Research of Radiographic Image Enhancement Technology

Chen Yan, Shao Yanling, Gui Zhiguo，
College of Information and Communication Engineering, North University of China，Tai Yuan，Shan Xi，030051

***Abstract*--Image enhancement has applied widely in biomedical, nondestructive testing, satellite remote sensing and other fields. Especially for the low contrast radiographic images, usually there are some disadvantages for a radiographic image such as the local area image does not show a striking contrast. In order to improve the clearness of low contrast radiographic images, in this paper we combined global adaptive equalization with local dynamic enhancement，then we simulate this enhancement algorithm. The new method will not only effectively increase the global contrast of low contrast radiographic images, but also intensify local details. Because the new algorithms' contrast enhancement coefficient function can be adjusted dynamically and locally, the new algorithms are not only adaptive to the process of radiographic images but also having great reference value to the other grayscale images.**

Keywords--image enhancement ; adaptive equalization; local dynamical enhancement

INTRODUCTION

In ray imaging system, rays penetrate the object and structure information is recorded. A direction different from the incident ray scatter increases the image noise，making the contrast reduction and the edge blur of the ray image. Sometimes the complex structure of the workpiece, structural inhomogeneities also make low-ray image contrast. In addition to improve digital imaging system to reduce the impact of the imaging process image information, we can also take image processing to show the clear outline of the object and the local details with enhancement algorithms at the same time. In this paper, the local dynamic contrast-enhanced and adaptive equalization are combined and the low contrast-ray image intensifier is simulated.

1. RAY IMAGE NOISE REDUCTION

In the digital radiography system, because of the characteristics of components of the system and the various external disturbances, the image contains a lot of noise. This situation not only reduces the image contrast and signal-to-noise ratio, but also increases the difficulty of detection of the test piece. For the acquired ray image, it is improved the detection accuracy. The noise is reduced before the image enhancement in general.

Threshold noise reduction method, which is based on wavelet transform the most widely used method. Wavelet noise reduction can not only get a good image signal-to-noise ratio, but also preserve better image details. Wavelet decomposition of the signal is decomposed into approximate components and detail components, which respectively correspond to the low frequency components and high frequency components of the signal. For images containing noise, noise components are concentrated in the detail components, so taking measures of the detail component to filter out the noise. The signal is decomposed by wavelet, according to reconstruction of the coefficients of the threshold processing out of the desired signal.

2. RAY IMAGE ADAPTIVE ENHANCEMENT ALGORITHM

Adaptive contrast enhancement algorithm is the center of the processing window in pixels within in general. According to the average grayscale value of the window to enhance, the calculation method is as follows:

$$g(m,n) = (f(m,n) - M) \times K + M \tag{1}$$

In formula, $f(m,n)$ is image grayscale value before the processing of (m,n), $g(m,n)$ is the processed image gray value, and K is the enhancement factor. Window average grayscale value of M may effectively remove uneven background interference. Uneven background make even enhance the effect. The effect of the algorithm for uneven low contrast images has better effect, the algorithm is simple, in contrast enhancement process. Enhancement coefficient K is fixed, the overall has enhanced. But it is not useful for local image fine-tuning.

In order to conduct the dynamic adjustment, we increase processing algorithm ideal image mean and variance E、D and mean adjustment factor α, by adjusting the E，D and α, in accordance with the need to adjust enhanced image.

$$g(m,n) = \alpha E + (1-\alpha)M + \frac{f(m,n) - M}{A + N/D} \tag{2}$$

M, N respectively is the mean and variance of the part statistics:

$$M = \frac{1}{W^2}\sum_{m=1}^{W}\sum_{n=1}^{W} f(m,n) \tag{3}$$

$$D = \frac{1}{W^2}\sum_{m=1}^{W}\sum_{n=1}^{W}\left[f(m,n) - M\right]^2 \tag{4}$$

The establishment of a fixed value of A is to control the enhanced multiples without exceeding a certain threshold. Because this algorithm does not have threshold control. It has domain value judgments of links after calculation. For the point is not in the image gray field values within assignment is the highest or lowest gray.

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2.1 Dynamic adjustment enhanced multiples

In different applications, enhanced requirements of different gray values are not the same. For example, high grayscale value region of contrast enhancement is less demanded. Low-grayscale region requires high enhanced multiples. This requires timely adjustments to enhance multiples, adjusted by adjusting the expected variance and maximum enhancement ratio enhanced multiples, it should be pointed that, variance is too small will cause a decrease in contrast, so D should not be too small. For low variance chart, image enhancement rely mainly on the maximum enhancement multiples, according to the actual situation of the images to adapt to the different requirements of the gray area.

Image local gray value and the relationship of the value of A can be adjusted by a variety of functions. For example, use the window to the reciprocal of the mean power function, when the increase in local gray value, the value of A is quickly tending to a constant value. Sometimes it can speed up computations by indexing table.

2.2 Global adaptive equalization

Gray value is ray image of uneven distribution, image value range is wide, and local contrast is small. This image advances contrast enhancement of local dynamic enhanced. The image dark area partially is enhanced, but the gray value of full chart area is low and the visual effect of the image is not obvious. In response to this situation, gray histogram equalization processing is more effective. Histogram image conduct equalization statistics. In the histogram of the field of statistics, use adaptive histogram equalization. First threshold value t is determined, to be processed the sliding window of the center pixel point a. Pending point a first field search point difference is less than the threshold value t is referred to as b, these markers is the target pixel of b. For the 1/2 point of the distance the distance of these regions is referred to as c. All marked points is statistical information globally adaptive equalization. The above process reduces the statistics of image noise. In a certain extent, avoid the blindness of statistics. The grayscale value G of the pixel gray scale value after the histogram equalization is denoted by H (G), so improved has multiple local dynamic enhanced contrast enhancement algorithms for:

$$g(m,n) = \alpha E + (1-\alpha)H(G) + \frac{f(m,n)-M}{A(M)+N/D} \quad (5)$$

3. THE SIMULATION

In this paper used a low-contrast-ray image to wavelet denoising and adaptive enhanced simulation experiment

3.1 Denoising simulation

First, using two-dimensional wavelet to denoise for ray image, effect diagram is as follows:

Figure 1. Experimental original image

Figure 2. De-noised image

3.2 Logarithmic enhancement algorithm simulation

If increasing the contrast of the dark area, can be transformed using a logarithmic, figure 3 is a logarithmic transformation of the effect after.

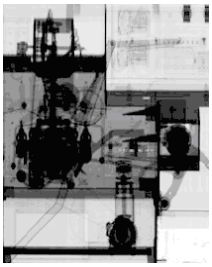

Figure 3. Logarithmic transformed image

By contrast, used after logarithmic transformation of the image enhancement in the dark region of member image better enhancement is effect, weaken the contrast of the bright areas, so in figure 3 of the upper-right corner portion of the image display is unclear.

3.3 This paper studies the enhanced algorithm simulation

From the above figure, the adaptive contrast enhancement algorithm makes it clear to the overall outline of the image objects and highlighting the local details, bright areas and dark areas of the overall image has better enhancement.

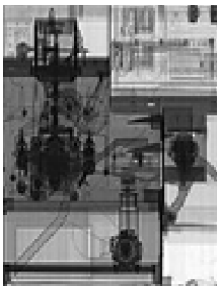

Figure 4. Adaptive enhanced image

From the above simulation, the global adaptive equalization and local enhancement multiples dynamic adjustment combined is image ray image of the complex components of the overall contour and local detail into account for ray image research have some reference value.

4. CONCLUSION

In ray image enhancement, global adaptive equalization and dynamic adjustment enhanced multiples combining is enhancement algorithms. It is a wide distribution in the range of gray values can be achieved under the requirements of the local enhanced multiple. To reach details contrast enhancement and global clear effect. Simulation results show based on wavelet transform image noise reduction and global adaptive enhancement and local [8] dynamic combination image enhancement algorithm is effective and feasible. This algorithm has the certain practical significance for non-destructive testing of complex components.

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