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Image Fusion Approach with NOISE REDUCTION USING GENETIC ALGORITHM & Sure-let Algorithm

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Abstract

Fusing information contained in multiple images plays an increasingly important role for quality inspection in industrial processes as well as in situation assessment for autonomous systems and assistance systems. The aim of image fusion in general is to use images as redundant or complementary sources to extract information from them with higher accuracy or reliability. In our research paper we introduce a new approach that begin with image de-noising using GA and then apply the Sure-let transform for image decomposition to get a multi focus image fusion image that is focused in all of its parts. The results show that Curvelet transform had been proven to be effective at detecting image activity along curves, and increasing the quality of the obtained fused images. GA shows more accurate results in image de-noising. We performed image fusion using Curvelet Transform with Genetic Algorithm and Sure-let algorithm for image denoising. This new method has reached an optimum fusion result. For the implementation of this proposed work we use the Image Processing Toolbox under Matlab Software.

Keywords: Image processing, Edge detection, Fusion, Genetic Algorithm, SURE-LET and Curvelet transform

Introduction

Image fusion is the process of merging two images of the same scene to form a single image with as much information as possible. Image fusion is important in many different image processing fields such as satellite imaging, remote sensing and medical imaging. The study in the field of image fusion has evolved to serve the advance in satellite imaging and then, it has been extended to the field of medical imaging. Several fusion algorithms have been proposed extending from the simple averaging to the Curvelet transform. Algorithms such as the intensity, hue and saturation (IHS) algorithm and the wavelet fusion algorithm have proved to be successful in satellite image fusion. The IHS algorithm belongs to the family of color image fusion algorithms. The wavelet fusion algorithm has also succeeded in both satellite and medical image fusion applications. The basic limitation of the wavelet fusion algorithm is in the fusion of curved shapes. Thus, there is a need for another algorithm that can handle curved shapes efficiently. So, the application of the Curvelet transform for curved object image fusion would result in better fusion efficiency. A few attempts of Curvelet fusion have been made in the fusion of satellite images but no attempts have been made in the fusion of medical images. According to the limitation of the wavelet transform, Donoho et al. was proposed the concept of Curvelet transform, which uses edges as basic elements, possesses maturity, and can adapt well to the image characteristics. Moreover, Curvelet Transform has anisotropy and has better direction, can provide more information to image processing. Through the principle of Curvelet transform we know that: Curvelet transform has direction characteristic, and its base supporting session satisfies content anisotropy relation, except have multi scale wavelet transform and local characteristics. Curvelet transform can represent appropriately the edge of image and smoothness area in the same precision of inverse transform.

Here we presents some paper review, Vishal P.Tank, Divyang D. Shah,Tanmay V. Vyas, Sandip B. Chotaliya Manthan S. Manavadaria in 2013. They are purpose Image Fusion Based on Wavelet and Curvelet Transform. In this paper we have put forward an image fusion algorithm based on wavelet transform and second generation Curvelet transform.
Myungjin Choi, Rae Young Kim, Moon-Gyu Kim in 2009. They are purposed THE CURVELET TRANSFORM FOR IMAGE FUSION. The fusion of high-spectral but low spatial resolution multispectral and low-spectral but high spatial resolution panchromatic satellite images is a very useful technique in various applications of remote sensing. Recently, some studies showed that wavelet-based

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image fusion method provides high quality of the spectral content of the fused image.

Jianwei Ma and Gerlind Plonka in 2012. He purpose A Review of Curvelets and Recent Applications. Multiresolution methods are deeply related to image processing, biological and computer vision, scientific computing, etc. The Curvelet transform is a multi scale directional transform, which allows an almost optimal non adaptive sparse representation of objects with edges. It has generated increasing interest in the community of applied mathematics and signal processing over the past years.

Proposed technique

This section illustrates the overall technique of our proposed algorithm. In this paper, we proposed 'Image fusion approach with noise reduction using Genetic Algorithm & Sure-let Algorithm'. The structure of this paper is as follows. In our proposed approach we first used Genetic Algorithm (GA) as a de-noising tool, Then this de-noised image which comes from applying GA to the Hybrid filter entered to the next stage which is applying the image fusion process using Sure-let transform to the two input images to obtain one fused image which is better in its focusing from the other two input images. A variety of algorithms have been evolved from nature. GA is one of the simplest and most popular evolutionary algorithms. Here we used PSNR as our fitness function for the GA which is directly proportional to the value of PSNR. Better the value of PSNR better is the quality of image. After applying the fitness function to the initial population we apply the selection function to select the highly fitness function chromosomes to be used for the next new generation and here we use the roulette wheel selection type for reproducing the new generation.

Image Fusion

In computer vision, Multi-sensor Image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images.

In remote sensing applications, the increasing availability of space borne sensors gives a motivation for different image fusion algorithms. Several situations in image processing require high spatial and high spectral resolution in a single image. Most of the available equipment is not capable of providing such data convincingly. Image fusion techniques allow the integration of different information sources. The fused image can have complementary spatial and spectral resolution characteristics. However, the standard image fusion techniques can distort the spectral information of the multispectral data while merging. In satellite imaging, two types of images are available. The panchromatic image acquired by satellites is transmitted with the maximum resolution available and the multispectral data are transmitted with coarser resolution. This will usually be two or four times lower. At the receiver station, the panchromatic image is merged with the multispectral data to convey more information. Many methods exist to perform image fusion. The very basic one is the high pass filtering technique. Later techniques are based on Discrete Wavelet Transform, uniform rational filter bank, and Laplacian pyramid. Multi-sensor data fusion has become a discipline which demands more general formal solutions to a number of application cases. Several situations in image processing require both high spatial and high spectral information in a single image. This is important in remote sensing. However, the instruments are not capable of providing such information either by design or because of observational constraints. One possible solution for this is data fusion. The process of image fusion is used to combine two or more images. The main idea behind image fusion is that different images contain different information. For example the image of the scene which is focused to the left contains different information than the one which is focused on to the right. By fusing these two images we can retain the best features of the two images. Similarly lower resolution multispectral images can be fused with higher resolution panchromatic images to get high resolution images which can provide insightful information about the scene under consideration. This type of image fusion is most commonly used in remote sensing. Thus there can be different sources for image fusion. Image fusion can be divided into signal level fusion, pixel level fusion, feature level fusion and decision level fusion. In signal level fusion the main idea is to improve the signal to noise ratio by combining the information from different sources. In pixel level fusion the pixel set from all the source images is fused. This process is repeated for all the pixels. In feature level fusion salient features are extracted from a given set of images and then these features are fused together. Finally decision level fusion involves the extraction of information from the given set of images. The extracted information is then combined using decision rules. For image fusion to take place the set of source images needs to be registered i.e. the images needs to be aligned spatially. For our proposed algorithm we use pixel based fusion of source and its histogram equalized image. Conventional histogram equalization is used for the

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purpose of equalization. An expression to obtain a fused image if with two source images is given as

If □ w* I1□ (1□ w) * I 2

Where I1 and I2 are the two images and $0 \leq w \leq 1$….

Genetic Algorithm

A genetic algorithm (GA) is a method for solving both constrained and unconstrained optimization problems based on a natural selection process that mimics biological evolution. The algorithm repeatedly modifies a population of individual solutions. At each step, the genetic algorithm randomly selects individuals from the current population and uses them as parents to produce the children for the next generation. Over successive generations, the population "evolves" toward an optimal solution. You can apply the genetic algorithm to solve problems that are not well suited for standard optimization algorithms, including problems in which the objective function is discontinuous, non differentiable, stochastic, or highly nonlinear.

SURE-LET Algorithm:

SURE-LET Algorithm based on the image-domain minimization of an estimate of the mean squared error which is Stein's unbiased risk estimate (SURE) In order for our approach to be viable, we add another principle that the de-noising process can be expressed as a linear combination of elementary de-noising processes that is linear expansion of thresholds (LET).

DURING acquisition and transmission, images are often corrupted by additive noise. The main aim of an image de-noising algorithm is then to reduce the noise level, while preserving the image features.

There are some parameters are give which used in this papers:

A. MSE:

Mean Squared Error is essentially a signal fidelity measure. The goal of a signal fidelity measure is to compare two signals by providing a quantitative score that describes the degree of similarity/fidelity or, conversely, the level of error/distortion between them. Usually, it is assumed that one of the signals is a pristine original, while the other is distorted or contaminated by errors. The MSE between the signals is given by the following formula:

$$MSE = (1/N)\Sigma i|x(i)- e(i)|2$$

Here x and e are the encrypted watermarked audio signals respectively and N is the number of samples in the audio signal.

B. PSNR

Embedding this extra data must not degrade human perception about the object. Namely, the watermark should be "invisible" in a watermarked image or "inaudible" in watermarked digital music. Evaluation of imperceptibility is usually based on an objective measure of quality, called peak signal to noise ratio (PSNR), or a subjective test with specified procedures. The PSNR values can be obtained using following formula-

$$PSNR=20\log10(PIXEL\_VALUE/\sqrt{MSE})$$

These all given parameters are important factor in watermarking techniques.

Evaluation and results

To verify the effectiveness (qualities and robustness) of the proposed image fusion technique, we conduct several experiments with this procedure. There are some steps of our proposed technique are given below:

Phase 1: Firstly we develop a particular GUI for this implementation. After that we develop a code for the loading the images in the Matlab database.
Phase 2: Develop a code for the Image Fusion.
Phase 3: After that we develop code for the Genetic Algorithm. With the help of GA we get more accurate image. This new method has reached an optimum fusion result.
Phase 4: Develop a code for denoising the image by SURE-LET.
In our implementation GA and Sure-let algorithm is used for denoising purpose.

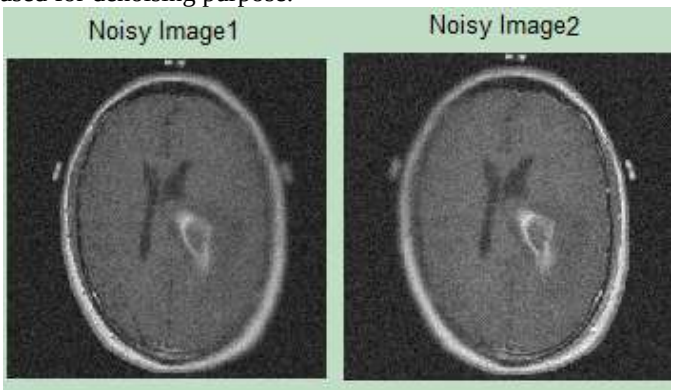

Fig 1.Input noisy images

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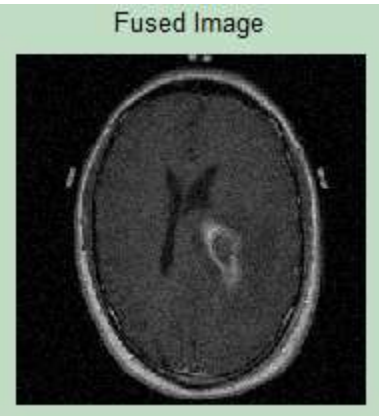

Fig 2. Fused Noisy Image.

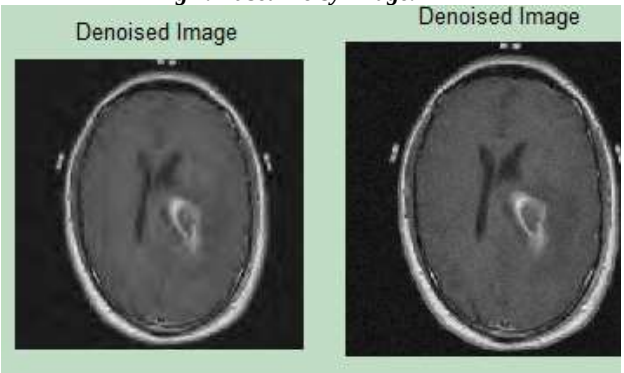

Fig 3. Denoise image i) G.A. and Curvelet, ii) SURE-LET Method.

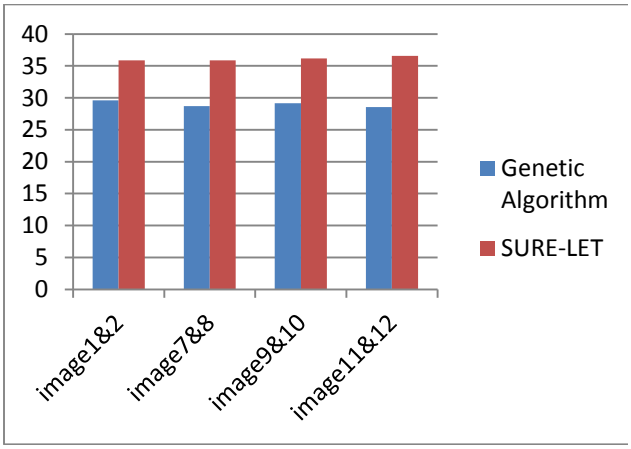

Fig 4. PSNR between genetic and SURE-LET Algorithm

Conclusion & futer scope

In this paper, we proposed 'Image fusion approach with noise reduction using Genetic Algorithm & Sure-let Algorithm'. An original image fusion method based on the non-separable multi-resolution analysis provided by the Curvelet transform. In this paper we present a new approach by applying Sure-let as a de-noising process, and showed that it is a much more benefit as a de-noising technique than the other techniques that we used for comparison. The future scope for this approach is using it with one grey scale image and one colored image and gets the same result that is quite better than any others. And further future work we can use other datasets and analysis. We can also use another transformation for the fusion of image.

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