Image Fusion Based On Wavelet Transform

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***Abstract* – This paper discusses the image fusion based on wavelet transform and analysis of image fusion basic principal, method and advantage. The main objective of image fusion is to combine information from multiple image of the same scene based on a certain algorithm, the result of image fusion is a new result which can be more suitable for human and machine. This day's image fusion technology has been widely applied in many fields including remote sensing, automata recognition, computer vision, medical image processing. This document designs and realizes the method of image algorithm which is based on wavelet transform.**

***Index Terms* – Image Fusion, Wavelet Transform.**

I. INTRODUCTION

Image fusion is one of the the branches of information fusion and this technology driven multisource image fusion technology. It is a process by which multiple image of the same scene and combined to generate a more accurate description of the scene than any of the individual source image this process can be performed at different levels of information representation sorted in ascending order of abstraction like pixel ,signal, feature and symbol levels. The level of pixel image fusion refers to process directly based on the pixel information from individual sensor. The result of image fusion is more suitable for human and machine perception or future image-processing task such as segmentation feature extraction and object recognition future extraction and object recognition. Image processing is a course of noice reduction. The main purpose of image fusion is sharpen images , reduce image blur achieve image enhancement purpose also used in digital cartography to improve dimensional drawings and geometric correction accuracy.

As different image data of the image sensor to obtain the geometry, spectrum, time and spatial resolution limitations and there is an obvious difference so using only an image data is difficult to meet the actual demand. In order to observe the target has a more comprehensive, clear and accurate understanding and awareness people are desperately seeking a Utilization of various kinds of image data technical methods. Compared with a single multi-source image fusion has more advantage which is the multi-source image has redundancy the source image can not be captured with a single message that the multi-complementarily between the source image so multiple source image fusion from multiple perspectives and multiple time access to information. expanding space-time sensing range improve the accuracy and clarity of observation. How to get from a variety of different sensors image fusion together in order to more fully utilize the information field of image processing to become an important research topic.

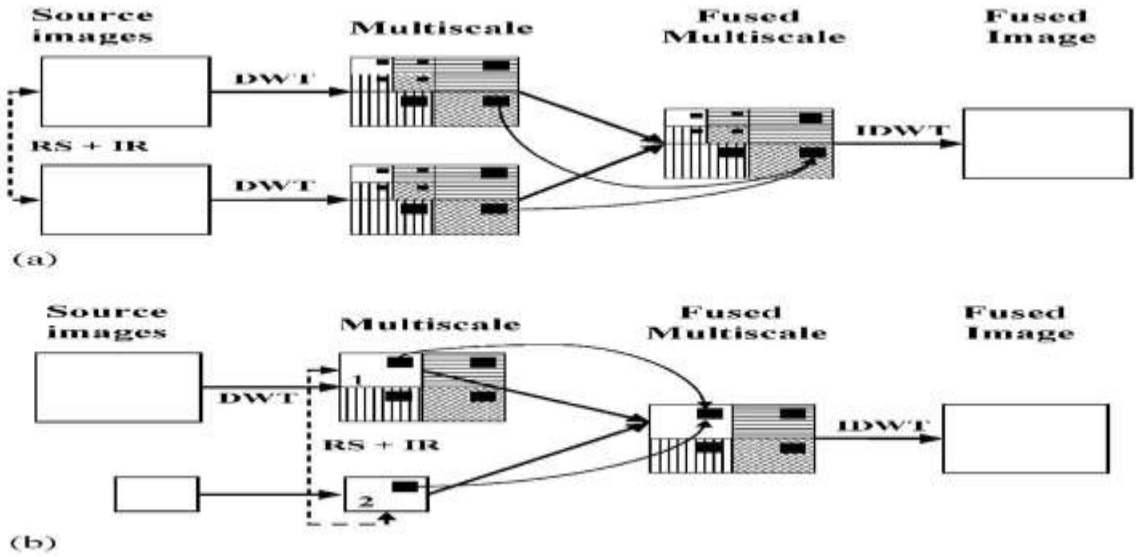
II. WAVELET TRANSFORM

The wavelet transform of image processing on different frequency channels and the source image is first multi-wavelet decomposition, the number of sub-image and the in the transform domain, feature selection, creating the fused image and finally fused image reconstruction by the transform.

In recent years, wavelet transform has attracted scientific attention, it not only in mathematics has formed a new branch, is perfect combination of functional analysis, Fourier analysis, numerical analysis, but also in engineering applications, such as signal processing, image processing, pattern recognition, speech recognition and synthesis as well as many nonlinear science, have a profound influence. Wavelet analysis is a new technology of time scale analysis and multiresolution analysis, has good localized features in both the time domain and frequency domain, but also due to the gradually fine time and space step on the high frequency, it can focus on analysis of the arbitrary details like, this characteristic is focusing wavelet transform the characteristics of wavelet transform, it was hailed as a mathematical microscope. The wavelet decomposition of the image is multi-scale, multi-resolution a decomposition of the image, because wavelet is non redundant, so that the image data after wavelet decomposition by total will not increase, at the same time wavelet decomposition has direction, using this characteristic may for the human eye to different directions of the high frequency components with different resolution of the visual characteristics, the fused image is obtained better effect in image fusion.

III. IMAGE FUSION METHOD

image fusion method basic steps are: For each source image, respectively, a discrete wavelet decomposition, the series of images in the band; separately for each decomposition level low fusion process, the decomposition layer different frequency components using different fusion fusion ways, finally obtained after fusion of each sub band images; discrete wavelet transform, the resultant fused image is reconstructed image. Fusion process diagram shown below:



In each layer, each of the four images is the source image and a wavelet image and then after the inner product in the x and y directions are carried out to generate twice the sampling interval. For the first level (j = 1) can be written as:

$$A_2^0(m,n) =< A(X,Y),\psi(x-2m,y-2n) >$$

$$D_2^0(m,n) =< A_1^0(x,y),\psi^1(x-2m,y-2n) >$$

$$D_2^2(m,n) =< A_1^0(x,y),\psi^2(x-2m,y-2n) >$$

$$D_2^3(m,n) =< A_1^0(x,y),\psi^3(x-2m,y-2n) >$$

Wherein A, D represents 4 superscript number resolution images, the subscript indicates decomposition level, whose specification is expressed as 2^j In the first resolution, since the j=1 ,Left A, D subscript of, abbreviated as 2, where the right is the original image j=0,Abbreviated as 1. . For subsequent levels $A_{2^j}^0(x,y)$ Are exactly the same way, constitute four in scale decomposition 2^{j+1} On a smaller image. Rewrite the above equation into convolution inner product, the resulting discrete wavelet transform algorithm ma11at general formula:

$$A_{2^{j+1}}^0(m,n) = \sum_{x,y} A_{2^j}^0(x,y)h(x-2m)h(y-2n)$$

$$D_{2^{j+1}}^1(m,n) = \sum_{x,y} A_{2^j}^0(x,y)h(x-2m)g(y-2n)$$

$$D_{2^{j+1}}^2(m,n) = \sum_{x,y} A_{2^j}^0(x,y)g(x-2m)h(y-2n)$$

$$D_{2^{j+1}}^3(m,n) = \sum_{x,y} A_{2^j}^0(x,y)g(x-2m)g(y-2n)$$

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Where instead h, g, respectively decomposition low-pass and high-pass filter decomposition, because scaling function and wavelet function is separable, so each filtering process can be broken down into the $A_{2^j}^0(x,y)$ The row and column directions on the one-dimensional filtering. From an implementation perspective, the two-dimensional image of the wavelet exchange is a process of filtering and resampling. First along the row direction, respectively, for the low-pass and high-pass filter, the image is decomposed into an overview and details of two parts, and for 2: l sample, and the row arithmetic operation result is then in the column direction,

the high-pass and low-pass filter operation and for 2: l sample. Quad output thus obtained by $\varphi(x)\varphi(y)$ Processing the obtained image $A^0_{2^{j+1}}(m,n)$ Overview of the original image. D Respectively, detail component in the vertical direction, horizontal direction of the detail components, the detail components in the diagonal direction.

IV. System design and requirement analysis

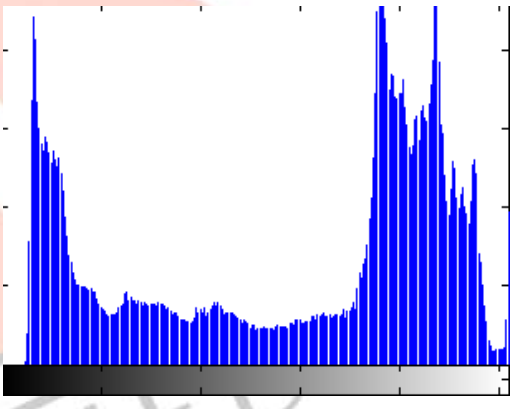
This design is the MATLAB image using wavelet transform based fusion, which can realize the processing of a variety of pictures. Specific requirements include:

- freedom to choose various format picture processing
- can be a variety of related image processing
- can be fused in different ways
- can be on the fusion of images for the save operation
- the whole process has the advantages of simple operation, good man-machine interface

V. Image histogram

The histogram is a function of gray level, it represents the number of each gray level of the pixel in the image, reflect a gray appeared in image frequency. It is the basis for a variety of spatial processing technology. Histogram operation can be effectively used for image enhancement; some properties of the histogram of the state judge image: bright image histogram tend to side gray level is high; the middle and low contrast image histogram is narrow and focused on the gray level distribution, gray level histogram components of high contrast image coverage is wide and pixels not too uniform, only a small amount of vertical than other high many. Intuitively: if an image whose pixel occupies all possible gray level and distribution.

Image



Gray level of histogram

VI. Result

Focus on right side

Focus on left side

Fused image

VII. ACKNOWLEDGMENT

Research in the field of image fusion has made great achievements, image fusion method in the application of various kinds, relates to the field is more and more widely and deeply. But in general, the research on image fusion technology is not yet mature, there are many problems and urgent,Due to a variety of image types of diversity and particularity, in fusion algorithm design of image need to take into account the actual image computing speed and storage capacity, how to design the image series of images of specific design a real-time, reliable, stable, practical fusion algorithm is one of the research hotspots and difficulties. Colleagues should also try to run other fusion algorithm on MATLAB platform.

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