Abstract

RADIATION THERAPY TREATMENT PLAN OPTIMIZATION ACCOUNTING FOR RANDOM AND SYSTEMATIC PATIENT SETUP UNCERTAINTIES

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External-beam radiotherapy is one of the primary methods for treating cancer. Typically a radiotherapy treatment course consists of radiation delivered to the patient in multiple daily treatment fractions over 6-8 weeks. Each fraction requires the patient to be aligned with the image acquired before the treatment course used in treatment planning. Unfortunately, patient alignment is not perfect and results in residual errors in patient setup. The standard technique for dealing with errors in patient setup is to expand the volume of the target by some margin to ensure the target receives the planned dose in the presence of setup errors.

This work develops an alternative to margins for accommodating setup errors in the treatment planning process by directly including patient setup uncertainty in IMRT plan optimization. This probabilistic treatment planning (PTP) operates directly on the planning structure and develops a dose distribution robust to variations in the patient position. Two methods are presented. The first method includes only random setup uncertainty in the planning

process by convolving the fluence of each beam with a Gaussian model of the distribution of random setup errors. The second method builds upon this by adding systematic uncertainty to optimization by way of a joint optimization over multiple probable patient positions.

To assess the benefit of PTP methods, a PTP plan and a margin-based plan are developed for each of the 28 patients used in this study. Comparisons of plans show that PTP plans generally reduce the dose to normal tissues while maintaining a similar dose to the target structure when compared to margin-based plans. Physician assessment indicates that PTP plans are generally preferred over margin-based plans. PTP methods shows potential for improving patient outcome due to reduced complications associated with treatment.

Reference

Moore J A, Gordon J J, Anscher M S and Siebers J V 2009 Comparisons of treatment optimization directly incorporating random patient setup uncertainty with a margin-based approach Med Phys 36 3880-90