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Tissue Characterization With Ultrasound Tomography Machine Learning

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Ultrasound tomography (UST) generates several different imaging modalities. This includes reflection, sound speed, and attenuation images. The images visualize different types of breast diseases or tissues. Typically, a radiologist views the images to determine a diagnosis for the patient. However, a learning algorithm could be trained to predict diagnosis based on the features contained within the image. Thus, our objective is to create classifier models which map features in images to labels.

Abstract

(2) Material and Methods

An region of interest (ROI) is drawn on an image corresponding to the location of a lesion. Various features, such as mean sound speed or gray level variations, are extracted from the ROI and the region surrounding the ROI. The lesion is given a label of malignant or benign. A radiologist also gives a BI-RADs like score to the lesion. Many patients with different types of lesions can be analyzed to generate a training set of data. Various classifier models such as decision trees, neural networks, and support vector machines were then trained with the training set. After the construction of the classifier model, features can be extracted from new patients with unknown labels. The classifier model can then map the unknown features to a label.

(3) Results

We analyzed 68 cancers, 55 fibroadenomas, and 38 cysts. Using only the radiologists' BI-RADs like score, we obtain a baseline classification accuracy of sensitivity (SEN) = 82%, specificity (SPE) = 91%, and positive predicative value (PPV) = 88%. Using only the features extracted from the images, SEN = 78%, SPE = 83%, and PPV = 77%. Combining the BI-RADs like score and features, the classification accuracy improves to SEN = 86%, SPE = 98%, and PPV = 97%.

(4) Discussion and Conclusion

Using only the extracted features to label a lesion, the only input a radiologist has to perform is the drawing of the ROI contour. Using only this input, it is remarkable how well the classifier model is able to label regions as benign or malignant. With the addition of some radiologists' assessment of lesion malignancy, the classifier model's performance improves. Some limitations of our work include small sample size. Classification accuracy should improve with more samples.

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