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Automated Planning for Fast on-line CT-guided Adaptive Re-planning in IMRT of Prostate Cancer

Purpose: The purpose of this study was to evaluate the potential of our recently developed automated planning method for automated on-line re-planning to account for inter-fractional changes encountered in prostate IMRT.

Method and Materials: Three prostate cancer patients treated in our institution were randomly selected for this study. For each patient, an initial plan was generated on the planning CT using automated optimization algorithm (AOA) without trial and error. Three on-line image guided strategies were evaluated: 1) the original plan applied to the repeated CT scan using the prostate-center-of-mass alignment; 2) re-optimized plan using the same objectives as those in the original plan; and 3) automated re-optimized plan by AOA.

Results: On average for 3 plans on 8 repeat CTs, V40, V60, and V70 for the rectum, V60 and V70 for the bladder of strategy 3 were reduced by at least 30.03%, 18.32%, and 12.12%, 6.98% and 5.43%, respectively, compared to those of strategies 1 and 2 for patient 1, by 22.23%, 14.89%, and 10.08%, 5.15% and 3.89%, respectively, for patient 2, and by 14.81%, 9.21%, and 6.90%, 4.56% and 3.77%, respectively, for patient 3. Strategy 3 also reduced the doses to the normal tissues (body excluding rectum, bladder and PTV) than strategy 1 and 2. CTV coverage for patient 2 in strategy 1 was compromised, but adequate for all other strategies for all three patients.

Conclusion: Fully automated, without trial and error IMRT re-planning is an effective approach for on-line compensation of the target dose deficit and critical organ overdose caused by inter-fractional anatomical change for CT-guided adaptive IMRT for prostate cancer.