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Computer Aided Abdomen Disease Diagnosis Using Curvelet Based Texture Analysis

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ABSTRACT

Designing computer aided diagnostic system for diagnosis diseases of various sizes is a difficult task. Hence, a method for classification of abdomen diseases of all sizes in computed tomography (CT) images is presented. The idea is to use features extracted using curvelet transform for the classification of the abdomen diseases that leads to the accurate texture analysis and classification method. Experiments have been performed on 40 CT images of abdomen comprising of 10 images, each of normal tissues, cysts, tumors and stones. Experimental result shows that the proposed method performs better than the conventional texture analysis and classification methods for diagnosis abdomen diseases.

1. INTRODUCTION

Abdomen related diseases are one of the most commonly reported diseases worldwide. Commonly known abdomen diseases are related to the liver, kidney and pancreas. There is need is to develop computer assisted texture analysis and classification method to assist radiologists in dealing with such a huge amount of data.

An image can be analysed by using the texture (Akgul et al., 2011). GLCM is used to calculate the texture features (Haralick et al., 1973) and run length coding (Candes and Donoho, 2000). Multi resolution methods are also used in texture analysis and classification methods using wavelets (Daubechies, 1993; Mallat, 1989; Laine and Fan, 1993 and Dua et al., 2012) contourlet (Do and Vitterli, 2005) and curvelets(Kumar, 2010). Liang et al., (1998) proposed automatic diagnostic system for the classification of liver diseases. Miltiades et al., (2003) classified liver lesions by optimizing neural network classifier. Dettori and Semler, (2007) presented comparative analysis of various multiresolution methods like wavelet, ridgelet and curvelet for classification of normal tissues in CT images.

Thus, in order to overcome all above mentioned constrains, there is urgent need to develop robust and reliable Computer Aided Diagnostic (CAD) method that classifies abdomen diseases accurately.

2. DESCRIPTION OF THE DATA SET

The objective of this research is to develop CAD system that will classify unknown input query images accurately to relevant texture class or ROI (disease). Various abdominal diseases are shown in Fig. 1, like tumor, cyst, stone and normal tissues as confirmed by experienced radiologist. The unknown input query images are created from segmented ROIs by sectioning ROIs.

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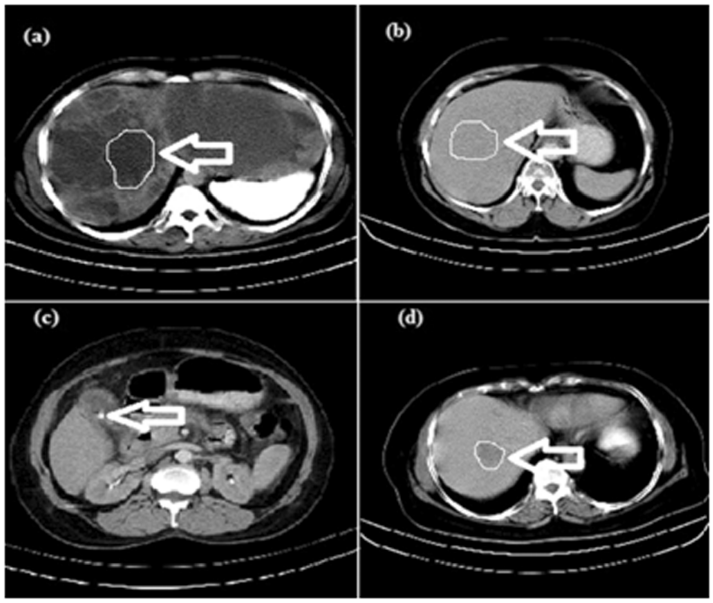

Figure 1: CT images of abdomen having various diseases
(a) Cyst (b) Healthy tissues (c) Stone (d) Tumor

3. CURVELET TRANSFORM

Candes and Donoho, (2000) developed Continuous curvelet transform which is defined by $W(r)$ and $V(t)$ which are angular and radial windows respectively Candes and Donoho, (2000). The admissibility conditions defined by (Candes and Donoho, 2000; Candes and Donoho, 1999 and Marr and Hildreth, 1980) using (1) and (2).

$$\sum_{j=-\infty}^{j=\infty} W^2(2^j r) = 1 \qquad r \in (3/4,\ 3/2) \tag{1}$$

$$\sum_{t=-\infty}^{t=\infty} V^2(t-l) = 1 \qquad t \in (-1/2,\ 1/2) \tag{2}$$

The discrete curvelet transform was introduced by Candes and donoho. IThecurvelet coefficients are defined using (3) $x_k^{j,l}$ (Dettori and Semler, 2007 and Do and Vitterli, 2005)

$$c_{jkl} =< f, \varphi_{jlk} > \tag{3}$$

ϕ_{jkl} is Digital Curvelet Transform.

For the purpose of disease classification features like energy and entropy are calculated using curvelet coefficient. Approximate sub-band is used for calculating the curvelet features.

4. EXPERIMENTAL RESULTS AND DISCUSSIONS

To demonstrate the effectiveness of the curvelet features in the proposed method, comparative quantitative analysis with other two other state-of-the-art methods. This work is implemented using Matlab 7.11.0 (R2010b). The performance of the proposed method in comparison to other two methods has been tested using classification accuracy as performance metrics.

From the experimental results, it is shown that the curvelet features performs far superior than other two traditionalwavelet based features in classifying unknown query.

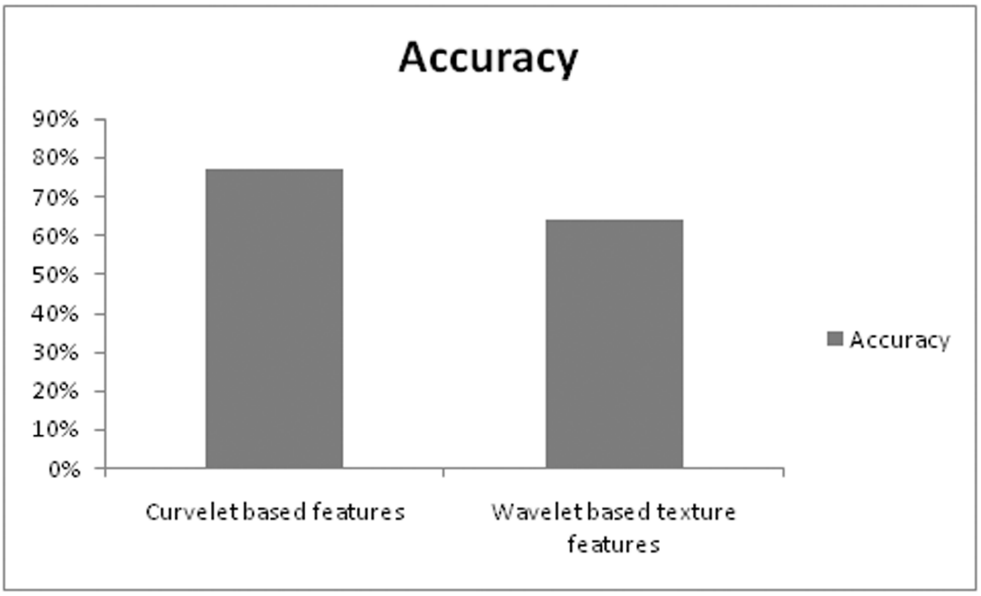

Figure 2: Accuracy

5. CONCLUSION

In this research work, development of CAD has been presented to characterize abdomen diseases like normal tissues, cyst, tumor and stone. The curvelet transform is used here to take out the features. It is concluded thatcurvelet based texture features achievesuperiorresults than wavelet based texture features.

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