AbstractID: 5542 Title: An optimized dose-based patient alignment method for on-line adaptive radiotherapy

Purpose: To develop an on-line patient alignment procedure that fully utilizes the CT guidance and dose verification feasibility in image guided radiotherapy. The new patient position is selected to optimize the plan that is evaluated using the daily contours created based on deformable image registration.

Method and Materials: Before a treatment fraction is delivered, a CT image of the patient in the treatment position is obtained. The couch is adjusted to match the planning CT image via on-line image guidance. Verification dose is calculated using this daily image. A deformable registration between the planning image and the daily image is performed and the ROIs are automatically re-contoured on the daily image. The daily dose is mapped back to the planning frame and then accumulated with the previous fraction dose. The new patient position is chosen via a procedure that optimizes the plan evaluated using the daily ROIs. The whole procedure entails the sequential execution of the following tasks: daily CT, CT-guided patient setup, deformable registration and automatic re-contouring, deformation of dose back to reference CT, dose-based patient position optimization, and plan evaluation using cumulative and daily doses.

Results: The new couch alignment procedure was validated on clinical prostate cancer data that includes a planning CT image and 17 fraction CT images (256×256×47) with resolution of $0.1875\times0.1875\times0.3cm^3$. The whole procedure was completed in a few minutes. The DVH results indicated improved sparing of the sensitive structures and better target coverage.

Conclusion: The new dose-based patient alignment procedure is an advancement to the image guidance alignment alone. Notable improvement in delivery dose can be achieved for certain types of treatment sites such as prostate cancer where the inter-faction positions of target relative to sensitive structures are not well correlated with the positions of rigid structures and are difficult to predict.