A Review on Texture Image Classification Using Different Methods

A.H.Karode, K.K.Pandey

***Abstract*— This paper describes the various texture Image classification techniques with their analysis. Classification refers to as assigning a physical object or incident into one of a set of predefined categories. In texture classification the goal is to assign an unknown sample image to one of a set of known texture classes. Texture classification is one of the four problem domains in the field of texture analysis. The other three are texture segmentation (partitioning of an image into regions which have homogeneous properties with respect to texture; supervised texture segmentation with a priori knowledge of textures to be separated simplifies to texture classification. Out of this one model is Linear Regression Model on Multi resolution Analysis for Texture Classification [1] and the second method which is widely used in based on Tree structured wavelet transform. Other recently developed methods Texture Classification using Curvelet Transform. This paper also describes the result and comparative analysis of various texture classification techniques.**

***Index Terms*— Curvelet, Linear Regression Model. Wavelet, Texture,**

I. Introduction

Texture Image Classification is a widely employed method used in Image processing as a statistical, geometrical and model based approach for various signal processing operations. Co-occurrence matrices as well as auto correlation function are few of the types of statistical method discussed mostly. Texture primitives are extracted and analyzed which forms the base of geometrical method. Various stochastic models have been proposed for texture modeling and classification such as spatial autocorrelation and Gaussian Markov random fields. Spatial and frequency domain techniques are employed for texture filtering in signal processing techniques.

II. LINEAR REGRESSION MODEL

Different frequency regions in an image have several correlations which created an effective tool for effective texture characteristics. The simple linear regression model is employed to verify the correlation. If a set of random data $(x_1, y_1)^T$, $(x_2,y_2)^T$,………..$(x_n, y_n)^T$ for two numerical variables X and Y, where X is a cause of Y.T he linear regression analysis distributes data in random ways appearing as a straight line in X, Y space when both X & Y are related linearly in perfection. This captures a relationship between two variables. This line function can be given as, $\hat{y} = ax + b$. The texture features are extracted from the correlation process in frequency channel pairs. . The channel energy matrix say M is considered to select the two frequency channels of one pairs in top ten lists and these energy values are taken as a random data $(x_1, y_1)^T$, $(x_2,y_2)^T$,………..$(x_n, y_n)^T$ for two variables X and Y represent a straight line in X,Y space. The parameters 'a' and 'b' of the line can be calculated using the expressions,

$$a = n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} {}^{y_i}/_{n} \sum_{i=1}^{n} x_{i^2} - \left(\sum_{i=1}^{n} x_i\right)^2 \tag{1}$$

$$b = {}^{1}/_{n} \sum_{i=1}^{n} y_i - {}^{a}/_{n} \sum_{i=1}^{n} x_i \tag{2}$$

When high correlation data is taken into the regression to obtain $\hat{y}$, there exists the residual between y and $\hat{y}$, such residuals exhibit a normal distribution curve. The normal distribution parameters are mean (μ) and standard deviation (σ). The values of μ and σ can be given as,

$$\mu = \sum_{i=1}^{n} {}^{(y_i - \hat{y}_i)}/_{n} \tag{3}$$

$$\sigma = \sqrt{\sum_{i=1}^{n} {}^{(y_i - \hat{y}_i)^2}/_{n-2}} \tag{4}$$

There are two phases of texture classification based on learning and classification phase. When texture analysis is carried with simple linear regression model, the directional lifting based on wavelet transform is used which improves the classification rate. In multi resolution analysis, the sub images are used to calculate the energy values and the requisite feature are extracted which characterizes the texture image ate multi resolution space and hence a correlation between frequencies regions are is employed to construct the texture features. In such cases, mostly the threshold comparison is widely used in contrast to some distance measurement method. So, it becomes fast and easy to analyze and examine by simply varying frequency channels for the texture image

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classification. It improves the classification rate as well and is highly accurate. [1] One of the most important features which determine the existence of textual characteristics of an image is characterized by coarseness which measures the size of primitives determining the texture and is composed of large primitives and higher degree of local grey levels uniformity. Directionality of an image is one of the global properties which determine the degree of visible dominant orientation in an image. An isotropic image has not a dominant orientation but rather several images have dominant orientation. This property is influenced by shapes of primitives and the rules by which they are oriented. The degree of clarity with which one can distinguish between various primitives is said to be Contrast of the image. If contrast is well defined, then primitives are clearly separable. The contrast is influenced by the grey levels and intensity change frequency of grey levels. Busyness of the images is referred as the change in intensity from pixel to neighborhood. In busy texture, the intensity changes are slow and gradual and hence describe the spatial frequency of the image. If the change and variation is too small, then there is a risk of invisibility of the image. [5]

III. TEXTURE CLASSIFICATION BASED ON WAVELET TRANSFORM

The texture classification based on wavelet transform helps to achieve several important goals. The data correlated suitably and it achieves the same goal as well as used in the case of the linear transformation. The frequency domain transform provides orientation and sensitive information as well which is required in texture analysis. It significantly reduces the computational complexity when the series of wavelet decomposition is used. [2]

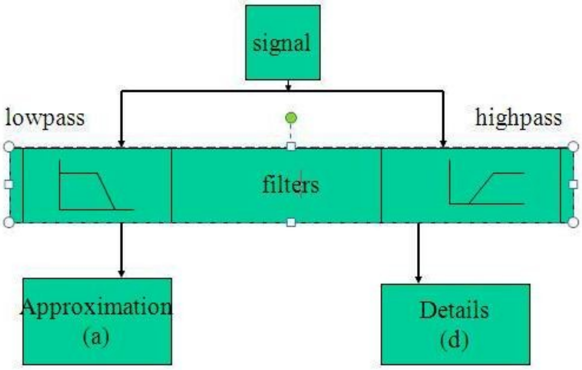

Fig 1: Discrete Wavelet Transform

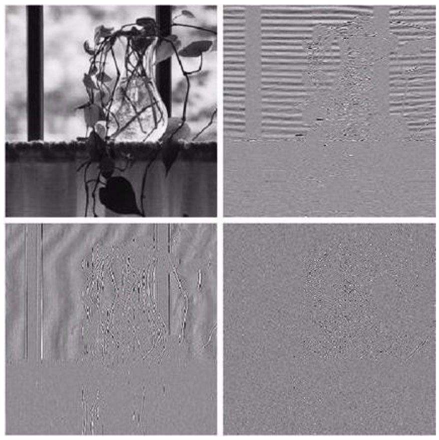

Fig 2: Sub band decomposition using Wavelet transform

In texture classification, mostly Haar wavelet is used. Haar transform, separable and symmetric T = HFH, where F is an N×N image matrix H is N×N transformation matrix, H contains the Haar basis functions, $h_k(z)$ $H_0(t) = 1$ for $0 \leq t < 1$

$$H_1(t) = \begin{cases} 1 if\ 0 \leq t < \frac{1}{2} \\ -1 if\ \frac{1}{2} \end{cases}$$

$$H_{2^P+n}(t) = \begin{cases} \sqrt{2^P}\ for \frac{n}{2^P} \leq t < \frac{(n+0.5)}{2^P} \\ -\sqrt{2^P}\ for \frac{(n+0.5)}{2^P} \leq t < \frac{(n+1)}{2^P} \\ 0 otherwise \end{cases}$$

$$where P = 1,2,3,\ldots and n = 0,1,\ldots,2^P - 1 \quad (5)$$

The above characterization describes the features of the different combination of sub band images. The experimental results show the combination of detailed sub bands with the approximate sub bands which helps to improve the classification rate at reduced cost. It also sets a good platform for the segmentation process based on the t4exture features. With the help of FIR filter bank, orthogonal and bi orthogonal wavelet transform can be performed effectively. [4]

IV. TEXTURE CLASSIFICATION BASED ON CURVELET TRANSFORM

To overcome the weakness of wavelets in higher dimensions, Candes and Donoho pioneered a new system of representations named ridgelets which deal effectively with line singularities in two dimensions. The idea is to map a line singularity into a point singularity using the Radon transform. Then, the wavelet transform can be used to effectively handle the point singularity in the Radon domain. So, Ridgelet transform allows representing edges and other singularities

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along lines in a more efficient way than wavelet transform, for a given accuracy of reconstruction. In image processing, edges are typically curved rather than straight and ridgelets alone cannot yield efficient representations. However at sufficiently fine scales, a curved edge is almost straight, and so to capture curved edges, one ought to be able to deploy ridgelets in a localized manner, at sufficiently fine scales. Candes and Donoho proposed another multiscale transform called Curvelet transform which is designed to handle curve discontinuities well. Here, the idea is to partitioning the curves into collection of ridge fragments and then handle each fragment using the ridgelet transform. In this paper, the curvelet transform is applied on a set of texture images. One group feature vector can be constructed by the mean and variance of the Curvelet Statistical Features (CSFs), which are derived from the sub-bands of the curvelet decomposition and are used for classification. Texture classification involves two phases, i.e., learning and classification. In the learning phase, the original image is decomposed using Discrete Curvelet Transform (DCvT) as explained in Section 2. Feature such as mean μ and standard deviation σ are calculated from each of these curvelet sub-bands and are used to construct a global feature vectors as G= [$G\mu$, $G\sigma$] where $G\mu = [\mu_1, \mu_2, \ldots \mu_s]$, $G\sigma = [\sigma_1, \sigma_2, \ldots \sigma_s,]$ and then are stored in the database for the purpose of classification. In the classification phase, an unknown texture image Q is decomposed using DCvT and its features are calculated to form the feature vector similar to that of the learning phase. [3]

V. CONCLUSION

The linear regression model is employed to analyze this correlation and extract texture features that characterize the samples. Therefore, this method not only considers the frequency regions but also the correlation between the frequency regions. So the classification rate is improved where as wavelet transform is used for the decomposition of images which is sub band decoding for texture classification. The characterization defines the features constructed from the different combination of sub-band images. Using wavelet transform, the combination of detailed sub band with approximation sub band helps to improve the classification rate and the texture features extracted from wavelet transform can be used for efficient segmentation for the various purpose. By using the Curvelet transform, one of the group features can be constructed by mean and the variance of the sub band s of discrete Curvelet transform. Thus the Curvelet transform is the advanced tool for texture classification with high Classification rates.

REFERENCES

[1] A.Subha, S.Lenty Stuwart, "Linear regression model on multiresolution analysis for texture classification," International Journal of Computer Applications (0975-8887), Vol. 2, No.4, June 2010.

[2] P.S.Hiremath, S.ShivShankar, "Wavelet based features for texture classification," GVIP Journal, Vol.6, Issue. 3, pp 55-58, December 2006.

[3] Liran Shen, Qingbo Yin, " Texture classification using Curvelet transform," Proceedings of the 2009 International Symposium on Information Processing(ISIP'09), Huangshan, P.R. China, August 21-23, 2009, pp. 319-324.

[4] W.Y.Ma, B.S.Manjunath, "A Comparision of wavelet transform features for texture Image aanotaion, "0-8186-7310-9195 © 1995 IEEE PP. 256-259.

[5] G.Tamilpavai, S.Tamil Selvi, "Multiple representation of perceptual features for texture classification", International Journal of Computer Applications (0975-888), Vol.48, N0.20, June 2012, pp. no. 05-11.

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