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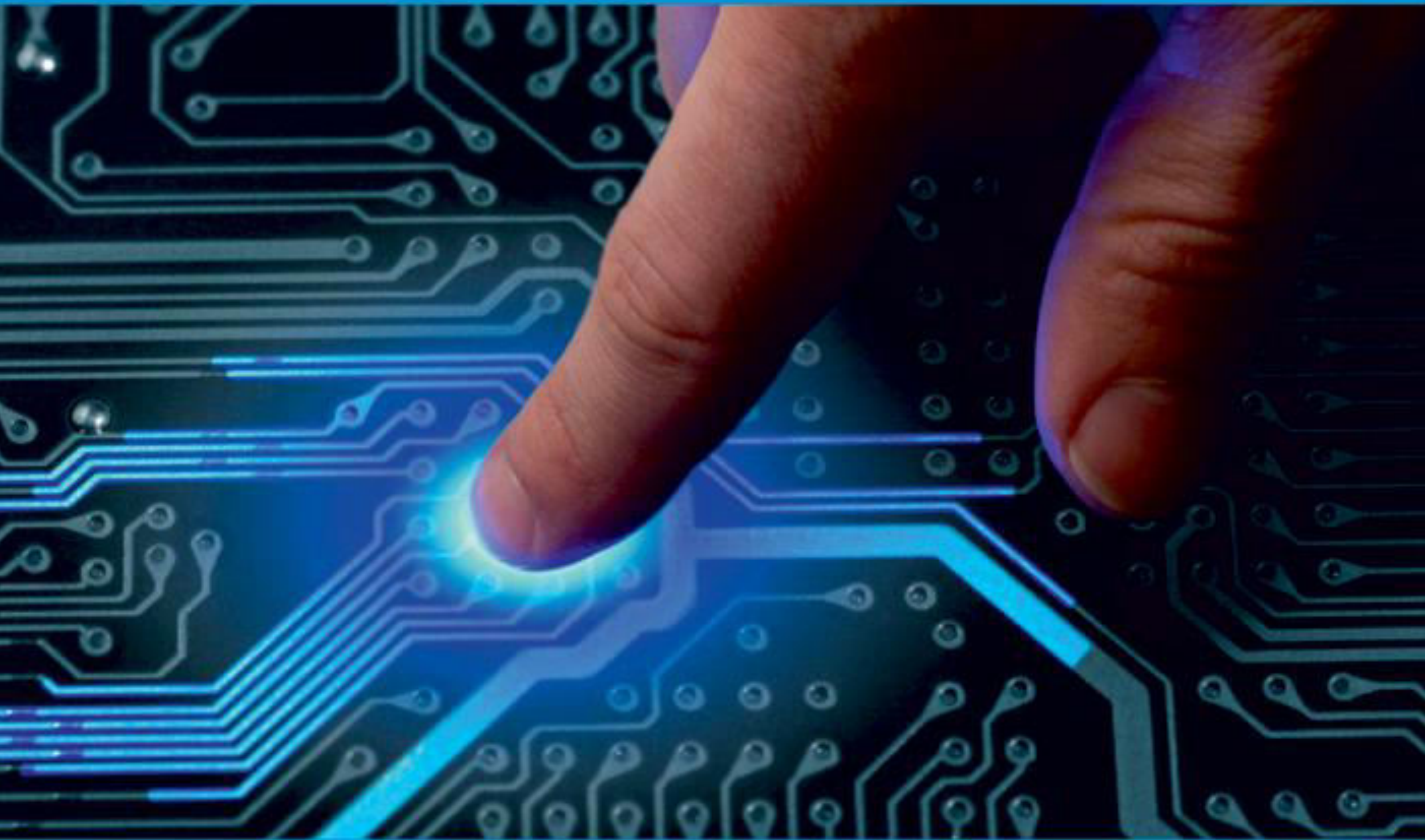

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Wavelets on Image Analysis

*R.Udayakumar, Dean- Computer science and IT, Kalinga University, Raipur, CG., India

*deancsit@kalingauniversity.ac.in,rsukumar2007@gmail.com

ABSTRACT: Reconstruction of image through algorithms on wavelet transform is enhanced through with the use of measures of central tendency and dispersion. Our objective is to design a wavelet based feature extraction algorithm that will measure tendency quality along the most important perceptual dimensions. We have found that the additional statistical information helps us to get better texture analysis and noise cleaning.

KEYWORDS: wavelet transform, texture analysis, reconstruction, decomposition statistical measure.

I.INTRODUCTION

Texture analysis is important in many applications of computer image analyses for classification, detection or segmentation of image based on local spatial patterns of intensity or color. There does not exist a widely accepted definition of texture. For the sake of simplicity, textures may be considered as a spatial area consisting of an arrangement of primitives resembling each other. Textures are replications, symmetries and combinations of various basic patterns or local functions, usually with some random variation. Textures have the implicit strength that they are based on intuitive notions of visual similarity. Texture classification methods have been classified into five major categories based on the types of features they associate with a texture: statistical, structural, geometrical, model-based and signal processing.

Of the signal processing methods, perhaps the most common approach is to decompose the input image frequency sub bands, from which it is hoped, the features that is associated with textures present in the image can be extracted. Discrete wavelet transform provides a tractable way of decomposing an image into a number of frequency sub bands at different scales, a feature that has been associated with human visual sytem.

A conventional dyadic wavelet transform, however, has a shortcoming in that it does not benefit from possibly useful features that can be obtained by further obtained by further decomposing the high frequency sub bands. Adaptive wavelet decomposition also known as wavelet packet decomposition, was developed to overcome this limitation by providing better frequency localization.

The wavelet transform has been widely used for description of image textures. Although numerous decomposition schemes have been proposed for the purpose of texture characterization, numerical description is mainly archieved through the second order statistical of wavelength co efficients.

Our objective is to design a wavelet based feature extraction algorithm that will measure texture quality along the most important perceptual dimensions. The wavelet transformation involves filtering and sub sampling. The filtering process, which involves convolving the image with the series of filters is linear. A compact representation needs to be derived in the transform domain for classification and retrieval. The mean and the varience of the energy and distribution of the transform co efficients for each sub band at each decomposition level are used to construct the feature vector.

II.WAVELET TEXTURE ANALYSIS

The principle behind wavelets is that shifts and dilations of a prototype functions are chosen as basic functions, decomposing the signal into its components belonging to different frequencies while providing good localization in time(space) at the same time. The discrete wavelet transform can be computed with the help of filter banks that decomposes the images into low and high frequency bands. The low frequency band is further decomposed in order to go down the transform one more level.

Wavelet based texture classification methods use the wavelet sub bands to extract textural features. Each sub band can be passed through the non-linearity followed by a smoothing function to compute a feature image.

Wavelet Decomposition

Texture characterization is based on a fixed over complete linear decomposition whose basis functions are spatially localized, oriented and roughly octave in bandwidth. A compact representation needs to be derived in the transform domain for classification and retrieval. The mean and the variance of the energy distribution of the co efficients for each sub band at each decomposition level are used to construct the feature vector.

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The 2D discrete wavelet transform represents an image with both the spatial frequency characteristics. Here we can obtain quad-tree structure in the three band i.e LH HL and HH. The probability density function of the wavelet co efficients can be described by a peak and heavy detailed non guassian density. In the case of general wavelet packet decomposition, a basis needs to be selected which has the maximum discriminating power among all possible bases in the library of wavelet packets.

III.WAVELET IMAGE DECOMPOSITION

Discrete Wavelet Transform

The Dicrete Wavelet Transform(DWT) is a linear transformation that operates on a data vector whose length is an integer power of two, transforming it into a numerically different vector of the same length. It is a tool that separates data into different frequency components and then studies each component with resolution matched to its scale. DWT is computed with the cascade of filtering followed a factor 2 sub sampling.

In the case of two dimensional images, the wavelet decomposition is obtained with separable filtering along the rows and columns of an image.

The wavelet analysis can thus be interpreted as image decomposition in a set of independent, spatially oriented frequency channels. The HH sub image represents diagonal details, HL give horizontal high frequencies, LH gives vertical high frequencies, LL corresponds to the lowest frequencies. At the subsequent scale of analysis, the image LL, undergoes the decomposition using the same g and h filters, having always the lowest frequency component located in the upper left corner of the image. Each stage of the analysis produces next 4 sub images whose size is reduced twice compared to the previous scale. Good texture segmentation results can be obtained within 2 to 4 scale of wavelet decomposition.

Wavelet Sub band Features

We combine the quad-tree data structure with wavelet sub band representation to perform image segmentation as follows: for each quad-tree block, features are extracted by computing the wavelet decomposition of the block, as indicated. Features are obtained by measuring statistics from the wavelet subbands.

ALGORITHM

1. Read 256x256 image.
2. Find all statistical texture measures.
3. Display results.
4. Select wavelet and apply quad tree decomposition to the given image.
5. Find approximate and detailed co efficients.
6. Concentrate on high energy part and compute all statistical measures.
7. Compare with step 2 results.
8. Reconstruct image using approximate and detailed coefficients.
9. Find statistical measures for reconstructed image.

IV.DATA AND RESULTS:[USING MATLAB]

Here we are using two images.

1.Camera man .tif and woman2 .tif

IMAGE	LL	LH	HL
WOMAN 2 LEVEL 1	126.8757	30.5862	28.54000
LEVEL 2	128.0791	33.4443	30.7383
CAMERAMAN LEVEL 1	116.3827	9.0101	9.0738
LEVEL 2	129.7373	9.922	16.7688

Table 1: Images mean value at 1D and 2D level decompositions

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RESULT	WOMAN2.TIF	CAMERAMAN>TIF
Reconstructed image mean(using wrcoef2)	125.666	118.7246
Reconstruction error(using wrcoef2)	4.64979e-010	6.19849e-010
Reconstructed image mean(using waverec2)	125.666	118.7245
Reconstruction error(using waverec2)	4.4922e-010	6.19849e-010
Original image mean	125.6656	118.7246

Table 2: Error computation for image.

V.CONCLUSION

Here we proved tree-structured wavelet transform provides a good analytic tool for texture analysis. Although the conventional pyramid structured wavelet transform are suitable for images with energy concentrated in the low frequency region, the tree structured wavelet transforms is more natural and effective for textures which have dominant middle frequency channels. The application of tree structured wavelet transform is texture segmentations and also used in medical imaging and other interesting problems.

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