Image Fusion Enhancement Using Gabor Algorithm

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Abstract: Today in this digital world Image Fusion is the emerging field in the area of Image Processing. Its main purpose is to combine two or more images in such a way as to keep the most desirable characteristics of each in resultant image. Image fusion techniques can enhance the quality and raise the application of these data. In this paper, we apply image fusion technique on color image as well as black and white image by using the Gabor algorithm. Gabor algorithm removes the redundancy from developed and enhanced image. The output fused image will also use to detect regions such as water, soil and vegetation etc of the satellite images using regression tree algorithm.

In the propose technique includes Gibbs sampling, segmentation algorithm, Bayesian classification algorithm and histogram equalization.

Keywords: Gabor algorithm, Gibbs sampling, Bayesian classification algorithm, histogram equalization, regression tree algorithm

I. INTRODUCTION

Image Fusion is a process of merging the relevant information from a set of images, into a single image, wherein the resultant fused image will be more instructive and complete than any of the input images. Image fusion process can be defined as the integration of information from a number of input images without the introduction of distortion. Image fusion find application in the area of navigation guidance, object detection and recognition, medical diagnosis, satellite imaging for remote sensing, rob vision, military and civilian surveillance, etc. Image fusion system has several advantages over single image source and resultant fused image should have higher signal to noise ratio, increased robustness and reliability in the event of sensor failure, extended parameter coverage and rendering a more complete picture of the system. The actual fusion process can take place at different levels of information representation. Image fusion is usually done in three different levels of image representation, they are:

✔ Pixel level: In this method, integration is performed at a level where pixels are least processed and each pixel in the fused image is calculated from the input images

✔ Feature level: It requires extraction of features from the input images first, and fusion is done based on features that matches certain selection criteria.

✔ Symbol level/Decision level: In this method, output from initial object detection and classification from source image are given as input to fusion algorithm.

Gabor filter algorithm is used for the image fusion enhancement. Gabor algorithm has properties of partial, direction selection and band-pass; therefore it can accurately extract local features of the image.

The Gibbs sampling is a technique for generating random variable from a (marginal) distribution indirectly without having to calculate the density. Then for further processing Bayesian classification will used. Bayesian fusion allows an intuitive interpretation of the fusion process via the posterior distribution. Since the fusion problem is usually ill-posed, the Bayesian methodology offers a convenient way to regularize the problem by using an appropriate prior distribution for the scene of interest [1]. Then histogram equalization is used.

The satellite images can be used for environment prediction, region identification etc. In some case we have to detect various areas present in that region using satellite images. But original satellite images do not give the exact idea of the regions such as water, soil, vegetation etc. The regression tree algorithm is use for detecting these areas classification. It uses threshold that gives minimum mean square error. This threshold is applied to Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), Soil Adjusted Vegetation Index (SAVI), and Normalized Difference Built-up area Index (NDBI) to detect vegetation, water, soil and built-up area respectively.
II. LITERATURE REVIEW

Since last few decades, an extensive number of approaches are used to fuse visual image information. These techniques vary in their complexity, robustness and sophistication.

A hybrid approach of fusion by combining the Laplacian pyramid and Shift Invariant Discrete Wavelet Transform Algorithm (SIDWT) is used [2]. Gabor filter and grey level co-occurrence probability (GLCP) features is used for improved texture recognition [8]. A Bayesian fusion method is used for remotely sensed multi-band images. The fusion problem is formulated within a Bayesian estimation framework. Bayesian algorithm was implemented to correct the saturated pixels in raw images. For each image, it estimates the distributions of the R, G, and B color channels based on the unsaturated pixels, and then verify the saturated pixels based on this prior distribution [5]. To find the Bayesian estimator of the scene of interest from its posterior distribution, a Markov chain Monte Carlo algorithm is designed to create samples asymptotically distributed according to the target distribution [1].

III. PROPOSED TECHNIQUE

Image fusion is very important tool because it can easily combine images from different sensors and gives the image having better quality than the original one. It adds the spatial content to image without changing the spectral content of the image. The complete process of image fusion is as shown in below fig.1.

A. HISTOGRAM EQUALIZATION

Histogram equalization is most commonly and important method in image enhancement on space. Histogram equalization is to amend the histogram of original image to gray-uniformed histogram through gray-scale transform function and then to amend the original image by the gray-uniformed histogram.

The process of histogram equalization is as follows:
✓ Calculating histogram of the original image
✓ Calculating the gray-scale cumulative distribution function of the original image, then get the gray-scale conversion table
✓ According to the gray-scale conversion table, map the gray-scale of the original image to the new gray-scale.

Histogram equalization can make gray-scale distribute uniformly, and then increase the contrast of the image to make the detail clear, which can achieve the goal of enhancement.

B. GIBBS SAMPLING

Gibbs sampling is a technique for generating random variables from a (marginal) distribution indirectly without having to the calculate density.

The Gibbs sampling algorithm is used to estimate the model parameters and approximate the posterior distribution of the latent variable. The Gibbs Sampler creates a Markov chain based on the conditional probabilities. When the Markov chain converges, the values of the Markov chain can be viewed as samples drawn from the a posteriori probability [6]. The Gibbs Sampler is a very useful statistical tool for Bayesian inference.

C. BAYESIAN CLASSIFICATION ALGORITHM

Bayesian classification is applied to decision making and inferential statistics that deals with probability inference. It uses Bayesian framework for estimating the true values of the saturated pixels. The joint distribution of the RGB color channels was used as the prior information. The output of the Bayesian classification algorithm is then providing to the Gabor algorithm (i.e. image 1 and image 2).

D. GABOR ALGORITHM

Gabor transform has properties of partial, direction selection and band-pass; therefore it can accurately extract local features of the image, and has some anti-interference capability. However, after filtered by Gabor filters of different directions under a certain scale, an image will not only generate a great deal of complementary information, but also a large number of redundant information. The superior performance of Gabor filtering cannot be effectively brought into play if we use all this information to get the edge image.

To solve the problem is to use image fusion technology, which can comprehensive utilize the complementary information of Gabor features and eliminate the redundant information. So that the new features after fusing can best display the Gabor features with the least amount of
IV. REGRESSION TREE ALGORITHM

The regression tree algorithm is used for detecting classification of areas such as vegetation, water, soil and built-up area. Regression tree algorithm uses threshold to detect class of data that gives least mean square error. As tree grows in each stage threshold to decide class is determined using least mean square error. The threshold value which gives least mean square error is used as final threshold for classification [4].

We have to detect vegetation, water, soil, built-up area etc from the satellite image. For this following indexes are used.

✓ Normalized Difference Vegetation Index (NDVI):

\[
NDVI = \frac{BAND4 - BAND3}{BAND4 + BAND3}
\]

✓ Soil Adjusted Vegetation Index (SAVI):

\[
SAVI = 1.5 \times \frac{BAND4 - BAND3}{BAND4 + BAND3 + 0.5}
\]

✓ Normalized Difference Water Index (NDWI):

\[
NDWI = \frac{BAND2 - BAND5}{BAND2 + BAND5}
\]

✓ Normalized Difference Built-up area Index (NDBI):

\[
NDBI = \frac{BAND5 - BAND4}{BAND5 + BAND4}
\]

Where, BAND1, BAND2, BAND3, BAND4 and BAND5 are sub-bands of an input image.

Basic regression tree algorithm implemented is given in the following flow chart fig 2.

![Flow Chart of Area Classification Using Regression Tree](image)

**Figure 2: Flow chart of area classification using regression tree**

V. CONCLUSION

In this work, Gabor algorithm is used to extracting the salient feature from the two input images (i.e. black and white or color), due to its ability to extract maximum information from local image regions. A Gibbs sampler technique is used to avoid difficult calculation, replacing them instead with a sequence of easier calculation and it is a very useful statistical tool for Bayesian inference. The resultant fused image is used to retain the important features of the source images.

Then fused image is given as input to regression tree to classify it and detect areas such as vegetation, water, soil, built-up area etc present in the region whose image is captured.

REFERENCES


