

# Comparative Evaluation of Contourlet and Wavelet Transform for Feature Extraction in Glaucoma Images

F. Fanax Femy<sup>1</sup> and S. P. Victor<sup>2</sup>

<sup>1</sup>Department of Computer Applications, Noorul Islam Center for higher Education, Kumaracoil.  
Kanyakumari – 629180, Tamil Nadu, India; femfanax@yahoo.co.in

<sup>2</sup>Computer Science Department, St. Xavier's College (Autonomous), Palaymkottai – 627007,  
Tamil Nadu, India; drspvictor@gmail.com

## Abstract

**Background/Objectives:** In this paper our proposed system easily detects the glaucoma affected eye from the fundus image database collected from the nearest eye hospital. **Methods/Statistical Analysis:** The feature extraction is done by contourlet transform and the best feature is selected for classification. Support vector machine is mainly applied for classification of images. **Findings:** In the conventional methods Wavelet Transform is applied for feature extraction of images and Support Vector Machine (SVM) adapted for classifying the Glaucoma images with non-affected and affected. The accuracy of classification is evaluated using existing and proposed techniques. **Applications/Improvements:** The proposed system is applied to find the Glaucoma disease of human eye with accurately which eliminates the human error to examine the disease of human eye. The system automatically finds the disease of human eye within the seconds from the applied fundus image.

**Keywords:** Feature Extraction in Glaucoma Images using Wavelet and Contourlet Transform

## 1. Introduction

Techniques in digital image processing such as feature extraction, feature selection and classification are used to identify Glaucoma at the earliest stages with high accuracy. In<sup>1,2</sup> developed a system which easily identifies the cause of glaucoma in the given fundus image. The extraction of features has taken from previously processed images. Then the draw out image features are given to the classification techniques such as Support Vector Machines, SMO, random forest, etc. In<sup>3</sup> developed shift-invariant discrete wavelet transform analysis for retinal image classification. This paper gives the overall idea of the automatic extraction of all the structural features from retinal images using wavelet transform and found the initial diagnosis of the Glaucoma disease. In<sup>4</sup> did the classification of microcalcification using dual-tree complex wavelet transform and support vector machine which includes more worth on effective drawn out of

feature in Glaucoma disease identification. In<sup>5</sup> developed the Contourlet-based mammography mass classification using the SVM family<sup>6</sup>. Developed the magnetic resonance brain images using wavelets and classification using support vector machine and neural network. In<sup>7</sup> developed the contourlet transform for an efficient directional multiresolution image representation. In our paper, we proposed a system which positively detects the glaucoma with higher accuracy, the system used the contourlet transform for feature extraction and SVM for classification which is compared with wavelet using SVM.

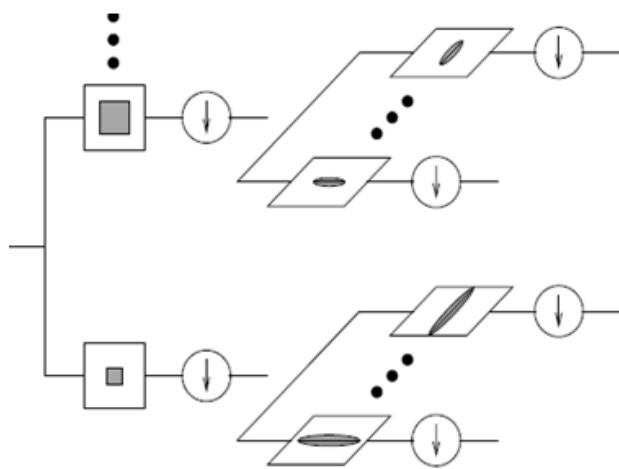
## 2. Contourlet Transform

The drawbacks of 1D transforms, such as the Fourier and wavelet transforms, used to capture the image geometry and edges which are evaluated in the conventional research work. In our paper, we proposed a 2D transform which can easily catch the inherent geometrical image

\*Author for correspondence

points which contains the true information. The real skill is to study the geometry in images derived from the discrete signals. The different other techniques, which are curvelets, the continuous domain is converted into discrete domain. This technique fully developed with the discrete domain based so that we can elaborately explore the images. Here we built the image with multiresolution and multi direction using cavities which are discrete in nature. This structure gives a modified multiresolution, and multidirectional image enlargement using contour regions, which is called as the contour let transform. Figure 1 shows the structure of contourlet transform with filter banks.

The Contourlet Transform (CT) is a novel technique used for feature extraction in glaucoma images. It is a redundant transform, so there will be a disadvantage using coding applications. It is derived from curve let transform. CT gives a varied and modifiable multiresolution and a multidirectional decomposition of images. The tool gets the different directions at each scale the image. The contourlet transform can be designed to be fitted in a tight frame. It gives robustness versus any noise due to quantization or threshold. Finally, the contour let transform is developed with filter banks.



**Figure 1.** Contourlet Transform with filter banks.

### 3. Wavelet Transform

The wavelet transform was found an alternate to the Short Time Fourier Transform(STFT) and to overcome the resolution related problems in STFT. The time domain signal is fed to the different high pass and low pass filters, taken out may be high frequency or low frequency of the input signal. The steps are continued every minute, hence

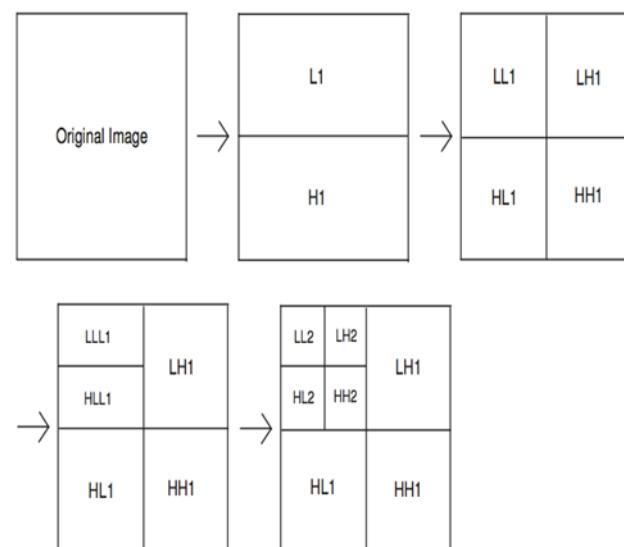
few portions of the signal according to few frequencies are being cancelled from the parent signal or image.

#### 3.1 Discrete Wavelet Transforms

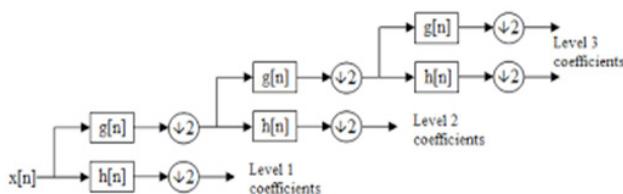
The idea behind this transform is same as of Continuous wavelet transform. The CWT is found by modifying the scale to investigate the window and rearranging the window as time scale. It is multiplied by the signal and integrated overall times. The filters with different cutoff frequencies with the discrete time format is developed and investigated using multi frequencies. The discrete time signal fed to high pass filter banks to know and investigate the high frequencies and it is also fed to the low pass filter banks to filter out the low frequencies. Thus the DWT investigates the signal at multi frequency bands with multi resolutions and decaying the signals to get an approximate clean and detail information. This transform gives two sets of jobs one is scaling and the other is wavelet functions which are coined with low pass and high pass filters alternatively. The decaying of signal into multi frequency bands is simply acquired by successive high pass and low pass filtering of the time domain signal.

#### 3.2 Image decomposition using DWT

The discrete wavelet transform is exact to an ordered subsystem where they placed logarithmically in frequency. When the image applied to Discrete Wavelet Transform the image is subdivided into four sub bands and it is shown in Figure 2. These four limited modes of sub bands are shown in Figure 3.



**Figure 2.** DWT Image Decomposition.



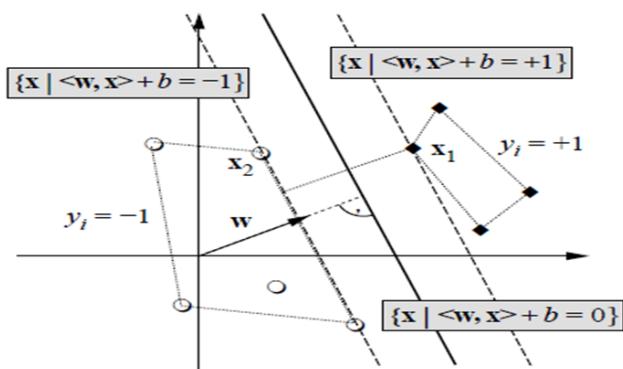
**Figure 3.** Wavelet filter bank decomposition for one level.

### 3.3 Feature Selection

Feature selection is the first step to get the feature extracted images. The Contourlet Transform estimates the feature from the input signal which are pre-processed fundus image form the database. The feature selection is fully depends on selection of variables and subsets. This selection method is very helpful to the repeated feature and the selected feature which has no data. The technique did not choose without data, which will not useful for future processing. The feature which is selected with data of the fundus image database which is again fed for classification of images.

## 4. Classification

### 4.1 Classification using Support Vector Machine



**Figure 4.** Support vector Machine.

SVM is among the best supervised learning algorithm for better classification. SVM is based on the three big ideas. The first idea is minimizing the margin. This means

that when we learn a linear separator we should try to choose the decision boundary so as to minimize the distance to the points that are closest to the boundary. The second idea is duality. This idea is used many times in optimization problems. It allows one problem to be transformed into another problem that may be easier to solve. The third big idea is kernels. This kernel allows a set of features to be mapped into a higher-dimensional and therefore more expressive feature space without incurring the full computational cost one might expect. Figure 4 shows the graphical representation of SVM.

## 5. Simulation Results

### 5.1 Non affected eye by Glaucoma as input

The different steps followed in this case for the new designed system is done with the input fundus images got from the nearest hospital. In the new system design the Support Vector Machine is run with 200 inputs and more such as eye affected by glaucoma and non- affected eye by glaucoma images. The simulated output has analyzed in two approaches. In the initial approach, non affected eye with glaucoma is selected as an input the actual proposed algorithm, the output results normal eye. The next approach, eye affected by glaucoma images is given as input and the results abnormal output. The Figures 5, 6 and 7 shows the input, pre-processed images and contour let coefficients for the two approaches.

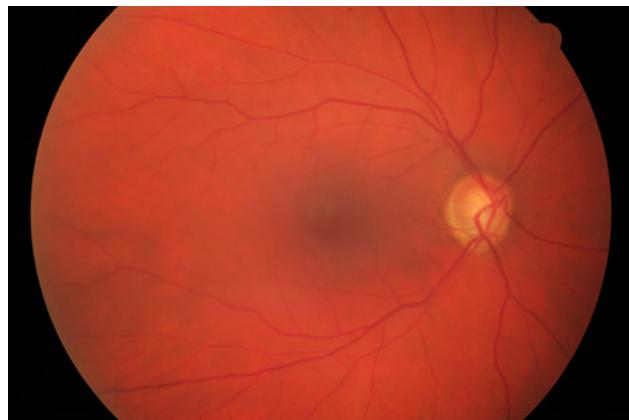


**Figure 5.** Non-Glaucoma Affected Image.



**Figure 6.** Contourlet Decomposed Images.

## 5.2 Glaucoma Eye as Input



**Figure 7.** Glaucoma Affected Fundus Images.

**Table 1.** Comparison of contour let and Wavelet with SVM classifier

Techniques	Recognition rate
Contourlet as feature extraction and SVM as Classification	98.6%
Wavelet as feature extraction and SVM as Classification	91.5%

The collected fundus images from the database shown in Figure 5 and 7 which is a normal image and glaucoma affected image is preprocessed to remove the noise and then feature extraction is done using contourlet transform and the selected feature is gone for classification. The algorithms are simulated in Matlab and the output gives

whether the given image is affected with Glaucoma or not affected. The accuracy of the classification techniques is evaluated and tabulated Table 1.

## 6. Conclusion

The contour let transform is very much helpful to generate better feature so that the feature has gone for classification gives the better classification. Hence, using contourlet as a transform for feature extraction with SVM as a classifier automatically classifies accuracy rate of 98.6 % for hundred input images. The wavelet transform with SVM gives only 91.6% recognition rate. Hence Contourlet based feature extraction gives better results compared to wavelet based extraction.

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