AbstractID: 7371 Title: A Decision Strategy for Re-optimization in Adaptive Radiotherapy

Purpose

Discrepancy between the delivered and the planned dose, hereafter referred to as dose discrepancy, occurs in every fraction due to patient or setup variation from the initial plan. Re-optimization is a necessary step in adaptive radiotherapy to correct for the cumulated dose discrepancy from previous fractions. However, re-optimization is very time consuming. The number of times it can be applied is limited. In this work, we propose a simple strategy to determine the best time to re-optimize based on some statistical assumption on dose discrepancy.

Method

Dose discrepancies of single fractions are modeled as independent random variables with known probability distributions. We assume that re-optimization can be performed only once for the whole treatment course and the correction amount generated by re-optimization to be applied for all remaining fractions can not exceed a given bound. Under this simplified conditions, we propose a decision criterion for re-optimization based on the expected squared cumulated dose discrepancy, which are built inductively from the one-fraction case.

Results

Assuming that the probability distribution of dose discrepancy is Gaussian, we calculate, for each fraction, both upper and lower threshold of cumulated dose discrepancy for re-optimization. For cumulated dose discrepancy within the upper and lower threshold, re-optimization should be postponed. The calculated thresholds are close to two lines with slopes $c-\mu$ and $-(c+\mu)$, where c is the correction bound and μ is the systematic dose discrepancy. The result of the retrospective study using simulated data agrees well with our theoretical calculation.

Conclusions

This study provides a guideline for determining whether re-optimization should be done given the cumulated dose discrepancy and the number of remaining fractions. Our inductive approach can also be extended to cases when multiple re-optimizations are allowed.