Purpose:Cone beam CT (CBCT) has been widely utilized for localizing daily tumor position and patient positioning in lung cancer radiotherapy. However, due to the respiratory motion during the CBCT scan, the tumor image is blurred and may introduce inaccuracy in treatment delivery. To solve this problem, and to obtain accurate daily lung tumor motion information, in this work we develop a cine CBCT technology, which can reconstruct a series of 3D CBCT images from a regular CBCT scan.

Methods:Provided a set of volumetric images of a patient at N breathing phases obtained by 4DCT as training data, a deformable image registration is first carried out between a reference phase and the other N-1 phases. As a result, N-1 deformation vector fields (DVFs) are generated. These DVFs are represented by a few eigenvectors and coefficients obtained from principal component analysis (PCA). New DVFs relative to reference images as a function of space and time can be generated by varying those PCA coefficients, resulting in new volumetric images. The volumetric reconstruction from a CBCT projection is realized by optimizing the PCA coefficients such that the computed projection matches the measured CBCT projection.

Results:The cine-CBCT method was tested on real patient data. 200 CBCT projection images acquired during a regular CBCT scan are used to reconstruct 200 corresponding cine CBCT images. Each reconstructed cine CBCT image precisely represent the patient anatomy and tumor geometry at a specific time point during the regular CBCT scan and thus can be utilized to improve the treatment accuracy.

Conclusions:Cine-CBCT, a method to reconstruct volumetric images based on a single CBCT projection, is introduced in this study. Experimental results based on real patient data also demonstrate that volumetric images can be precisely generated.

Acknowledgement:The authors would like to acknowledge the support from Varian Medical Systems, Inc.