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Synthesizing 2D mammographic image from compressed-sensing digital breast tomosynthesis image for reducing imaging dose

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Two-dimensional (2D) digital mammography (DM) has played a important role in clinic for breast cancer screening. However, it has drawn criticism for limited sensitivity and excessive false-positive screening owing to the superimposition of breast tissue [1]. Recently, with the development of full-field DM, digital breast tomosynthesis (DBT) which provides 3D image acquisition has been rapidly gained a role in clinical practice, remedying the shortcoming of the DM. According to previous literatures, DBT alone or combined with DM improves diagnostic ability over standard DM and has the potential to reduce false-positive recalls. However, DBT combined with DM increases radiation dose to patients above that of DM alone, approximately by a factor of two. Thus, developing methods that decrease radiation dose is critical to the widespread acceptance of this imaging modality. One such method to reduce radiation dose is based on the fact that DM can be synthesized from the DBT-reconstructed image (Fig. 1) [2]. In this study, we synthesized a 2D DM from a compressed-sensing (CS)-reconstructed DBT image using a prototype DBT system that mainly consisted of an X-ray tube (28 kVp and 100 mAs), a CMOS-based flat panel detector (70 micro-meter detector pixel size), and a rotational arm to move the X-ray tube in an arc (Fig. 2). Figure 3 shows our preliminary experimental results: DM images acquired directly from the DBT system and synthesized from the CS-reconstructed DBT image. According to our results, CS-based reconstruction algorithm yielded DBT images of high quality, compared to the filtered backprojection (FBP)-based reconstruction algorithm. In addition, the image quality of the synthesized DM was better in visualizing of the structural details of the breast, verifying the efficacy of the proposed approach. Consequently, we successfully reconstructed DBT images of substantially high image quality by using the CS-based algorithm and synthesized 2D DM from the resulting CS-reconstructed DBT image. More quantitative simulation and experimental results will be presented in the paper.

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