Classification of Large Magellan cloud Using Wavelet Transform (lifting scheme)

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Abstract

This paper was introduce a new method of supervised classification can be achieved through our field work, study of Astronomical image the galaxy "Large Magellan cloud". In remote sensing, classification methods are usually improved by adopting multi-spectral-bands of satellite images. The problem is arising when only single band is available. In this research, the wavelet transform is adopted to generate multi-band images from the available single band. The New classification method as supervised , this classification technique depend upon statistical-features For astronomical image processing scientists, it is very well known that entropy features refer to the amount of information within an image. Our present research adopted the relative entropy of the transferred single band into multi-band images to perform the classification. The transformation used in this research is the wavelet transforms (lifting scheme).

1. Introduction:-

Magellan clouds are two irregular galaxies that are among the nearest neighbors of the Milky Way, which are part of the local group. The Magellan clouds consist of large and small Magellan Clouds [1]. In this research we study and classification the large Magellan cloud (LMC) by Wavelet transform.

i. Large Magellan Cloud (LMC):- The LMC is a nearby satellite galaxy of our own galaxy, the Milky Way. At a distance of slightly less than 160,000 light-years, the LMC is the third closest galaxy to the Milky Way. The LMC is the fourth largest galaxy in the local Group [1]. The LMC is considered an irregular type galaxy. It's contains a very prominent bar in its center, suggesting that it may have previously been a barred spiral galaxy. The LMC's irregular appearance is possibly the result of tidal interactions with both the Milky Way, and the Small Magellan Cloud (SMC)[2]. It's visible as a faint "cloud" in the night sky of the southern hemisphere, straddling the border between the constellations of Dorado and Mensa.

ii. Supervised Classification: Supervised classification always classifies pixels of unknown identify by samples of known identity located within training areas[3]. The analyst defines training areas by identifying regions on the image that can be clearly matched to areas of known identity on the image[4]. Such areas should typify spectral properties of the categories they.

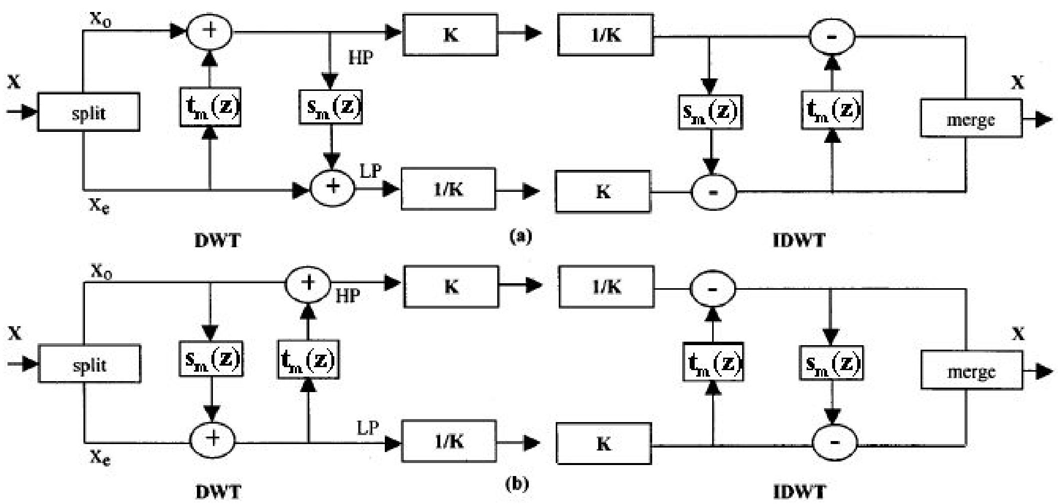
2. Theory:-

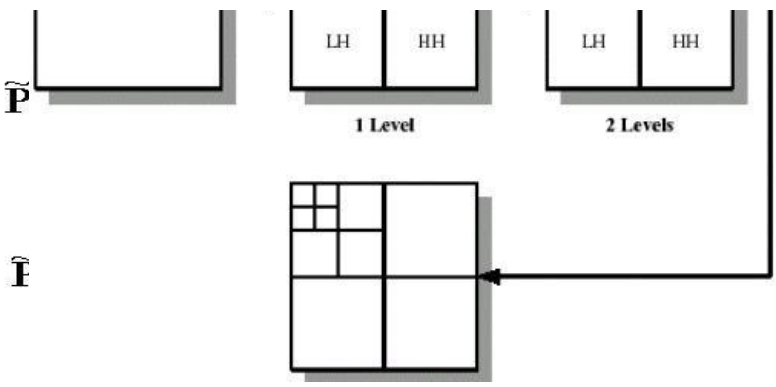
i. Wavelet Transform: Wavelet transform (WT) represent an image as a sum 0f wavelet function (wavelet) with different location and scale. And decomposition of an image into wavelet involves a pair of waveforms: (1)high frequencies corresponding to the detailed part of an image (wavelet function) (2)Low frequencies or smooth parts of an image (scaling function)[5] .

Figure (1): Tow dimensional wavelet Transform 3levels

ii. Fast Wavelet Transform:- The DWT matrix is not sparse in general, so we face the same complexity, by fast DWT into a product of few matrices using self-similarity properties. The need for improvement of wavelet comes from a short coming that is inherent because of its construction. Second generation wavelet named when the concept of lifting was introduced [6].

iii. Wavelet Transform by Lifting Scheme:- Lifting scheme is a rather new method for constructing wavelet. The main different with the classical construction is that it does not rely on the Fourier transform. The basic idea behind Lifting Scheme is very simple; one tries to use the correlation in the data to remove redundancy [5]. Lifting steps is a technique to construct Wavelet filters into basic building blocks.





iv. Texture Classification using DWB. Wavelet packet decomposition capable of providing maximum inter-class discrimination power would be the most suitable representation for a given image in a texture analysis framework. However, it cannot always be guaranteed that using more sub bands directly translates to smaller classification error. Experiments demonstrate that using only a few of the subbands instead of all of the wavelet subbands can result in smaller error rates, where error rate is the ratio of total number of misclassifications and total number of pixels with the ratio expressed as a percentage. The subbands were chosen by heuristically selection, whereby subbands with apparent difference in magnitudes of the transform coefficients for different texture regions are given priority over those which do not react very strongly to one texture or other.

There are ${}^{n}c_{k} = \binom{n}{k}$ possible combinations of k (3)

Subbands from a total of n subbands. It is not practical to employ a brute force approach, which finds out the best combination by trying out each of them. This is motivation enough for finding out an efficient way of determining which of these combinations of subbands is optimal in terms of best discriminating different textures. Reduction in dimensionality of the problem may result in not only more accurate but also faster classification.

v. Discriminate Measure:- Consider a wavelet packet subband node $\ddot{e}_{d}^{p,q}$, where d is the depth and p, q represents the location at depth d of the wavelet packet tree. We use the convention that in case of an image, a subband $\ddot{e}_{d}^{p,q}$ is decomposed into four subbands $\ddot{e}_{d+1}^{2p,2q}$, $\ddot{e}_{d+1}^{2p+1,2q}$, $\ddot{e}_{d+1}^{2p,2q+1}$ ¸ $\ddot{e}_{d+1}^{2p+1,2q+1}$ and $\ddot{e}_{0}^{0,0}$ denotes the root node (original image). Let $f_{d}^{p,q}$ and $g_{d}^{p,q}$ denote the normalized energy distributions of wavelet packet coefficients corresponding to the subband node $n_{d}^{p,q}$ associated with classes 1 and 2 respectively given by;

$$f_{d}^{p,q}(x,y) = \frac{(w_{d}^{p,q}(x,y)^{t} c^{(1)})^{2}}{\left\| c^{(1)} \right\|^{2}} \quad (4)$$

$$g_{d}^{p,q}(x,y) = \frac{(w_{d}^{p,q}(x,y)^{t} c^{(2)})^{2}}{\left\| c^{(2)} \right\|^{2}} \quad (5)$$

Where $w_{d}^{p,q}(x,y)^{t}$ denotes the basis vector corresponding to position (x, y) in the subband $n_{d}^{p,q}$ and $c^{(1)}$ and $c^{(2)}$ denote texture images corresponding to classes 1 and 2 respectively. A discriminate measure $D_{d}^{p,q}(f,g)$ should be able to measure how differently f and g are distributed thus relating it directly to the discrimination power of subband $n_{d}^{p,q}$.The Kullback-Leibler distance, also known as the relative entropy, between f and g is given by;

$$I_d^{p,q}(f,g) = \sum_x \sum_y f(x,y) \log \frac{f(x,y)}{g(x,y)}. \quad (6)$$

A symmetric version of this distance measure, also known as the J–divergence, given by:

$$D_d^{p,q}(f,g) = I_d^{p,q}(f,g) + I_d^{p,q}(g,f)\,. \quad (7)$$

is proposed to measure the discrimination power of a subband.

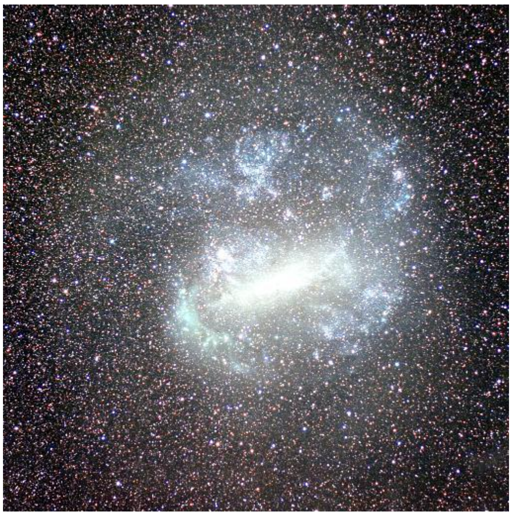


Figure (3) represented the original image.

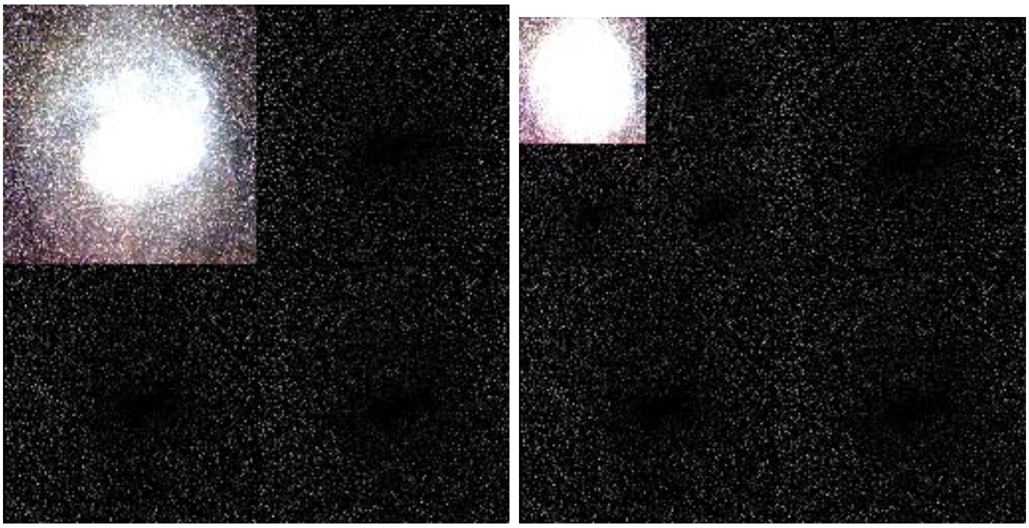


Figure (4) (a–b) represented when we apply 1^{st} and 2^{nd} level of Wavelet transform.

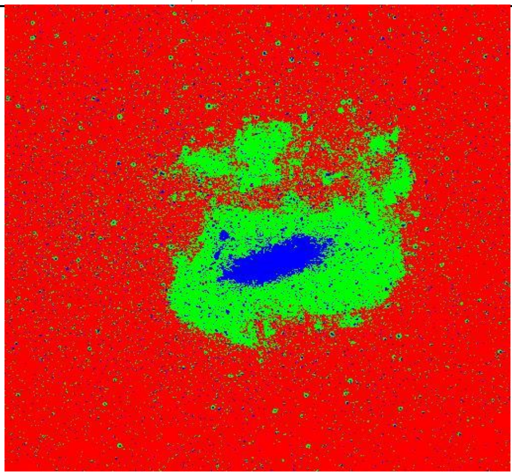
.

Figure (5) represented the classified image

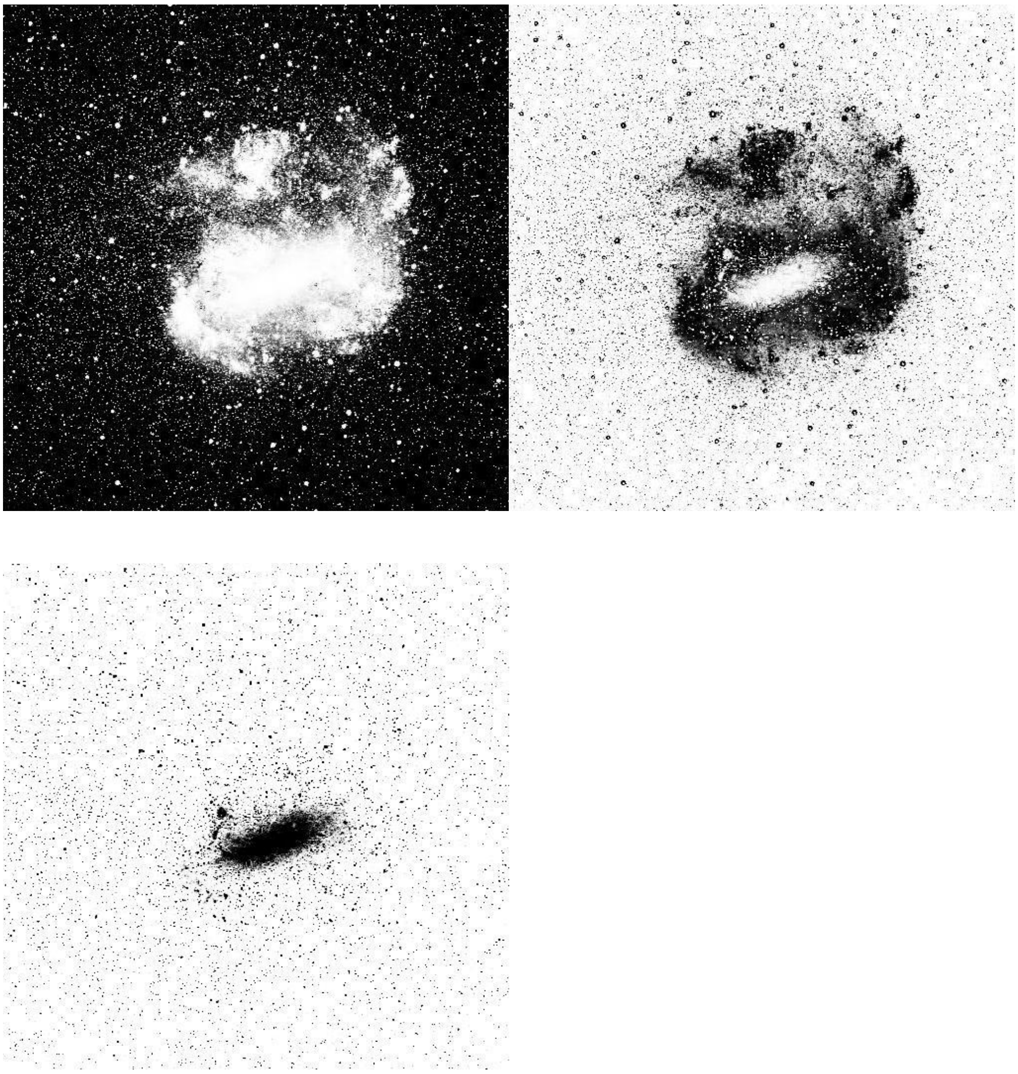


Figure (6) represented the three bands we obtained from single band .

Table (1): Statistical Result of Classification for three Bands.

Percent	Total	No. of pts	Band No.
80.1563	210125	210125	1
15.7768	251483	41358	2
4.0668	262144	10661	3

4. Experimental Result:-

The new efficient wavelet image classification using Lifting scheme is applied to color astronomy image large Magellan cloud size (512x512). The classification is performed using the visual basic the classification method had been conducted depend upon the two criteria (Mean and Standard deviation) for three band was obtain within image The following figure illustrate the steps of technique . The figure (3) represents the origin (LMC) image. Figure (4) (a-b) represent (LMC) images when we apply wavelet transform first and second level. Figure (5) represent The Classification image of (LMC).Figure (6) represented three bands we can obtain when apply. Table (1) represented the statistical result of each bands.

5. DISCUSS AND CONCLUSION

The process of classifying this image wasn't easy because of interfering of the regions with each other. So there was a difficulty to point out the area of the test, and also because of the farina of the picked image by the telescope, we found the follows:-

1. Important point in this search to prove according to the result (a)The LMC's contains a very prominent bar in its center, suggesting that it may have previously been a barred spiral galaxy. (b) The LMC's irregular appearance is possibly the result of tidal interaction with both the Milky Way , and the small Magellan cloud .
2. The most of areas were for the young stars and massive stars. That makes a clue that the galaxy (SMC) is the vessel of the small stars or at the primmer forming.
3. We show from original image and Classified Images There are many Pieces of evidence indications between the Magellan clouds (the small Magellan cloud and large Magellan cloud) and our Galaxy because the interaction between them.

6. Reference:-

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