Blur Detection in Mammography

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Introduction

Breast cancer is the most frequently diagnosed form of cancer and causes the second most number of deaths, for women. The most effective way to prevent it is early detection and treatment. For this reason there are large scale screening programs where women between the ages of 50 and 60 years, get invited for a mammography examination. In Switzerland this usually amounts to a couple of hundreds of thousands patients per year.

AI tools have shown to be an effective way of supporting radioligsts in the detection of potential breast cancer in digital mammography [1]. However, no AI tool to support mammography technicians in the assessment of image quality has been developed yet. One crucial quality aspect is local motion blurring in the mammography image. Blurring often remains undetected but can obscure crucial features that might indicate potential cancer. Therefore, the goal of this thesis was to develop a method to automatically detect motion blurring in mammography images as labeled in figure 1.

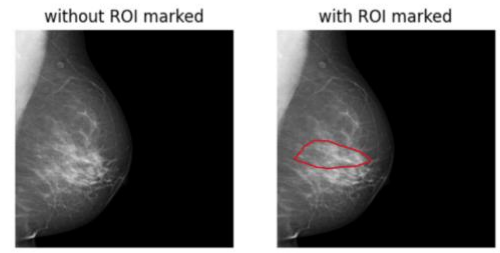

Fig. 1 region of motion blur marked in mammography.

Materials and Methods

Since blurring is usually detected during the mammography examination and directly followed by a sharp retake, there exists little labelled data of locally blurred mammograms. The provided dataset consisted of 235 images with 49 of them containing local blurring. This is by far not enough data for a deep learning approach as used in [1]. Therefore several different computer vision and machine learning approaches were explored and implemented. These approaches can be put into three different categories. First, image based approaches. In this the idea was to extract meaningful parameters based on the pixel value distributions of the image, or gradient image. The goal was to find regions with few edges and low variances. The second category was frequency based. The frequencies were analyzed in terms of magnitude, phase and power. For both the image based and the frequency based methods, a sliding window was used to find local characteristics. The third approach was to prepare the data in such a way that a deep learning model could be used. This could be done by either proliferating the dataset by artificially recreating this motion blur and applying it to a much larger publicly available dataset. Or to extract certain characteristics using a sliding window approach and then running a deep learning model on those.

Results

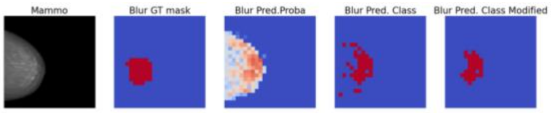

Fig. 2 Blur segmentation comparing ground truth and prediction

The best method achieved an average accuracy of 78%, with a sensitivity of 70% and a specifcity of 78%. The average DICE score was 45%. On an AMD Ryzen 7 5800U with 16GB RAM it took exactly 4.00 seconds to run the model for blur segmentation.

Discussion

Good results were achieved in terms of classification. A sufficient pixelwise segmentation was not achieved. However, since this method is intended to be used as an assistance to a trained mammography technician or radiologist, a 100% correct segmentation is not necessary. The method can reliably predict if there is blurring present and indicate the area where it is located. Therefore, it can provide a good assistance to detect and blurring and reduce the cost of recalls, as well as improve the probability of correct diagnosis afterwards. This method is part of the latest product of b-rayZ AG that will be used in a large scale European screening program.

References

[1] Sabani. A. et al. BI-RADS-Based Classification of Mammographic Soft Tissue Opacities Using a Deep Convolutional Neural Network. Diagnostics. 2022; 12(7):1564.
https://doi.org/10.3390/diagnostics12071564

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