

Evaluation of mammogram vendor-style transfer with generative AI

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Abstract— The aim of this work is the generation of synthetic mammograms with different vendor features, by means of a Neural Style Transfer (NST) method based on CycleGAN. An extended parametric analysis is performed, to quantitatively evaluate the method performance, in terms of target style matching and preservation of input content.

Clinical Relevance— This enables us to expand available clinical data, including variability due to mammogram equipment. Such data augmentation can play a key role in the application of AI systems, allowing the generation of virtual patients' databases, for the accurate validation of AI algorithms.

I. INTRODUCTION

Steps forward have been recently made in AI-driven generative models to expand existing datasets of real medical images via data-driven approaches. In breast imaging, neural style transfer (NST) methods have been used to solve domain generalization and gap issues, like the ones associated with the large diversity of mammogram style due to vendor factor [1]. Despite the utility of synthetic data in ensuring an enhancement of robustness and adaptability of AI models, accurate tests have to be performed to assess their realism and quality, by means of proper quantitative metrics.

In this work, we perform a thorough assessment of a CycleGAN-based NST method in transferring the vendor-style from mammograms with features strongly dependent on the post-processing software implemented by the equipment manufacturer [2]. The method is applied on real images acquired with vendor scanners from Hologic, Siemens, Planmed and GE HealthCare.

II. METHODS

The investigated NST method is based on a CycleGAN architecture suitable for unpaired settings, and designed to transfer the target vendor style of a set of mammograms to images acquired with another vendor scanner [2]. An exhaustive parametric analysis is performed, to quantitatively evaluate the NST method in matching target style, while preserving input content. The benchmarking is carried out by calculating two metrics, i.e. the Fréchet Inception Distance for style reproduction, and the Learned Perceptual Image Patch Similarity for content preservation. Gray-scale histogram representation is also used to examine the transformed images, together with Principal Component Analysis, to extract and compare image features for qualitatively evaluating the

effectiveness of domain translation. A further assessment is carried out by means of a custom vendor-style classifier, designed with a transfer learning approach based on a residual neural network with 50 weight layers.

III. RESULTS

Figure 1 shows four examples of application of the NST method in multi-style transfer. For each set of mammograms, the real content image is reported, together with the associated transformed images for the other vendor-styles. They are generated using the combination of hyperparameters leading to the best metric scores and guaranteeing the preservation of breast shape, without artifact occurrence. A further indication of the result validity is provided by the custom vendor-style classifier; very high sensitivity is obtained for the Siemens and Hologic style classes, with values higher than 0.9.

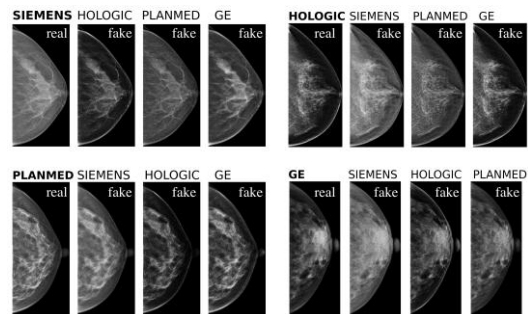


Figure 1. Mammograms generated transferring the style of four vendors.

IV. DISCUSSION & CONCLUSION

Thanks to an exhaustive evaluation, we demonstrate the capability of the CycleGAN-based NST method to generate realistic mammograms, which can be used for expanding clinical databases. This can lead to a reduction in bias and generalizability issues in diagnostics application of AI.

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