Deblurring X-Ray Digital Image Using LRA Algorithm

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Abstract. Deblurring of X-rays digital images has always been a problem of crucial interest. A specific solution to the problem of image restoration is generally determined by the nature of degradation phenomena. So, it is highly dependent on the nature of the noise present there. In this work Lucy Richardson algorithm (LRA) is implemented on the X-ray image and deblurring is processes is observed. Deblurring is an important step of image processing especially when the diagnosis needs to be classified based on the result of X-ray image. LRA is an iterative procedure in which the pixels of the observed image are represented using the PSF. Image restoration is an emerging field of image processing in which the focus is on recovering an original image from a degraded image. The blurred image can be a result of a known degradation or unknown degradation. Hence image deblurring can be defined as a process of recovering a sharp image from a degraded image which is blurred by a degradation function, commonly by a Point Spread Function (PSF). The Point Spread Function describes the response of an imaging system to a point source or point object.

1. Introduction

Image Processing is a form of signal processing for which the input is an image either it can be photograph or video frame. The output of the image can be set of characteristics or parameters related to the image. It includes several techniques such as image segmentation, image recognition, image restoration, etc [1]. Image Restoration is an up-and-coming field of image processing which refers to group of methods or techniques that focus on recovering an original image from a degraded image. The degradation may occur due to several ways that includes sensor noise, camera misfocus, relative object-camera motion, random atmospheric turbulence [2][3][4]. There are two subprocesses. The concerns of image restoration techniques are the removal or reduction of degradations which are included during the acquisition of images. In medical applications, these techniques have a vital effect on the diagnose of the patient situation.

In this paper we introduce a frame work to use non blind method to restore a damaged medical image to improve the quality of X-Ray image which has an main role to decide the patient situation.

The structure of the paper as follows: section 2 introduces the related work, section 3 presents the proposed method. While section 4 depicts the experiment results. The conclusion section will be conducted on section 5.
2. Related work

There are different restoration techniques used to make the damaged image similar to that in the original image which can be categorised into non-blind restoration techniques and blind restoration techniques. Non-Linear Methods [1] such as Lucy Richardson algorithm which is a process for recovering an underlying image that has been blurred by a known point spread function. It was named after William Richardson and Leon Lucy, who described it independently. Another technique is a wiener filter which is linear estimation of the original image, the approach is based on a randomized frame, in practice, the Wiener filter has two separate parts, an inverse filtering part and a noise smoothing part. The filter was proposed by Norbert Wiener during the 1940s and published in 1949. Another approach B-direct inverse filtering. This technique responds badly to any noise in the picture, because noise tends to be high frequency.

To overcome on the issue, there are two methods: the threshold method and the iterative method. There are many other techniques, D-Adaptive Mean Filter is a simple, intuitive and easy to implement method of smoothing images, i.e. reducing the amount of intensity variation between one pixel and the next. It is often used to reduce noise in images. And E-Median Filter which is normally used to reduce noise in an image, somewhat like the mean filter. However, it often does a better job than the mean filter of preserving useful detail in the image. Moreover, F-IBD (Iterative Blind De-convolution) method, the techniques that have been discussed so far have been concerned with inverse filtering or deconvolving an image given the point spread function. Blind deconvolution on the other hand does not assume any prior knowledge of the image or the point spread function, hence, we can see how it can be lot more useful in practical situations.

Other restoration method is Block Matching works[4][5] depend on a way of locating matching macroblocks in a sequence of digital video frames for the purposes of motion estimation. The underlying supposition behind motion estimation is that the patterns corresponding to objects and background in a frame of video sequence move within the frame to form corresponding objects on the subsequent frame. Finally, K- Deconvolution using Regularized Filter (DRF) can be used effectively when limited information is known about the additive noise.

3. Proposed method

The proposed method deals with the damaged and noisy medical image to enhance the quality of that image to use it in different applications such as an image classification, segmentation and recognition. Difficulty using a blurred image in these application because of the vital impact of that noise on the making decision using these noisy images. Our proposed method based on non-blind method to restore the damaged image. Lucy Richardson algorithm [1] is one of non-blind restoration methods used to restore and improve the quality of the image by using iterative procedure to produce a high quality image. Figure 1 explains the framework of the proposed system.
Figure 1: Framework of the proposed system

Initially, the blurred image read and then denoising applied on that image. In the next step LAR[6][7][8] applying to deblurred the image and produce the restored image using deconvolution. Deconvolution is an algorithm-based process used to reverse the effects of convolution on image data. Deblurred image has a main role in computer vision applications such as image recognition, image segmentation and other multimedia applications. The Richardson—Lucy algorithm, also known as Lucy—Richardson deconvolution, is an iterative procedure for recovering a latent image that has been blurred by a known point spread function. The equation of LAR defines as follows:

\[ f^{n+1} = f^n \cdot \left( \frac{g}{h \ast f^n} \right), \]

Richardson-Lucy Algorithm:
Suppose,
Y: Degraded Image,
\( \Lambda \): Original Image,
P: Point Spread Function,
Operation of Convolution. Then, \( Y = \Lambda \ast P \)

The point spread function (PSF) describes the response of an imaging system to a point object. A more general term for the PSF is a system's impulse response, the PSF being the impulse response of a focused optical system.
Experiments results

To explain the results of the LAR algorithm. X-ray images It is a popular imaging test that has been used for decades to help doctors view the inside of the body without having to make an incision. It is used to find orthopaedic damage, tumours, pneumonias, etc. We use this format of the image to test our system. Figure 2 shows blurred images (X_rays) with their histograms which explains the noise and blurred degree of the input image. Figure 3 the output of the algorithm using LAR algorithm. It is clearly to see that, the output of the algorithm shows clear and obvious processed image which give a clear vision of the patient situation and then give an accurate decision on their medical state.

Figure 2: Blurred X_rays images with histograms
Figure3: Output of LAR algorithm

From figure3, we can see that the algorithm gives reliable results to decide and use these images in computer vision applications to interpreter the contents of the image and make valuable decision.

4. Conclusion
It is clear that the algorithm gives some sort of improvement in the blurred image. The proposed methodology can be used to recover the degraded image to the greater extent. Future work of this paper is to develop and build improved technique which will give better performance than LAR algorithm.

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6. References
[1] Charu Khare and Kapil Kumar Nagwanshi,"Image Restoration Technique with Non Linear Filter", International Journal of Advanced Science and Technology, Vol.39, pp. 67-74, February 2012.
[2] Rinku Kalotra, Sh. Anil Sagar, “A Review: A Novel Algorithm for Blurred Image Restoration in the field of Medical Imaging,” International Journal of Advanced Research in Computer and Communication Engineering, Vol. 3, Issue 6, June 2014.

[3] R. Kaur and E. N. Singh, “Image Restoration - A Survey,” IOSR J. Comput. Eng., vol. 16, no. 4, pp. 107–111, 2014.

[4] P. Sumitra, A Comparative Study Algorithm For Noisy Image Restoration in the Field of Medical Imaging, International Journal of Advanced Information Technology (IJAIT) Vol. 6, No. 1, February 2016.

[5] Anamika Maurya, Rajinder Tiwari, “A Novel Method of Image Restoration by using Different Types of Filtering Techniques”, International Journal of Engineering Science and Innovative Technology (IJESIT), Vol 3, Issue 4, July 2014.

[6] Sanchez MG, Vidal V, Verdu G, Mayo P, Rodenas F., “Medical Image Restoration with different types of noise”, IEEE Eng Med Biol Soc. Conference Proceedings 2012.

[7] Ramya, S.; Mercy Christial, T, “Restoration of blurred images using Blind Deconvolution Algorithm,” IEEE, Emerging Trends in Electrical and Computer Technology (ICETECT), pp. 496–499, 2011.

[8] Chidananda Murthy M V, M. Z. Kurian, and H. S. Guruprasad, “Performance evaluation of image restoration methods for comparative analysis with and without noise,” International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT), 2015, pp. 282–287.