AbstractID: 8987 Title: Dynamic Leaf Sequencing with Monitor Units Control

Purpose

Our work is motivated by the following observations: (1) Due to MLC leaf transmission, continuous intensity patterns for IMRT cannot be identically reproduced; thus, an objective of dynamic leaf sequencing should be to minimize the error between the delivered and the ideal intensity patterns. (2) The popular sliding-window algorithm always starts with all MLC leaf pairs closed; substantial reduction in beam-on time is possible if delivery starts with an open field. This research aims to develop a dynamic leaf sequencing algorithm that produces plans with significantly less MUs while approximating the ideal intensity patterns with the minimum error.

Method and Materials

Our new algorithm, called MUCDLS (Monitor Units Controlled Dynamic Leaf Sequencing), solves the following problem: Given an intensity pattern *IM* and an integer *h*, calculate the MLC leaf trajectories whose beam-on time is *h* MUs and which approximate *IM* with the minimum error. The trajectories can start at any positions and end at any positions. In MUCDLS, the problem is modeled as a shortest path problem on directed acyclic graphs and solved efficiently.

Comparing to the sliding-window method, MUCDLS has several advantages: (1) It mathematically guarantees the optimality of the solutions; (2) it computes a trade-off between the MUs and approximation error, offering the flexibility to choose a balanced plan; (3) it incorporates the MLC leaf transmission effect into the optimization.

Results

We applied our MUCDLS algorithm to over 100 intensity patterns from 18 clinical cases. Comparisons showed MUCDLS can produce plans of the same quality as that of the sliding-window plans but with 50-75% less MUs. Sequencing time of 5-10 seconds per intensity pattern was observed.

Conclusion

A new dynamic leaf sequencing algorithm that produces plans with significantly less MUs while having the same quality as the sliding-window algorithm is developed and verified.