AbstractID: 11690 Title: Image registration for real-time dose calculation of adaptive radiation therapy

Purpose: To enhance the speed and accuracy of certain treatment plan in radiation therapy, a real-time dose calculation strategy is performed based on Fast Fourier Transformation (FFT) and CT image registration. For this purpose, different registration methods are achieved by using Insight Segmentation and Registration Toolkit (ITK) in MATLAB.

Method and materials: Our group developed an efficient method for kernel calculation for pencil beam convolution-superposition based on FFT. In this paper, different image registration methods are developed in MATLAB by using ITK, such as rigid 3D, similarity 3D, Demons deformation and BSpline based Free Form. As ITK is written and used in a C++ template, smart pointer and generic structure, an open source wrapper MATITK is modified to facilitate the use of its image processing capabilities while working in the high-level environment of MATLAB. The image registration methods are demonstrated on head and neck (H&N) CT image sets of 6 patients. The results of evaluation and visualization for the registration are presented.

Results and discussion: Transformation similarity and computation complexity as evaluation criteria are compared between rigid and deformable registration methods. Judging from the mutual information histogram and mean square metric, the deformable registration will get more improvement on similarity than the rigid registration. Checkerboard composites of the reference and registered images are displayed. The computational time of deformable registration are 10~20 times longer with the whole set of images because of the pre-processing, complicated transformation matrix and more parameters. A similarity3D registration method is adopted for the image registration of H&N radiation therapy to trade off between registration effect and the time consumption.

Conclusion: The image registration can greatly contribute to the automatic contour adjustment and dose deformation for adaptive radiation therapy. A GUI program will be designed for the customized deformation region to speed up deformable registration.