

- **Fspecial with lapcian filter**

Detecting edges within an image can be done by the laplacian filter. It denotes areas where the intensity changes rapidly, hence producing an image with all the edges. [7] The Laplacian is often applied to an image that has first been smoothed with something approximating a Gaussian smoothing filter, in order to reduce its sensitivity to noise. Fig.3 (g).

- **Fspecial with motion filter**

A filter to approximate once convolved with an image, the linear motion of a camera by len pixels, with an angle of theta degrees in a counterclockwise direction. The filter becomes a vector for horizontal and vertical motions. [7] The motion filter reduces to the ideal inverse filter. The blurred and noisy image is restored by a constrained least square restoration algorithm that uses a regularized filter. Fig.3 (h).

- **Fspecial with log**

LOG filter for image edge detection consists of Gaussian filter and Laplace operator. Applying Gaussian approximation filter in LOG filtering is helpful for multi-scale LOG filtering because only one parameter in the algorithm needs to be changed. This method is more convenient than the template method in which the coefficients of the whole mask of LOG filter with different scale need to be refreshed. [8] This is a new implementation for LOG filter. Fig.3 (i).

- **Fspecial with prewitt**

Prewitt filter is a discrete differentiation operator computing an approximation of the

gradient of the image intensity function. The Prewitt operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical direction and is therefore relatively inexpensive in terms of computations. [11] The working of Prewitt filter consists of computing the root mean square root of two 3 cross 3 matrices. Fig.4 (j).

- **Fspecial with sobel**

The Sobel operator is used in image processing, particularly within edge detection algorithms. The Sobel operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical direction and is therefore relatively inexpensive in terms of computations. **[**14] The Sobel filter consists of two kernels which detect horizontal and vertical changes in an image. Fig.4 (k).

2.4 Second Order Filter

Second Order Filter are nonlinear spatial filters whose response is based on ordering the pixel contain in the image area by the filter, and then replacing the value of the center pixel. [15] The based known filter in this category is the median filter, which as its name implies, replaces the value of a pixel by the median of the intensity value in the neighborhood of that pixel. Fig.4 (l).

2.5 Salt-and-pepper Noise

Salt-and-pepper noise is also called as Fat-tail distributed or impulsive noise or spike noise.[8] An image containing salt-and-pepper noise will have dark pixels in bright regions and bright pixels in dark regions. Fig.5 (m).

- **Average filter**

Mean filtering is a simple, intuitive and easy to implement method of smoothing images, and to reduce the amount of intensity variation between one pixel and the next. Average filtering replaces each pixel value in an image with the mean value of its neighbours, including itself. [10] The simplest procedure would be to calculate the mask for all the pixels in the image. Fig.5 (n).

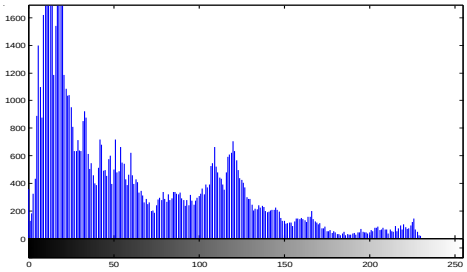
- **Median filter**

It is important to perform noise removal during signal processing on an image or on a signal. The median filter is an effective method that can suppress isolated noise without blurring sharp edges. [9] In Median Filtering, all the pixel values are first sorted into numerical order and then replaced with the middle pixel value. See Fig.5 (o).

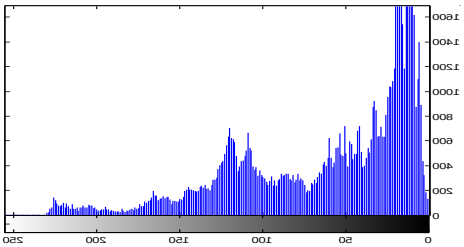
1.7 Control Points Using the Control Point Selection Tool

Specifying To specify control points in a pair of images you want to register, use the Control Point Selection Tool, cpselect. The tool displays the image you want to register, called the input image, next to the image you want to compare it to, called the reference image. Fig.6 (p).

Fig.1:(a)original, (b)gray scale of original image, (c) histogram equalization



(b) Histogram of gray scale image



(c) Histogram of histogram Equalization

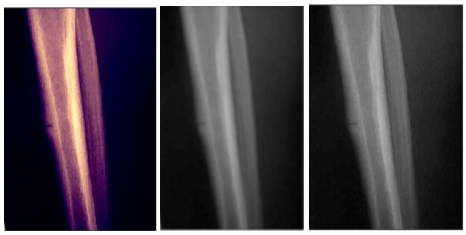


Fig.2 :(d) Adjust RGB of Image,(e) Fspecial with disk filter,(f) Fspecial with Gaussian filter

Fig.3 :(g) Fspecial with Lapcian Filter, (h)Fspecial with Motion Filter, (i) Fspecial with log filter

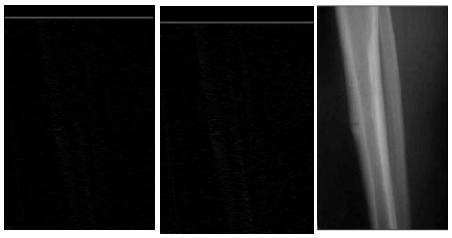


Fig. 4 : (j) Fspecial with prewitt filter,(k) Fspecial with sobel filter,(l)Second order filter

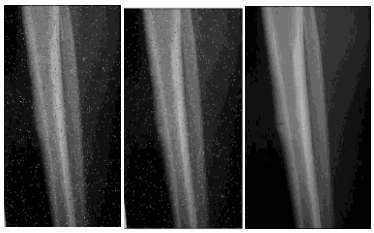


Fig. 5 : (m) Salt and Paper Noise, (n) average filter,(o) Median filter

Fig.6 :(p) Control Points Using the Control Point Selection Tool

3. Edge Detection Technique

Edges characterize boundaries and are therefore a problem of fundamental importance in image processing. Image Edge detection significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image.

3.1.1 Prewitt Edge detector

The Prewitt edge detector is a much better operator than Roberts's operator. The prewitt edge detector is an appropriate way to estimate the magnitude and orientation of an edge. [12] The prewitt operator is limited to 8 possible orientations, experience shows that most direct orientation estimates are not much more accurate. Fig.7(b)

3.1.2 Canny edge detection

The Canny's operator is one of the most widely used edge finding algorithms. Canny proposed a method that was widely considered to be the standard edge detection algorithm in the industry. [13] In regard to regularization explained in image smoothing, Canny saw the edge detection as an optimization problem. He considered three criteria desired for any edge detector: good

detection, good localization, and only one response to a single edge. Fig.7(c)

3.1.3 Sobel Edge Detection

The Sobel operator performs a 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial frequency that correspond to edges. [12] In theory at least, the operator consists of a pair of 3x3 convolution kernels. One kernel is simply the other rotated by 90o.This is very similar to the Roberts Cross operator. Fig.8 (d).

3.1.4 Roberts edge detection

The Roberts Cross operator performs a simple, quick to compute, 2-D spatial gradient measurement on an image. It thus highlights regions of high spatial frequency which often correspond to edges. In its most common usage, the input to the operator is a grayscale image, as is the output. [12] Pixel values at each point in the output represent the estimated absolute magnitude of the spatial gradient of the input image at that point. Fig.8 (e).

3.1.5 Log edge detection

Gaussian filters are the most widely used filters in image processing and extremely useful as detectors for edge detection. It is proven that they play a significant role in biological vision particularly in human vision system.[13] Gaussian-based edge detectors are developed based on some physiological observations and important properties of the Gaussian function that enable to perform edge analysis in the scale space. Fig.8 (f)

3.1.6 Block Processing Large Images

Using blockproc, specify an image, a block size, and a function handle. blockproc then divides the input image into blocks of the specified size, processes them using the function handle one block at a time, and then assembles the results into an output image. Fig.9 (g).

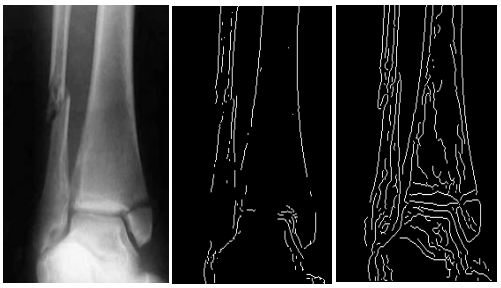


Fig.7 :(a)original image,(b)Prewitt Edge detector, (c)canny edge detector

Fig.8 :(d) Sobel edge detection,(e) Roberts edge detection, (f)Log edge detection

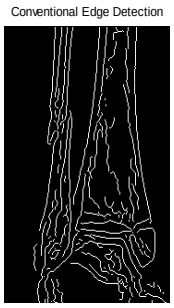


Fig.9 :(g) Block Processing Large Images

3. ROI Based Processing

A region of interest (ROI) is a portion of an image that you want to filter or perform some other operation on. You define an ROI by creating a binary mask, which is a binary image that is the same size as the image you want to process with pixels that define the ROI set to 1 and all other pixels set to 0. The regions can be geographic in nature, such as polygons that encompass

contiguous pixels, or they can be defined by a range of intensities.

3.1 Creating a Binary Mask (roi)

This section describes how to create binary masks to define ROIs. However, any binary image can be used as a mask, provided that the binary image is the same size as the image being filtered. Fig.10(II).

3.2 Cropping an Image Using the Crop Image Tool

Cropping an image means creating a new image from a part of an original image. To crop an image using the Image Tool, use the Crop Image tool. To use the Crop Image tool, follow this procedure. By default, if you close the Image Tool, it does not save the modified image data. To save the cropped image, you can use the Save As option from the Image Tool File menu to store the modified data in a file or use the Export to Workspace option to save the modified data in the workspace variable. Fig.11and 12.

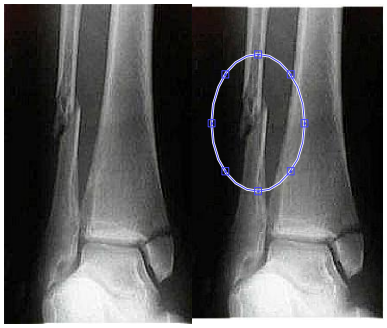


Fig. 10:(I)original image,(II) Creating a Binary Mask

Fig.11: Crop Image Tool

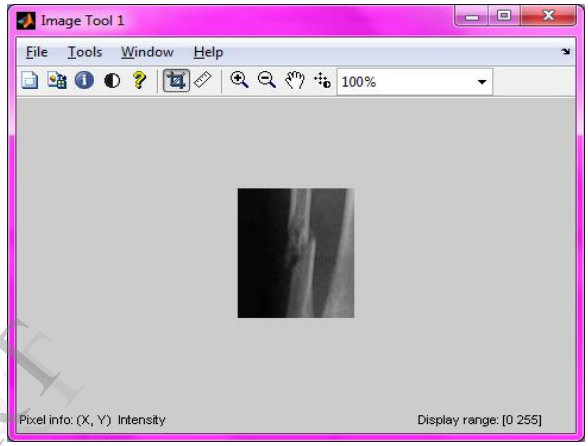


Fig. 12: Cropped Image

4. Result

A number of experiments have been conducted using Matlab R2010a version for evaluation of the filters on different types of noises. For the accurate result the image is converted to gray scale image. Different noises are added and the filtering techniques are applied for reconstruction of X-Ray images. In this experimental work we have taken medical images of X-Ray. These X-Ray images contain various types of fractures in bones in the body. Applying Sobel edge detection method, canny edge detection method, Prewitt edge detection method, LOG edge detection method, Roberts's edge detection method on X-Ray images. Fig.1,2, 6,7,8.

5. Conclusion

In this paper various filtering techniques were applied on X-ray image. It is also observed that median filter is better in removing salt and pepper noise. In this work different medical images of X-Ray have been studied for detecting edges using various types of edge detection methods. Sobel, Canny, Prewitt, Roberts, Log have been tested to detect the edges. For the X-Ray image Canny edge detection method is the best method. From this experimental work it is also observed that the convential edge detection methods also gives best results for the X-ray images.

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