An Auto-Accessing Method for Reducing the Reading Time of Digital Breast Tomosynthesis with a Synthetic Mammogram

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INTRODUCTION

- The combined use of DM and DBT images has shown to increase breast cancer diagnostic performance.[1,2]
- This combo mode acquisition, however, raises concerns on increased data acquisition time, interpretation time, and radiation dose.[3]
- One possible solution to reducing radiation dose is composing a synthetic mammogram (SM) from the DBT slices.[4,5]
- Clinical studies have shown that the use of SM is not inferior to the use of DM.[6,7]

AIM

- A method reducing the reading time of the DBT has not been studied much yet.
- Besides, one of the significant artifacts in the SM image is pseudo-calcifications.
- The presence of pseudo-calcifications makes radiologists read through DBT slices to check whether or not the calcification is real, which is time-consuming and laborious.[8]
- Examples of the reconstructed DBT slices and the generated SM image are presented in Fig. 1.
- One can rapidly carry out a global assessment of the breast by using the SM image, while the multiple reconstructed DBT slices provide depth-differentiated information of the breast anatomy.
- If one can automatically access DBT slice-in-focus information of suspicious findings in the SM image, it would help reducing reading times substantially.

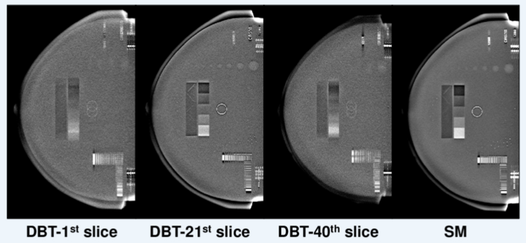

Fig 1. Reconstructed DBT slices and synthetic mammogram images

METHOD

- In synthesizing a mammogram from DBT slices, we generated a linear structure weighting map by use of the oriented bins operator.[9]
- We computed a weighted forward projection by use of the linear structure weighting map accordingly.
- For an auto-accessing method, we additionally generated a linear structure weighted maximum intensity projection (LS-MIP) and a linear structure weighted maximum intensity depth map (LS-MID).

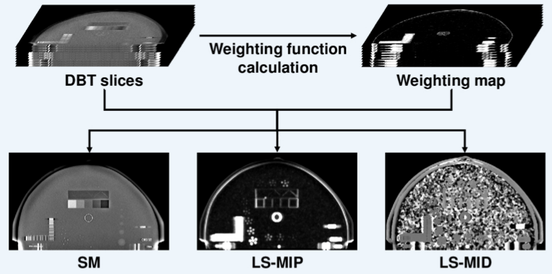

Fig 2. Schematic diagram for SM, LS-MIP, LS-MID generation procedure

- For a selected ROI in the SM image, we estimated the depth of the object using the LS-MIP and the LS-MID.
- Since ROI would also contain background regions, we only took pixels having the top 10% high values inside the ROI in the LS-MIP.
- We collected the values of the chosen pixels in the LS-MID and calculated the counts of each depth.
- After that, we displayed the reconstructed DBT slices at the calculated top three counted depths.
- For evaluation, We scanned CIRS breast phantom and collected patient DBT data.
- We reconstructed DBT images from the acquired DBT projections by use of the expectation-maximization algorithm.
- We synthesized SM, LS-MIP, and LS-MID images from the reconstructed DBT images.

RESULTS

- In Fig. 3, we displayed the proposed auto-accessing processes and the reconstructed DBT slices at the calculated top three frequently counted depths of the selected ROI containing five real micro-calcifications and a pseudo-calcification.
- The calculated depths led to two separate depths where multiple calcifications and a calcification-like structure exist.
- Because the depth where the single calcification-like structure exists is far from the micro-calcification cluster (MCC), it is likely to be a pseudo-calcification.

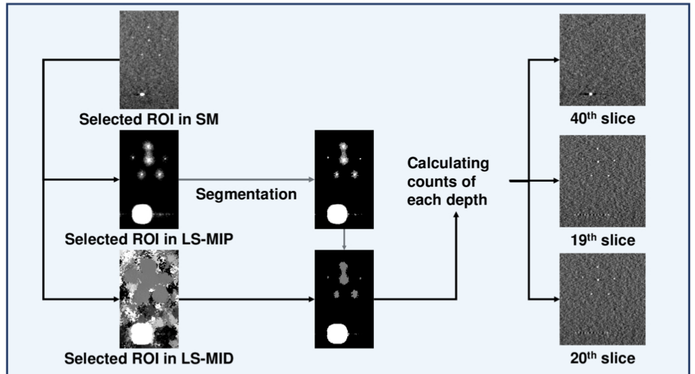

Fig 3. Example images out of the auto-accessing procedure

- We have also applied the proposed method to the patient data, which contains complex overlapped structures.
- Consistently, the proposed method successfully estimated appropriate slice numbers for the MCC and the bright linear area in the fiber structure.

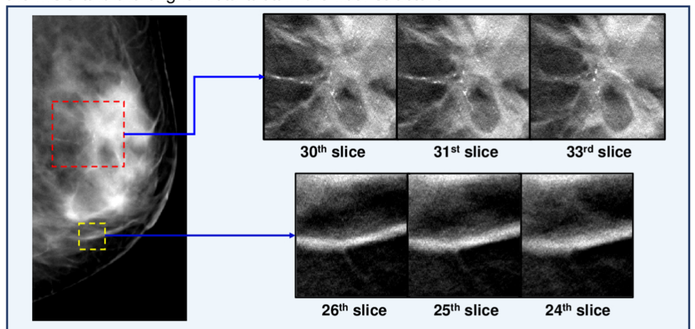

Fig 4. Results of the auto-accessing algorithm for patient data

CONCLUSIONS

- We have developed an auto-accessing method to seek reconstructed DBT slices contributing mainly to the selected ROI in the SM, which can hopefully reduce the reading time of DBT.
- The experimental phantom and clinical study showed the proposed method accurately figured the depth of selected ROIs from the SM image in the DBT slices.

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