Chapter 15
Diagnosis and Prognosis of Ultrasound Fetal Growth Analysis Using Neuro-Fuzzy Based on Genetic Algorithms

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ABSTRACT

Acquisition of the standard plane is the prerequisite of biometric measurement and diagnosis during the ultrasound (US) examination. Based upon the analysis of existing algorithms for the automatic fetal development measurement, a new algorithm known as neuro-fuzzy based on genetic algorithm is developed. Firstly, the fetal ultrasound benchmark image is auto-pre-processed using normal shrink homomorphic technique. Secondly, the features are extracted using gray level co-occurrence matrix (GLCM), grey level run length matrix (GLRLM), intensity histogram (IH), and rotation invariant moments (IM). Thirdly, neuro-fuzzy using genetic approach is used to distinguish among the fetus growth as abnormal or normal. Experimental results using benchmark and live dataset demonstrate that the developed method achieves an accuracy of 97% as compared to the state-of-the-art methods in terms of parameters such as sensitivity, specificity, recall, f-measure, and precision rate.

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INTRODUCTION

There is a significant advancement in the analysis of ultrasound imaging and now use of modern machine learning into the medical image analysis field, this art is more challenging for the researchers (Maraci et al, 2017). Computer Aided Diagnosis (CAD) has become one of the major research subjects in medical imaging and diagnostic radiology. Ultrasound imaging modality is quite popular and most widely used modality for visualizing and studying the medical images for any disease conditions without causing any pain or discomfort to the patient (Ali *et al*, 2014; Jalalian *et al*, 2013; Cheng *et al,* 2010). Ultrasound imaging is widely used due to less costly and non-persistent nature as compared to other imaging modalities. The diagnosis is performed on various diseases based on image features such as the Echogenicity, Legion Shape, and Echo Texture (Kalyan *et al*, 2014). Accurate ultrasound-based fetal biometric measurements are important for delivery of high quality obstetrical health care. Common measurements include: the Bi-Parietal Diameter (BDP), Head Circumference (HC), Abdominal Circumference (AC), Femur Length (FL), Humerus Length (HL), and the Crown Rump Length (CRL). The American Institute of Ultrasound in Medicine (AIUM) publishes guidelines for measuring these values. These values help diagnose fetal pathology including growth restriction, microcephaly, and macrosomia. In addition, these are utilized to estimate the gestational age (GA) of the fetus (i.e., length of pregnancy in weeks and days). Accurate estimation of GA is important to determine the expected delivery date, assess the fetal size and monitor fetal growth as in Fig. 1 (Carneiro *et al*, 2017; Loughna *et al,* 2009; Hearn, 1995; Pramanik *et al*, 2013; Espinoza *et al*, 2013).

Figure 1. Fetal Ultrasound images of (a) head, (b) femur, (c) abdomen, (d) whole fetus of age 13 weeks