

# A Hybrid Approach to Diagnosis of Hepatic Tumors in Computed Tomography Images

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## ABSTRACT

*Liver cancer is one of the most popular cancer diseases and causes a large amount of death every year, can be reduced by early detection and diagnosis. Computer-aided liver analysis can help in the early detection and diagnosis of liver cancer. In this paper, enhancement and segmentation process is applied to increase the computation and focus on liver parenchyma. This parenchyma also segmented using Watershed and Region Growing algorithms to extract liver tumors. These tumors will be analyzed and characterized to distinguish between hemangioma (benign) and hepatocellular (malignant) tumors using Local Binary Pattern (LBP), Gray Level Co-occurrence matrix (GLCM), Fractal Dimension (FD) and feature fusion technique is applied to maximize and enhance the performance of the classifier rate. The authors review different methods for liver segmentation and abnormality classification. An attempt was made to combine the individual scores from different techniques in order to compensate their individual weaknesses and to preserve their strength. The authors present and exhaustively evaluate algorithms using computer vision techniques. The experimental results based on confusion matrix and kappa coefficient show that the higher accuracy is obtained of automatic agreement classification and suggest that the developed CAD system has great potential and promise in the automatic diagnosis of both benign and malignant tumors of liver.*

*Keywords: CAD, Classification, CT, FD, GLEM, Hemangioma, Hepatocellular, LBP, RG, Segmentation*

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## 1. INTRODUCTION

Medical image analysis becomes more and more popular in recent years due to the advances of the imaging techniques, including Magnetic Resonance Imaging (MRI), Computer Tomography (CT), Mammography, Positron emission tomography (PET), X-ray, and Ultrasound or Doppler Ultrasound. Liver cancer, one of the more common cancer diseases that cause a large number of deaths every year, can be reduced by early detection and diagnosis. Computer-Aided Diagnosis (CAD) can play a key role in the early detection and diagnosis of liver cancer. In a CT scan these can be identified by a difference in pixel intensity from that of the liver. Manual segmentation of this CT scans are tedious and prohibitively time-consuming for a clinical setting. Automatic segmentation on the other hand, is a very challenging task, due to various factors, such as liver stretch over 150 slices in a CT image, indefinite shape of the lesions and low intensity contrast between lesions and similar to those of nearby tissues. The irregularity in the liver shape and size between the patients and the similarity with other organs of almost same intensity make automatic liver segmentation difficult (Seong-Jae et.al., 2006; Suzuki et.al., 2010).

Several studies have developed various algorithms that can be categorized on the degree of automation (fully, semi or interactive) and in two approaches: region-based or contour-based. Region-based segmentation is commonly based on intensity of neighbor pixels. While contour-based segmentation includes geometrical or statistical active shape model. Each of these approaches has its advantages and disadvantages in terms of applicability, suitability, performance, and computational cost (Amir et.al., 2009; Miltzer et.al., 2009).

It is always desirable to develop computer-aided diagnosis system to distinguish between benign and malignant tumors. Such systems can help in performing initial diagnosis of liver, and lend objective tools to help radiologists in analyzing difficult cases and decide on biopsy recommendations.

GLCM, LBP, FD and feature fusion approaches were used to analyze the texture of CT liver tumors and extract the corresponding feature vectors. Liver texture is a combination of repeated patterns with regular/irregular frequency. Liver structure exhibit similar behavior, it has maximum disparity in intensity texture inside and along boundary which serves as a major problem in its segmentation and classification.

Mandelbrot defined a number, associated with each fractal, called its fractal dimension. It reflects the measure of complexity of a surface and the scaling properties of the fractal i.e. how its structure changes when it is magnified. Thus fractal dimension gives a measure of the irregularity of a structure (Mandelbrot et.al., 1983). The fractal dimension used to quantify the texture information. Among the texture analysis techniques, fractal geometry has become a tool in medical image analysis.

Particularly, no one who did not consider above characteristics of the abdominal CT image can meet desirable results on liver segmentation. Therefore, to address the above mentioned problems, we present fully automatic liver segmentation and classification algorithms in abdominal CT images based on a hybrid approach.

The goal of this paper is to develop an efficient system to assist radiologists in categorizing liver into normal and abnormal such as benign and malignant. Normal liver usually have a regular structure, but due to the presence of the abnormal tissues the complexity of abnormal liver increases. Thus, naturally they will have higher fractal dimension. Malignant masses are generally rough and have more irregularity structure whereas benign masses commonly have smooth, round, oval contours. In this research, we present fully automatic computer-aided diagnosis (CAD) system based on hybrid techniques to classify the ROI into three classes: normal, benign and malignant. To improve the classification performances, the CT images are pre-processed and segmented to extract liver and tumors using hybrid segmentation techniques. Finally, the statistical classifier is used to clas-

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