2nd PANHELLENIC CONGRESS OF MEDICAL PHYSICS
4-6 OCTOBER 2024| EUGENIDES FOUNDATION

Computer-aided diagnosis system for breast lesion detection in DCE-MRI using Otsu's multilevel thresholding

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Background

Dynamic Contrast Enhanced Magnetic Resonance Imaging (DCE-MRI) has been recognized as an effective tool for early detection and characterization of breast lesions. This study proposes an automated CAD system to facilitate lesion detection in DCE-MRI images.

Materials & Methods

The system initially identifies and crops the breast tissue reducing the overall computational burden. Then, Otsu's multilevel thresholding method is applied to detect and segment the suspicious ROIs, considering the dynamic enhancement changes across two post-contrast sequential phases. After segmentation, a feature vector mainly based on texture and contrast features is extracted, and a two-stage false positive reduction process is applied. Specifically, a simple rule-based stage is first applied followed by supervised classification using two classifiers (Feed-Forward Backpropagation Neural Network (FFBPN) and Support Vector Machine (SVM) with Gaussian kernel function).

Results

138 enhancing lesions were identified by an experienced radiologist and corresponded to CAD-detected ROIs. System's sensitivity was 83% when the FFBPN classifier was used and 92% when the SVM was applied (Table 1). Moreover, the calculated AUC for the SVM classifier was 0.95 (Fig. 1).

Conclusion

Both employed classifiers exhibited high performance in identifying enhancing lesions and in differentiating them from healthy parenchyma. Results suggest that the employment of a CAD system for the automatic reading of DCE-MRI images can expedite lesion detection and further research over larger datasets is warranted.

Classifier	Accuracy	Sensitivity	Specificity	Precision
ANN (n=6)	86,46%	83,31%	89,59%	88,71%
ANN (n=10)	86,17%	83,12%	89,22%	88,37%
SVM	88,77%	92,25%	85,71%	85%

Table. 1: Classification performance

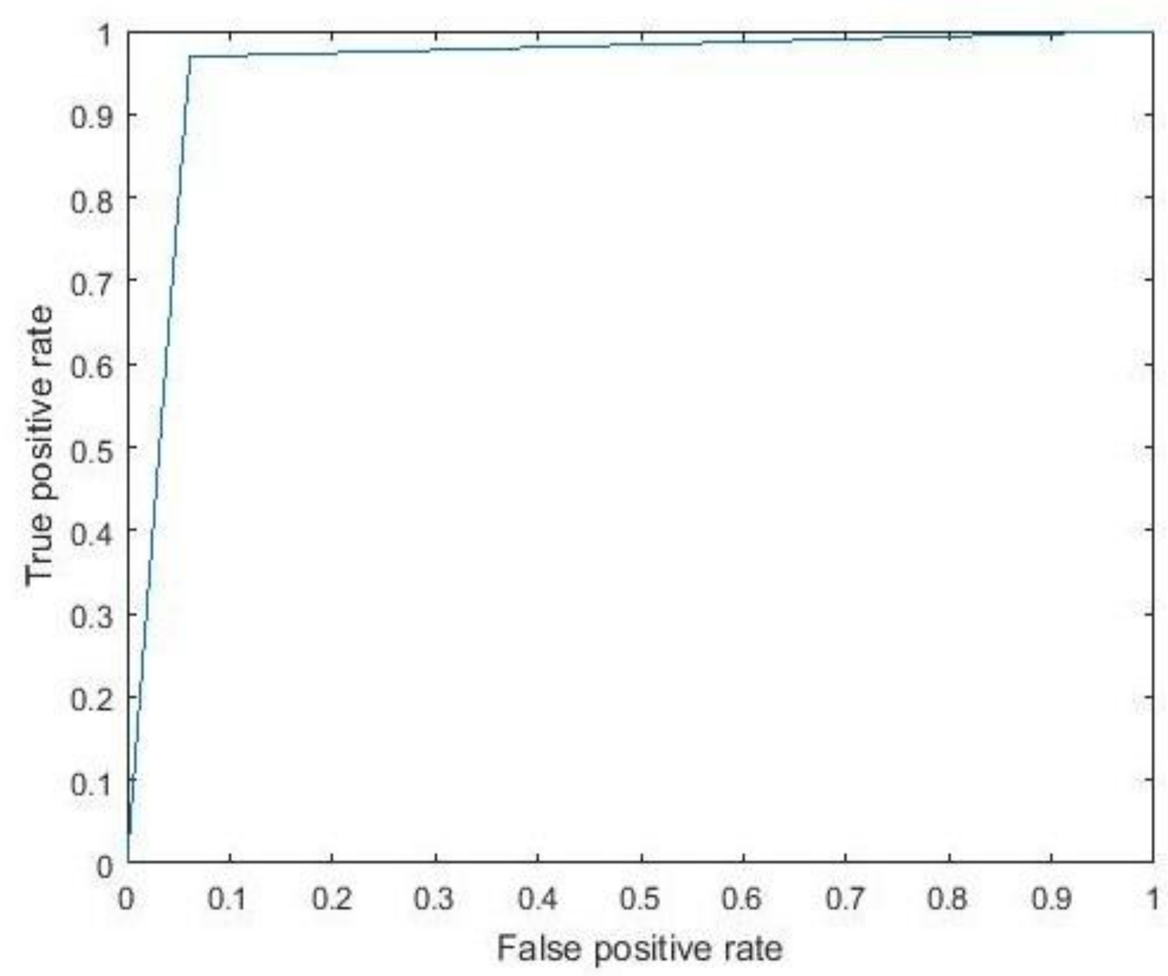

Fig. 1: False positive rate using the SVM classifier