Challenges with Machine Learning for Microwave Breast Tumor detection

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Abstract

In this paper, challenges of combining machine learning techniques with near-field microwave probes for breast tumor detection is presented.The concept of using microwaves imaging (MI) modality for breast tumors detection is based on the electrical properties contrast between normal and tumors breast tissues. MI utilized microwave signals to illuminate the breast tissues using near field probes placed at different locations surrounding the breast. The backscattered microwaves signals are then received by the same probes. Diagnosis breast tumor is done by estimating the variations in the response of the reflection coefficient of the probe. Machine learning techniques are applied to accentuate the variance in the sensor's responses for both healthy and tumorous cases. The main challenge of using the machine learning technique with near-field microwave probes for breast tumor detection is to find a suitable combination of features and classifiers which discriminates between the normal and abnormal breast.

1 Introduction

Breast cancer is considered to be one of the major causes of mortality in women worldwide [1]. Currently, four common clinical detection modalities are used for breast tumor detection: X-ray mammography, ultrasound scanning, magnetic resonance imaging (MRI), and CAT scan [1]. The current modalities have some limitations including ionizing radiation, discomfort, low sensitivity, low reliability for women with high density breasts, and high cost[2]. Microwaves imaging (MI) has been proposed as an alternative technique for breast tumor detection which has some advantages such as low cost and non-ionizing radiation [2]. In recent years, machine learning has been applied to breast cancer detection. Many studies developed various modalities of machine learning for breast tumor detection by using different classifiers algorithms [3].

2 Results and Discussion

Classification techniques involve three steps for analyzing the collected data: preprocessing data, features extraction and selection from each recorded backscattered microwaves signal and the classification approach itself as shown in Fig. 1. The detection technique introduced here employs two identical probes for testing both normal and abnormal breasts at the same time. The reflection coefficient responses of the two probes were recorded and then analyzed using machine learning to distinguish between normal and abnormal breast.

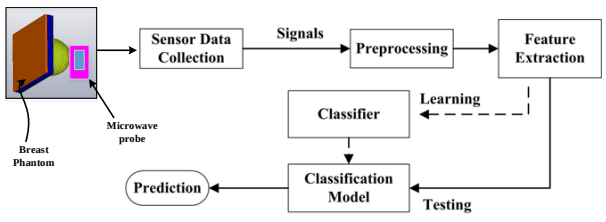

Fig. 1: Flow chart diagram shows the methodology process for breast tumors detection using machine learning techniques.

Machine learning has many challenges for distinction the variance in the sensor responses for both healthy and tumorous cases as shown in Fig. 2 including: 1) similarity in the recoded microwave signal between normal and abnormal breast, 2) microwave signal consists only from two main parameters magnitude and phase which are changed with frequency 3) small area of interest.

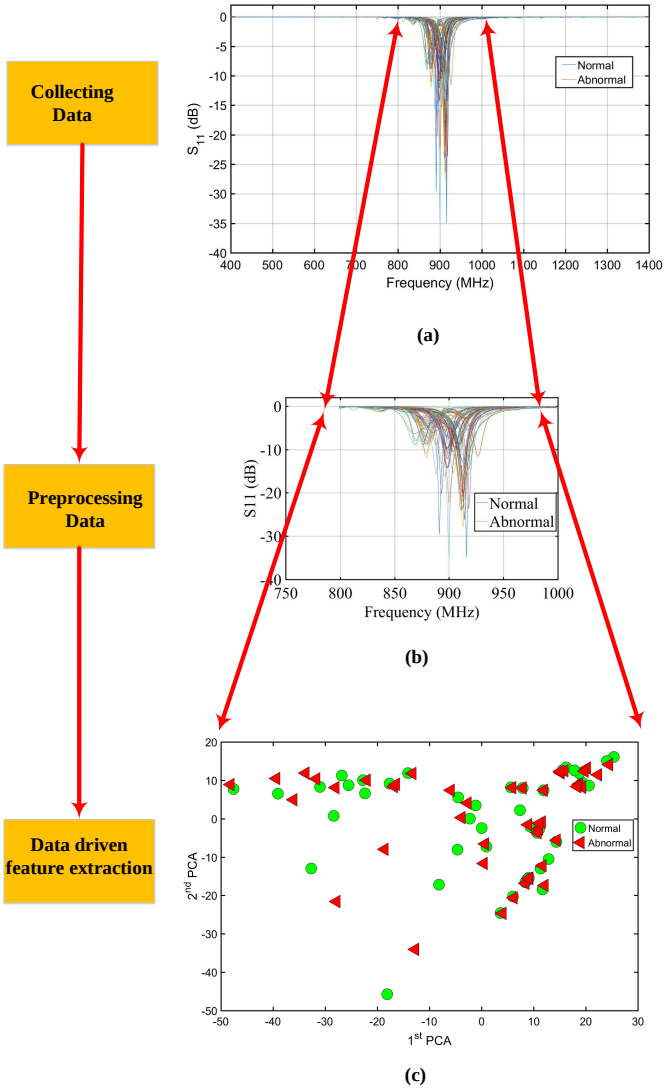

Fig. 2: Preprocessing and feature extraction steps of using machine learning techniques.for breast tumor detection.

3 Conclusion

In conclusion, challenges of combination a machine learning technique with near-field microwave probes for breast tumor detection is presented. The main challenge of using the machine learning technique with near-field microwave probes for breast tumor detection is to find a suitable combination of features and classifiers which discriminates between the normal and abnormal breast.

References

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