International Journal of Innovative
Computing, Information and Control
Volume **7**, Number **11**, November **2011**

ICIC International ©2011 ISSN 1349-4198
pp. 6541–6558

ULTRASONIC LIVER TISSUE CHARACTERIZATION BY MULTIRESOLUTION FEATURE VECTOR AND AN ENSEMBLE OF CLASSIFIERS

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Received July 2010; revised December 2010

Abstract. *This study describes the feasibility of characterizing liver tissue through multiresolution feature vector and combined classifiers in the interpretation of ultrasonic imagery. This approach comprised three main stages. The first stage utilized multiresolution analysis to extract intrinsic features from ultrasonic liver images. As a result of spatial-frequency decomposition, feature representation for each subimage was obtained. The second stage tested various classification algorithms based on respective texture measurements and filter banks. The final stage involved the aggregation of individual classifiers based on fuzzy integral. The proposed approach was applied to discriminate among ultrasonic images of liver tissue in three states: normal liver, liver with cirrhosis and liver with hepatoma. The classification results showed that the approach yielded performance superior to that obtained through the use of individual classifiers. Furthermore, clinicians could use the quantitative index of the classification results to decide whether to proceed with an advanced medical examination, thereby improving the quality of medical care.*
Keywords: Multiresolution analysis, Fractal dimension, Fuzzy k-NN classifier, Neural network, Support vector machine, Ensemble of classifiers, Fuzzy integral

1. **Introduction.** Ultrasonic imaging has been widely adopted in many hospitals and clinics as an effective, safe, diagnostic tool for the visualization of organs and soft tissues in the human abdominal cavity. Through the visual interpretation of B-scan images, clinicians are able to evaluate the pathological condition of liver tissue by observing the brightness and texture in the images, and comparing it to surrounding areas [1]. Hence, the characterization of liver tissue using ultrasound apparatus depends principally on the clinic experience of physicians to observe particular textural characteristics, leaving the process prone to subjective interpretation. For this reason, further examination using other invasive methods is generally required. Liver biopsy is the standard clinical routine in the diagnosis of liver disease; however, this approach is often associated with morbidity and mortality. Therefore, clinicians require a reliable, non-invasive, quantitative method for diagnosing liver disease.

Ultrasound B-scan images present various granular structures as texture, and interpreting ultrasound images is analogous to the problems associated with analyzing texture [2]. Previously, applications, using algorithms for texture analysis, usually adopted a supervised classification system to characterize liver disease. To perform supervised classification, determining a set of efficient, meaningful features is crucial [3, 4]. In recent studies, different approaches based on multiresolution analysis such as wavelet transform or Gabor filter bank have been widely studied with regard to their applicability in the