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Compressed-sensing based digital tomosynthesis (DTS) using a moving multi-slit collimator for low-dose x-ray imaging

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Conventional digital tomosynthesis (DTS) reconstruction based on the filtered-backprojection (FBP) method requires a full field-of-view scan and relatively dense projections, which results in still high x-ray dose especially for medical imaging purposes. In this work, to reduce the x-ray dose delivered to the patient in DTS examinations, we propose a new type of DTS scan in which the x-ray span is blocked by a moving multi-slit collimator having a duty cycle of 0.5 during the projection data acquisition. We considered a compressed-sensing (CS)-based algorithm for more accurate DTS reconstruction in the proposed scan geometry. To validate the proposed method, we performed a systematic simulation and investigated the image characteristics. In the simulation, several types of multi-slit collimators having a closing size equal to the widths in the range of 14-60 pixels were tested. All projections were taken at a tomographic angle range of ±50o and an angle step of 2o. We successfully reconstructed collimated DTS images of high accuracy and no truncation-related artifacts in the proposed scan. We expect that the proposed approach can considerably reduce the x-ray dose in the present DTS examinations, if the moving collimation is realized in real DTS systems.

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