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Novel sinogram restoration method based on Fourier separation of higher-order harmonics in sparse-view CBCT for improving its reconstruction quality

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Cone-beam computed tomography (CBCT) has made major progress in dentistry and industry, facilitating the transition of X-ray imaging from 2D to 3D images with faster scan time and lower radiation dose than in medical CT by employing large-area flat panel detectors. CBCT images are typically reconstructed with dense-view (> 800) projections by using the standard filtered-backprojection (FBP) algorithm, which imposes examined objects to an excessive radiation dose. Because the use of CBCT systems is growing in dental and industrial imaging applications, radiologists are continuously seeking ways to reduce the radiation dose. In the medical CT community, several methods for radiation dose reduction, including interior CT, low-dose CT, and sparse-view CT, have been extensively investigated. Among these methods, sparse-view (or under-sampling) CT is a promising method that can be directly implemented in the current real-world CBCT systems. In this method, fewer projections (typically less than 200) are acquired from the system and used for CT reconstruction. However, FBP-reconstructed images usually suffer from severe streak artifacts owing to theoretically insufficient angular sampling. Recently, iterative reconstruction algorithms based on the compressed-sensing or dictionary-learning theory have been applied to sparse-view CBCT reconstruction demonstrating high image quality, but their practical utility is limited due to heavy computation burden. Few studies have been conducted to obtain CBCT images in sparse-view sampling by using the analytic reconstruction algorithm owing to its poor reconstruction quality. In this study, we revisit the FBP algorithm with a novel sinogram restoration method based on Fourier separation of higher-order harmonics to obtain a reasonable reconstruction quality in sparse-view CBCT [1]. Figure 1 shows the simplified flowchart of the proposed sinogram restoration process. Figure 2 shows the experimental setup used in this study. According to our preliminary experimental results (Fig. 3), the proposed effectively reduced streak artifacts in the analytic sparse-view CBCT reconstruction, maintaining the image quality.

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