Double-Dilation Non-Pooling Convolutional Neural Network for Breast Mass Mammogram Image Classification

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ABSTRACT

Background and Objective: Many researchers have examined breast mammogram images by using deep learning methods. Some scholars have used the existing convolutional neural network (CNN) model for classification, whereas other scholars have improved on the CNN model to obtain superior image classification performance.

Method: This study used breast mass mammograms (BMMs) from the INbreast database, MIAS database, and Digital Database for Screening Mammography to establish a new BMM database for testing two developed breast mass classification models that can extract diverse features: (1) a double-dilation non-pooling CNN (DDNPNet) and (2) AlexNet II. We compared the results of these two classification models with those of three other CNN models, namely AlexNet, DenseNet, and ShuffleNet.

Results: For the established BMM database, DenseNet exhibited the highest evaluation indices. The accuracy, specificity, sensitivity, F1 score, and training time of DenseNet were 98.59%, 98.21%, 99.08%, 98.43%, and 6 h 39 min 21 s, respectively. Although DenseNet provided satisfactory results, it required a long training time. For the established BMM dataset, the accuracy, specificity, sensitivity, F1 score, and training time of the DDNPNet model were 95.41%, 95.86%, 94.83%, 94.81%, and 26 min 23 s, respectively. Thus, the DDNPNet model provided similar classification results to the other models but in considerably less time.

Conclusion: The breast mass classification models proposed in this study can assist physicians in the analysis of BMMs.

Keywords: Breast mass mammogram database, Convolutional neural network, DDNPNet, Mass classification

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