ABSTRACT

Mammary Carcinoma is highly spread and the foremost reason for death among women. Early detection is an efficient method to diagnose and supervise mammary carcinoma using Computer-Aided Detection (CAD) systems. The objective of the Research is to develop an efficient speckle-noise removal and contrast enhancement technique to effectively segment the carcinoma region by detecting the boundary with the help of soft computing techniques.

The system involves the following phases speckle noise reduction, contrast enhancement, segmentation with boundary detection. To remove speckle noise, Memetic Adaptive Neuro-Fuzzy Inference System (ANFIS) is used. Contrast enhancement is performed using fuzzy Hough Transformation (HT). The enhanced image is segmented using clustering technique called Modified Fuzzy Possibilistic C-Means (MFPCM) technique with Repulsion factor to identify the affected region. The boundaries of the detected carcinoma lesion are found using Generalized Gradient Vector Flow (GGVF) snake algorithm.

In the system, preprocessing involves two phases: Speckle Noise Reduction and Contrast Enhancement. Speckle-Noise is an inherent property of ultrasound images. The capabilities of the Memetic Algorithm are added to the ANFIS. This acts as a filter to despeckle the ultrasound image. Memetic algorithm is used to optimize and set the neuro-fuzzy parameters. Noise reduced image is normalized to map the gray levels into the similar range [0, 1] with the help of the membership function. In this technique, the fuzzy S function and membership values are utilized. Hough transformation (HT) is applied and...
triangular filter function is used to filter the needless signal. The intensities are adjusted by using inverse de-fuzzification process.

Segmentation is the process of identification of the carcinoma cells by clustering. The characteristics of fuzzy and possibilistic c-means is incorporated. To obtain the possibilistic type of FCM membership function, the PCM for unsupervised clustering is proposed. The objective function depends on membership and typicality which are needed to enhance the quality of clustering. The usage of repulsion is to minimize the intra-cluster distances, while maximizing the inter-cluster distances. The pixel values are the inputs of the clustering algorithm, and the pixels are clustered based on the optimum centers of clustering. After the mammary gland is segmented, the round-like regions are kept as the lesion-like regions and the others are rejected.

Snake algorithm is used to detect the edges of the lesion. Generalized Gradient Vector Flow (GGVF) is used to initiate the process of computation of field forces above the image domain. The GGVF forces are exploited to force the snake to extend and bend towards the boundaries of the object. The GGVF forces are computed by applying generalized diffusion equations to the components of the gradient of an image edge map. The shape and size of the lesion is determined, to categorize carcinoma as benign, premalignant, and malignant.

The system is assessed with the help of real-time mammary ultrasound images. Speckle noise is reduced and compared with the traditional Median filter for Mean Square Error (MSE), and Peak Signal to Noise Ratio (PSNR). The results were 32% better. The denoised image is contrast enhanced for better diagnosis and is compared with Adaptive Mean method. It is observed that Hough Transformation has lesser MSE values.
The contrast enhanced image is segmented using Modified FPCM with repulsion to cluster based on the intensity. The standard deviation for MFPCM with repulsion and Eliminating Particle Swarm Optimization (EPSO) is calculated. The low standard deviation values of MFPCM with repulsion indicate the data points are close to the mean. The lesion is extracted, as a result of segmentation. To determine the correct shape and size, GGVF snake is used. The accuracy of the GGVF snake method is 97.9%. The system helps to determine and improve the efficiency of ultrasound image mammary carcinoma elucidation.