AbstractID: 3965 Title: Cone beam CT imaging versus digital tomosynthesis: a computer simulation study for comparisons

Purpose: We used a general-purpose PC cluster to develop a parallel computer simulation model for comparisons between the cone beam CT imaging and digital tomosynthesis with the same image acquisition geometry.

Method and Materials: Our model incorporates quantum noise, detector blurring, and additive system noise into the computer simulation. Radon transforms formalism was applied to analytically calculate the phantom image projection data which were then used to reconstruct the volumetric images for low contrast performance and image quality studies. Feldkamp algorithm was used in the cone beam CT imaging, while the shift-and-add, filtered backprojection, and optimization based algorithms were used in digital tomosynthesis. We implemented a parallel random number generator based on the Weyl sequence to simulate both quantum and system noise. For digital tomosynthesis, we used blurring profiles and the artifact spread function (ASF) to quantify the magnitude of the out-of-plane artifacts. We also calculated the noise power spectra to characterize the image quality for cone beam CT imaging and digital tomosynthesis. Some artifacts removal methods and programming optimization techniques were also investigated in this study.

Results: The test results showed that our parallel random number generator had good randomness quality and can be used in the noise study. The images reconstructed from using the digital tomosynthesis algorithms were worse than the Feldkamp algorithm in the cone beam CT imaging. However, it was possible to remove the out-of-plane blurring in digital tomosynthesis by using some special techniques.

Conclusion: We had successfully developed a parallel computing technique to simulate quantum noise, detector blurring, and system noise for both cone beam CT imaging and digital tomosynthesis. Several quantification methodologies were used to compare these two 3D imaging techniques.

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