A deep learning method trained on synthetic data for digital breast tomosynthesis reconstruction

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Editors: Under Review for MIDL 2023

Abstract

Digital Breast Tomosynthesis (DBT) is an X-ray imaging modality enabling the reconstruction of 3D volumes of breasts. DBT is mainly used for cancer screening, and is intended to replace conventional mammography in the coming years. However, DBT reconstructions are impeded by several types of artefacts induced by the geometry of the device itself, degrading the image quality and limiting its resolution along the thickness of the compressed breast. In this study, we propose one of the first deep-learning-based pipelines to address the highly challenging DBT reconstruction problem, focusing on the removal of sparse-view and limited-angle artefacts. Specifically, this procedure is composed of two steps: a classic reconstruction algorithm is first applied on normalised projections, then a deep neural network is tasked with erasing the artefacts present in the obtained reconstructed volumes. A major difficulty to address this problem is the lack of real conditions artefact-free data. To overcome this complication, we resort to a new dataset comprised of synthetic breast texture phantoms. We then show that our training method and database strategy are promising to tackle the problem as they improve the informational value of planes orthogonal to the detector, whose imaging quality is currently too low to be used by radiologists. Eventually, we assess the impact of removing the bias components from the network and using stacks of slices as inputs, with regard to the generalisation ability of our approach on both synthetic and clinical data.

Keywords: DBT reconstruction, inverse problem, deep learning, limited angle, sparse view, synthetic phantoms, 2.5D, bias-free network.

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