AbstractID: 12615 Title: Quality Assurance of Tomotherapy Breast/Chest-Wall Treatments using Exit Detector Data

Purpose:

Purpose of this study is to explore the feasibility of utilizing Tomotherapy's exit-detector-data for identifying setup-errors in treatments of breast-cancer patients.

Material and methods

Tomotherapy treatment plan mimicking breast treatment, generated on an anthropomorphic phantom, was used in this study. Thorax phantom was irradiated with the planned delivery sinogram after registering MVCT with kVCT. TomoTherapy's exit-detector-data-sinograms (EDDSs) were downloaded and ported into MatLab for further analysis. The phantom was then shifted by known off-sets in x-,y-,z directions and collected the EDDSs after each irradiation. EDDSs from repeated irradiations were used to characterize the noise in the detector-signals. Average EDDS of the unshifted irradiations was subtracted from the individual EDDSs of the shifted simulations. Resulting difference EDDSs were analyzed to determine the extent of sinograms changes in frequency and magnitude. EDDSs from five clinically treated breast patients were downloaded after completion of their daily treatments and analyzed the data.

Results and Discussion

Difference EDDSs show that sinogram differences in frequency and magnitude were increased with increase in shifts. Linear regression analysis revealed a good correlation with regression coefficients >0.97. The features of the difference EDDSs are quite predictable; the difference EDDSs were positive for +X-shifts due to missing tissue; negative for +Y-shifts near sloping portion of the chest-wall and also for +Z-shifts due to increase in attenuation. Different histogram plots of the shifted simulations show that the maximum deviations were up to ±60% and ±250% for shifts of 5mm and 20mm, respectively. Maximum deviation in the EDDSs of five clinically treated breast patients were within ±50% suggesting a ~5mm residual uncertainty in the patient setup.

Conclusion:

Preliminary investigation of exit detector sinograms data suggests that EDDSs are useful to identify the inter-fraction and intra-fraction setup errors and has great potential for in-vivo QA of the patient treatments.