Review of an Edge Preserving Image Fusion

Sandeep Singh¹, Navneet Bawa², Amarjit Kaur³
¹M.Tech. Scholar, ²Associate Professor, Department Of CSE, PTU Regional Centre ACET, Amritsar, India
³Assistant Professor, Department of CSE, BCET, Gurdaspur, India

Abstract -- The process of merging two or more images into a single image is called as image fusion. The need of fusing images is to improve the quality of image that helps to retrieve the more information from the fused image. Image fusion usually refers to digital image processing, but optical and analog image processing also are possible. This article is about image fusion, need of image fusion and techniques that apply to image fusion. The techniques are PCA based image fusion, IHS transform based image fusion, Wavelet transform image fusion and High pass filtering technique.

Keywords-- PCA, HIS ,Wavelet , High Pass Filtering ,color distortion, transforms

I. INTRODUCTION

In computer revelation, Multisensor Image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more explanatory 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 need 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 methods 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 garble the spectral information of the multispectral data while merging.

In satellite imaging, two types of images are available. The panchromatic image developed 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.

1.1 Need of Image Fusion?

Multisensor 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 material 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.

Image fusion methods can be generally categorized into two sets - spatial domain fusion and transform domain fusion.

The fusion procedures such as averaging, Brovey method, principal component analysis (PCA) and IHS based methods fall under spatial domain approaches. Another important spatial domain fusion technique is the high pass filtering based technique. Here the high frequency details are injected into up sampled version of MS images[4]. The drawback of spatial domain approaches is that they produce spatial distortion in the fused image. Spectral distortion becomes a negative factor while we go for further processing, such as classification problem. Spatial distortion can be very well handled by frequency domain methodologies on image fusion. The multiresolution analysis has become a very useful tool for analyzing remote sensing images. The discrete wavelet transform has become a very useful instrument for fusion. Some other fusion methods are also there, such as Laplacian pyramid based, curve let transform based etc. These methods show a better performance in spatial and spectral quality of the fused image compared to other spatial methods of fusion.
1.2 Image fusion methods

The images used in image fusion should beforehand be registered. Misregistration is a major source of error in image fusion. Some well-known image fusion methods are:

- PCA based image fusion
- IHS transform based image fusion
- Wavelet transform image fusion
- High pass filtering technique

1.2.1 Principal Component Analysis (PCA)

PCA is a mathematical tool which transforms a number of correlated variables into a number of uncorrelated variables. The PCA is used comprehensively in image compression and image classification. The PCA involves a mathematical process that transforms a number of correlated variables into a number of uncorrelated variables called principal components. It computes a compact and optimal explanation of the data set.

The first principal component accounts for as much of the variance in the data as possible and each succeeding module accounts for as much of the remaining variance as possible. First principal component is taken to be along the direction with the maximum variance. The second principal component is constrained to lie in the subspace perpendicular of the first. Within this Subspace, this module facts the direction of maximum variance. The third principal component is taken in the maximum variance direction in the subspace perpendicular to the first two and so on. The PCA is also called as Karhunen-Loève transform or the Hostelling transform. The PCA does not have a fixed set of basis vectors like FFT, DCT and wavelet etc. and its basis vectors depend on the data set.

1.2.2 IHS Fusion Method

The IHS technique is a standard way in image fusion, with the major inadequacy that only three bands are involved. Originally, it was based on the RGB true color space. It offers the advantage that the separate channels outline certain color properties, namely intensity (I), hue (H), and saturation (S). This precise color space is often chosen because the visual cognitive system of human beings tends to treat these three components as roughly orthogonal perceptual axes.

These first two values give the two structures the 'H' and 'S' in their names. The height corresponds to a third value, the system's representation of the perceived luminance in relation to the saturation[3].

Perceived luminance is a extremely difficult aspect of color to represent in a digital format, and this has given rise to two systems attempting to solve this issue: HSL and HSV or HSB (V for value or B for brightness). A third model, HSI (I for intensity), common in computer vision applications, attempts to balance the advantages and disadvantages of the other two schemes

1.2.3 Wavelet Based Image Fusion

A wavelet is a wave-like oscillation with amplitude that begins at zero, increases, and then decreases back to zero. It can classically be visualized as a "brief oscillation" like one might see recorded by a seismograph or heart monitor. Generally, wavelets are purposefully crafted to have precise properties that make them useful for signal processing[1]. Wavelets can be combined, using a "reverse, shift, multiply and integrate" technique called convolution, with portions of a known signal to extract material from the unknown signal. The word wavelet has been used for decades in digital signal processing and exploration geophysics. The equivalent French word ondelette meaning "small wave" was used by Morlet and Grossmann in the early 1980s. Almost all practically valuable discrete wavelet transforms use discrete-time filter banks[5]. These filter panels are called the wavelet and scaling coefficients in wavelets nomenclature. These filter banks may contain either finite impulse response (FIR) or infinite impulse response (IIR) filters. The wavelets forming a continuous wavelet transform (CWT) are subject to the ambiguity principle of Fourier analysis respective sampling theory: Given a signal with some event in it, one cannot allocate concurrently an exact time and frequency reaction scale to that event[2]. The product of the uncertainties of time and frequency response scale has a lower bound. Thus, in the scale gram of a continuous wavelet transform of this signal, such an event marks an entire region in the time-scale plane, instead of just one point. Also, discrete wavelet bases may be reflected in the framework of other forms of the uncertainty principle.

1.2.4 High Pass Filter Approach

A high-pass filter (HPF) is an electronic filter that passes high-frequency signals but attenuates (reduces the amplitude of) signals with frequencies lower than the cutoff frequency. The actual quantity of attenuation for each frequency differs from filter to filter. A high-pass filter is usually modeled as a linear time-invariant system[6]. It is sometimes called a low-cut filter or bass-cut filter.
High-pass filters have many usages, such as blocking DC from circuitry delicate to non-zero average voltages or RF devices. They can also be used in conjunction with a low-pass filter to make a band-pass filter. For the high pass filtering (HPF) fusion, first the ratio between the spatial resolution of the panchromatic and the multispectral image is calculated[8]. A high pass convolution filter kernel is shaped and used to filter the high-resolution input data with the size of the kernel based on the ratio. The HPF image is added to each multispectral band. Before the summation, the HPF image is weighted relative to the global standard deviation of the multispectral image with the weight issues again calculated from the ratio[7]. As a last step, a linear stretch is applied to the new multispectral image to match the mean and standard deviation values of the original input multispectral image. It displays acceptable results also for multi sensorial and multi temporal data. Sometimes the edges are stressed too much.

II. FUTURE WORK

In computer vision, Multisensor Image fusion is the process of combining related information from two or more images into a single image. The resulting image will be more useful than any of the input images in research field. Many processes are used for image fusion. It is often not possible to get an image that contains all applicable objects in focus. One way to overcome this difficulty is image fusion, in which one can attain a series of pictures with different focus settings and fuse them to yield an image with stretched depth of field. Image fusion techniques can increase the excellence and increase the use of these data.

1. Guileless in this is the simplest technique of image fusion. The main disadvantage of Pixel level method is that this method does not give guarantee to have a clear stuffs from the set of pictures.

2. Guileless Extreme in this Resulting in extremely focused image output obtained from the input image as compared to average method. Pixel level method are affected by blurring effect which directly effect on the contrast of the image.

3. PCA is a outfit which transforms number of associated variable into number of uncorrelated variables, this property can be used in image fusion. But spatial domain fusion may create spectral degradation.

4. The DWT fusion technique may outperform the slandered fusion method in terms of reducing the spectral distortion. It offer enhanced signal to noise ratio than pixel based approach. In this technique final fused image have a less spatial resolution.

5. Combine DWT, PCA Transform Multi level fusion where the image undergoes fusion twice using proficient fusion technique deliver better-quality result. Output image contained both high spatial resolution with high quality spectral content. This technique is complex in fusion algorithm. Requisite good fusion technique for enhanced result.

III. CONCLUSION

The goal of image fusion is to combine related material from two or more source images into one single image such that the single image contains most of the information from all the source images. In this proposed work previously we have used wavelet transformation but because of some problems like shift variant there’s a need to introduce algorithm which eliminates such problems. So we have implemented laplacian pyramid with PCA. Laplacian pyramid smoothens the image and PCA to fuse the image.

REFERENCES


