J Nucl Med Radiat Ther 2015, 6:4
http://dx.doi.org/10.4172/2155-9619.S1.003

OMICS International
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International Conference on
Medical Physics
August 03-05, 2015 Birmingham, UK

Automatic texture analysis of the breast cancers by ultrasound imagingapproach to RTOG 0933

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Introduction: Breast cancer is a major public health problem in women from developed and developing countries. Early detection and treatment of breast cancer increase the cure rate and provide optimal treatment. In regularly examination, ultrasound (US) is a more convenient and safer tool than mammography.

Objective: To explore diagnostic potential of computer aided texture analysis (TA) methods in differentiation of benign and malignant breast cancers by ultrasound imaging and to compare the discrimination performance of the applied texture analysis methods.

Materials and Methods: Database consisted of ultrasound images of 91 breast patients including 35 benign and 56 malignant tumors. Two slices per patient was loaded in Mazda Software for automatic texture analysis. Regions of interests (ROIs) were defined within the abnormal part of the breast ultrasound images. Gray levels within a ROI normalized according to three normalization schemes: N1: default or original gray levels, N2: +/- 3 Sigma or dynamic intensity limited to μ+/- 3σ, and N3: present intensity limited to 1% - 99%. Up to 270 multi scale texture features parameters per ROIs per each normalization schemes were computed from well known statistical methods employed in Mazda software. From the statistical point of view, all calculated texture features parameters are not useful for texture analysis. So, the features based on maximum Fisher coefficient and minimum probability of classification error and average correlation coefficients (POE+ACC) eliminated to 10 best and most effective features per normalization schemes. We analyze this feature under two standardization states (standard (S) and nonstandard (NS)) with Principle Component Analysis (PCA), Linear Discriminant Analysis (LDA) and Non Linear Discriminant Analysis (NDA). The 1NN classifier was performed to distinguish between benign and malignant tumors. The confusion matrix and Receiver operating characteristic (ROC) curve analysis were used for formulation of more reliable criteria of the performance of employed texture analysis methods and classification method performance.

Results: Significant separation between benign and malignant breast tumors was by standard feature parameters extracted by Fisher coefficient under default and 3σ normalization schemes via NDA with accuracy of 97.8%, sensitivity of 94.28%, specificity of 85.5% and the area under the ROC curve A_Z value of 0.97. While the performance of the PCA and LDA was good and more or less the same with no significant statistical differences.

Conclusions: It is shown that automatic texture analysis can effectively discriminate benign and malignant breast cancers and thus has the potential to increase confidence of radiologist in correctly distinguishing US images of the breast with no need to other radiological and or pathological examination.

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