

Study on Combination of In-Treatment MV and Diagnosis kV CT Images for Precise and Safe X-ray Cancer Therapy

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Abstract: In radiation therapy, in-treatment CT reconstruction is a major challenge as the treatment projection images lack sufficient information due to limited-field-of-view irradiation. In this research, we propose the use of planning CT as prior images to provide complementary information for the purpose of in-treatment beam CT reconstruction.

Keywords: IGRT, IMRT, CT Reconstruction, Cone-beam CT, ART, LFOV

1. Introduction

The intensity and volume of x-ray beams are modulated by changing gantry rotation speed and locations of MLC. However, the success of IMRT is largely dependent on the delivery accuracy. Therefore, it is critical to have real-time image-guided technology. Whereas the conventional technique of CT reconstruction can only reconstruct the irradiated region (called delivery CT), but the other regions are not reconstructed correctly due to the under sampling^[1]. We propose using the priori image information to compensate the missing region that are not irradiated. Hence the purpose of this research is:

1. to develop a technique to reconstruct CT image during treatment with clear anatomical information;
2. to reconstruct in-treatment CT image without strong distortion or artifact based on dual energy sources;
3. to verify its potential advantages on the CT image spatial resolution over cone-beam CT reconstruction using either kV or MV projections only to improve treatment safety.

2. Materials and Methods

An experiment was conducted in order to find the relation between planning CT images and MV CT images. Using the CIRS phantom(Fig1) with different inserts of human organ equivalent material, we acquired the plotting of attenuation coefficient(μ) versus electron density for 6MV and 120kV x-ray respectively. The conversion of CT image is completed using the conversion equation we obtained from comparing the μ of two energies. Then we acquired reprojected images from converted CT images and conducted reconstruction using the combination of original and converted projection images.

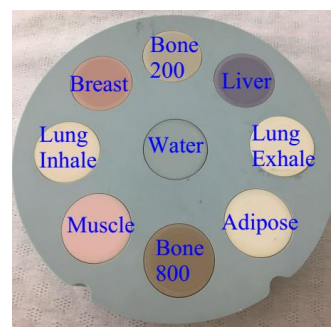


Fig1. The CIRS Phantom

3. Summary

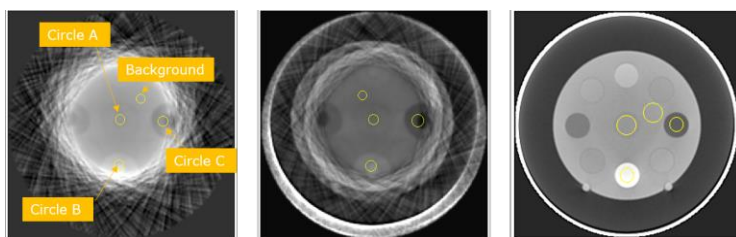


Fig2. CBCT of truncated MV beam. CBCT of combined projections. CBCT of kV projections.

References

- [1]Poludniowski G, et al. CT reconstruction from portal images acquired during volumetric-modulated arc therapy[J]. Physics in medicine and biology, 2010, 55(19): 5635.

In this study, a MV/kV CT combination technique is proposed for a more precise X-ray delivery of IMRT. From the result(Fig2), the technique was verified to be capable of improving the quality of LFOV CT reconstruction.