MAMMOGRAPHY CLASSIFICATION with DATA AUGMENTATION of ADAPTIVE INSTANCE NORMALIZATION STYLE TRANSFER

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Introduction

- *Background:*
  - Early diagnosis of breast cancer can effectively save patients' lives.
  - Deep Convolutional Neural Network produced unprecedented performance in image classification tasks[1].
- *Problems:*
  - Mammography Images are limited and unpublic.
  - The lack of dataset makes the model less robustness and be difficult to generalize to unknown data.
- *Objectives:*
  - Classify mammograms to malignant or benign
  - Improve model robustness through data augmentation based on Adaptive Instance Normalization Style Transfer.

Methods

- *Data Preparation*
  - Dataset: CBIS-DDAM(curated Breast Imaging Subset of Digital Database for Screening Mammography)
  - Pre-processing: Cropping[2]
- *Data Augmentation*
  - Adaptive Instance Normalization Style Transfer(AdaIN)

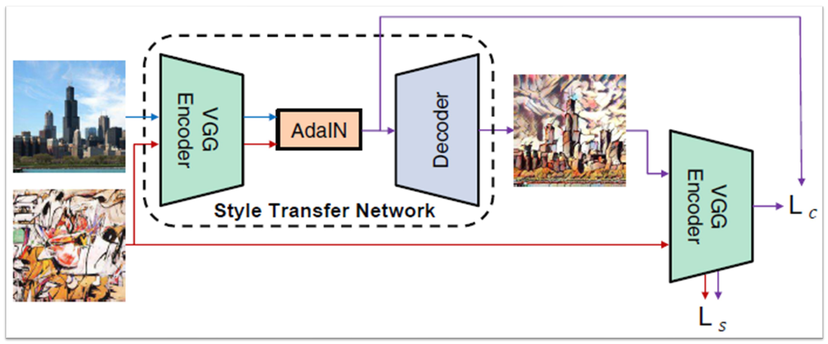

Figure1. An overview of AdaIN style transfer algorithm [3]

The equation of AdaIN layer[3] is as follows:

$$AdaIN(f(c), f(s)) = \sigma(f(s))\left(\frac{f(c) - \mu(f(c))}{\sigma(f(c))}\right) + \mu(f(x))$$

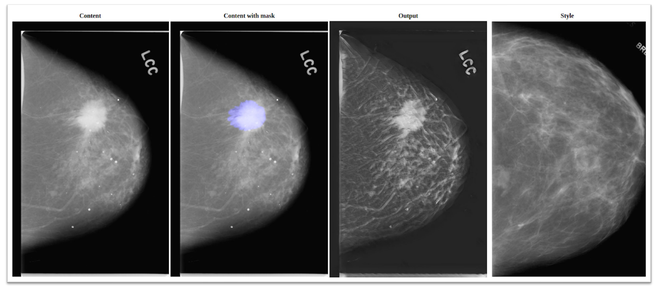

Figure2. An example of stylized mammogram

- *Single-view ResNet50 as baseline network for classification*

Results

- 5-fold cross validation
- The initialization of parameters is based on pretrained ResNet 50 on ImageNet.
- According to ROC-AUC score on test set, data augmentation by applying AdaIN style transfer did not improve performance.

Tabel1. The performance comparison

Experiments(ResNet 50)	AUC_ROC	STDEV
without AdaIN data augmentation	0.8929	0.0144
With AdaIN data augmentation	0.8876	0.0220

Future Work

- *Problems*: By reviewing the stylized CBIS—DDSM dataset, abnormalities of parts of mammograms are less visible, backgrounds are also stylized and the intensity range changes, etc.
- *Improve the quality of stylized mammograms*:
  - Fine-tune AdaIN network on CBIS-DDSM dataset.
  - Do stylization only on the foreground of mammograms.

References

1. Geirhos R, Rubisch P, Michaelis C, Bethge M, Wichmann FA, Brendel W. ImageNet-trained CNNs are biased towards texture; increasing shape bias improves accuracy and robustness. arXiv preprint arXiv:1811.12231. 2018 Nov 29.

2. Wu N, Phang J, Park J, Shen Y, Huang Z, Zorin M, Jastrzębski S, Févry T, Katsnelson J, Kim E, Wolfson S. Deep neural networks improve radiologists' performance in breast cancer screening. IEEE transactions on medical imaging. 2019 Oct 7;39(4):1184-94.

3. Huang X, Belongie S. Arbitrary style transfer in real-time with adaptive instance normalization. InProceedings of the IEEE International Conference on Computer Vision 2017 (pp. 1501-1510).