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Rotation Invariant Texture Analysis Using Radon transform in CT Image

[1]Jason Jebasingh.G.V, [2]B. Suresh Chander Kapali, [3]B. Priyanka,[4]A. Brightline

[1,2] Assistant Professor, [3,4] UG Scholars
Department of Biomedical Engineering,
Alpha College of Engineering, Chennai.
[1]jasonjebasingh@gmail.com and [2]suresh.kapali83@gmail.com

Abstract - **Texture analysis is an important area of study in image processing. It is a key problem in many application areas, including medical imaging, remote sensing, object recognition, and so forth However, the problem with the majority of existing works on texture analysis is that it is assumed that all images are acquired from the same orientation. This assumption is not realistic in practical applications, where images may be taken with different rotation, scale, etc. As a result, the performance of these methods becomes worse when this underlying assumption is no longer valid. This paper deals with the rotation invariant texture analysis for which initially the CT image is taken and texture category is found out. The images are categorized by the above under individual groups, Isotropic, Anisotropic or mixed. The peak obtained from the plot of variance and theta determines this. The feature values for the CT image are thus found out.**

Key Words: invariant, Texture, radontransforms and anisotropic.

I. INTRODUCTION

In this paper a new scheme for texture analysis is carried out in this the texture category is found out by applying Radon transform .here the image taken for analysis is CT image of lung. CT imaging is one of the best tools for studying the chest and abdomen because it provides detailed, cross-sectional views of all types of tissue. often the preferred method for diagnosing many different cancers, including lung, liver and pancreatic cancer, since the image allows a physician to confirm the presence of a tumor and measure its size, precise location and the extent of the tumor's involvement with other nearby tissue. invaluable in diagnosing and treating spinal problems and injuries to the hands, feet and other skeletal structures because it can clearly show even very small bones as well as surrounding tissues such as muscle and blood vessels. Radon transform is calculated for the CT image and variance is found for the obtained angle a graph is plot between variance and theta that determines the category of the image. Texture feature extraction is carried out by Gabor wavelet transform; here the feature vectors were obtained. Feature vectors were calculated for test images.

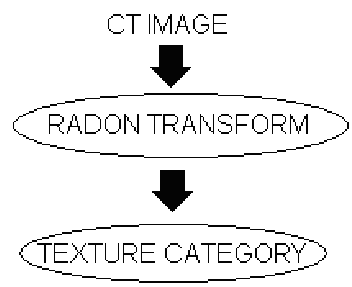

Figure 1 Block diagram.

II. TEXTURE CATEGORY

Radon Transform

The Radon transform is the projection of the image intensity along a radial line oriented at a specific angle. It transforms a 2D image with lines (line-trends) into a domain of the possible line parameters ρ and θ, where ρ is the smallest distance from the origin and θ is its angle with the x-axis. The Radon transform is defined as

$$R(\rho,\theta) = \int_{-\infty}^{+\infty}\int_{-\infty}^{+\infty} f(x,y)\delta(\rho - x\cos\theta - y\sin\theta)dxdy, \quad (1)$$

Or equivalently

$$R(\rho,\theta) = \int_{-\infty}^{+\infty} f(\rho\cos\theta - s\sin\theta, \rho\sin\theta + s\cos\theta)ds, \quad (2)$$

The Radon transform is applied for CT image for angle 0◦ to 179◦.From the out put obtained the variance is calculated for all the possible degrees obtained. A histogram is obtained by taking angle along X-axis and variance along Y-axis. The wave form in the histogram represents the number of peaks which tells about the texture category, if the number of peaks is more than 7 then it belongs to category called mixed and number of peaks less than 7 it belongs to category Isotropic and with one peak represent Anisotropic. Christo Ananth et al.

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measuring the evidence for a boundary between two regions using Geodesic Graph-based representation of the image. The algorithm is applied to image segmentation using two different kinds of local neighborhoods in constructing the graph. Liver and hepatic tumor segmentation can be automatically processed by the Geodesic graph-cut based method. This system has concentrated on finding a fast and interactive segmentation method for liver and tumor segmentation. In the preprocessing stage, the CT image process is carried over with mean shift filter and statistical thresholding method for reducing processing area with improving detections rate. Second stage is liver segmentation; the liver region has been segmented using the algorithm of the proposed method. The next stage tumor segmentation also followed the same steps. Finally the liver and tumor regions are separately segmented from the computer tomography image.

III. TEXTURE FEATURE EXTRACTION USING GABOR WAVELET TRANSFORM.

The texture feature extraction is carried out using Gabor wavelet transform. A 2D Gabor function $g(x, y)$ and its Fourier transform is defined as

$$g(x,y) = \left(\frac{1}{2\pi\sigma_x\sigma_y}\right)\exp\left[-\frac{1}{2}\left(\frac{x^2}{\sigma_x}+\frac{y^2}{\sigma_y}\right) + j2\pi Wx\right] \quad (3)$$

$$G(u,v) = \exp\left[-\frac{1}{2}\left(\frac{(u-W)^2}{\sigma_u}+\frac{v^2}{\sigma_v}\right)\right] \quad (4)$$

Where. $\sigma_u = 1/2\pi\sigma_x$ and $\sigma_v = 1/2\pi\sigma_y$.
Considering $g(x, y)$ as the mother Gabor wavelet, a class of self-similar functions (filters), referred to as discrete Gabor wavelets can be obtained by appropriate dilations and rotations of $g(x, y)$ as

$$g_{mn}(x,y) = a^{-m}g(x',y'), \quad a>1,\ m,n=\text{integer}.$$
$$x' = a^{-m}(x\cos\beta + y\sin\beta),$$
$$y' = a^{-m}(-x\sin\beta + y\cos\beta). \quad (5)$$

Here, we define the parameters of the Gabor filters as

$$a = \left(\frac{U_k}{U_l}\right)^{\frac{1}{S-1}}, \quad \beta = \frac{n\pi}{K}, \quad \sigma_u = \frac{(a-1)U_k}{(a+1)\sqrt{2\ln 2}},$$
$$\sigma_v = \tan\left(\frac{\pi}{2k}\right)\left[U_k - 2\ln\left(\frac{2\sigma_u^2}{U_k}\right)\right] \times \left[2\ln 2 - \left(\frac{(2\ln 2)^2\sigma_u^2}{U_k}\right)\right] \quad (6)$$

Where S and K are the number of scales and orientations, and Ul and Uh denote the lower and upper center frequencies. Given an image $I(x, y)$, its Gabor wavelet transform is then defined as

$$G_{mn}(x,y) = \iint I(s,t)g_{mn}^{*}(x-s, y-t)\,ds\,dt. \quad (7)$$

We can construct a texture feature vector *ft* for S scales and K orientations using the means and standard deviations.

IV. RESULTS

Here three images were taken and the feature values obtained are described.CT image of lung is taken for finding feature values.

Figure 2. CT image of lung.

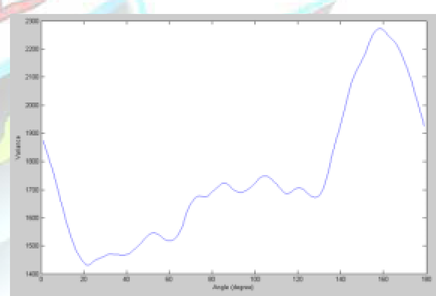

Figure 3. Histogram, Representing Isotropic having No of peaks=6.

Table1, Feature values.

MEAN	S.D	MEAN	S.D	MEAN	S.D
0.0064	0.0030	0.0075	0.0022	0.0093	0.0035
0.0074	0.0021	0.0099	0.0051	0.0113	0.0039
0.0147	0.0053	0.0112	0.0036	0.0127	0.0064
0.0143	0.0055	0.0181	0.0073	0.0141	0.0046
0.0161	0.0079	0.0177	0.0074	0.0221	0.0107
0.0182	0.0067				

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Figure 4. CT image of lung.

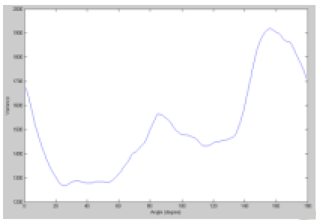

Figure 5. Histogram, Representing Isotropic having No of peaks=2.

Table 2. Feature values.

MEAN	S.D	MEAN	S.D	MEAN	S.D
0.0062	0.0035	0.0073	0.0023	0.0093	0.0035
0.0071	0.0023	0.0096	0.0062	0.0111	0.0041
0.0148	0.0056	0.0108	0.0040	0.0123	0.0075
0.0142	0.0058	0.0182	0.0076	0.0136	0.0054
0.0155	0.0085	0.0175	0.0074	0.0224	0.0112
0.0173	0.0070				

Figure 6, CT image of lung.

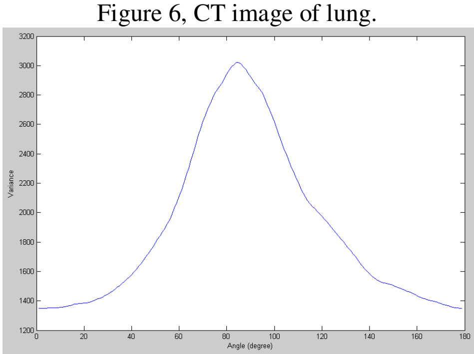

Figure 7, Histogram, Representing Anisotropic having No of peaks=1.

Table 3, Feature values.

MEAN	S.D	MEAN	S.D	MEAN	S.D
0.0057	0.0025	0.0077	0.0020	0.0099	0.0028
0.0075	0.0017	0.0084	0.0041	0.0120	0.0040
0.0162	0.0048	0.0113	0.0035	0.0102	0.0053
0.0155	0.0059	0.0207	0.0076	0.0141	0.0052
0.0124	0.0069	0.0171	0.0070	0.0235	0.0104
0.0166	0.0068				

V. CONCLUTION

The feature values for different category classes Isotropic and Anisotropic were found and the feature values were displayed in tables above. Similarly the feature values for the original image should be find out and classification should be performed and from that diagnosis should be made.

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