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DG-CNN: Introducing Margin Information into CNN for Breast Cancer Diagnosis in Ultrasound Images

Xiaozheng Xie, Jianwei Niu, Xuefeng Liu*, Qingfeng Li, Yong Wang, Jie Han, Shaojie Tang

Research Objectives

We try to find and use another kind of domain knowledge, the margin information in our method, and integrate it into the breast cancer diagnosis on ultrasound images. The representation of the domain knowledge, the integrating method of it, and the diagnostic performance of networks after integrating it are all considered.

Research Method

In our method (DG-CNN), various attention maps that highlight margin areas of tumors are first generated, and then incorporated into the networks. Specifically, three kinds of margin maps and four integrating methods are evaluated on our dataset and one public dataset. Additionally, different network structures are also utilized to demonstrate the generalization of DG-CNN.

Research Results

Experiments show that the DG-CNN can be applied to different network structures like VGG and ResNet to improve their performance. For example, with a certain integrating mode, the improvement of using DG-CNN on ResNet18 is 2.17% in accuracy, 1.69% in sensitivity and 2.64% in specificity and 0.0257 in AUC. While DG-CNN is proved more prone to improve diagnostic sensitivity than specificity.

Research Conclusions

Experimental results on our dataset and one public dataset demonstrate the effectiveness of the margin information as well as the DG-CNN. To the best of our knowledge, this is the first time the margin information is utilized to improve the performance of deep neural networks in diagnosing breast cancer in BUS images, and we believe introducing medical domain knowledge into the networks bears great promise for the CAD in medical images.