AbstractID: 5324 Title: New Field Splitting Algorithms for Intensity-Modulated Radiation Therapy

Purpose:
To develop new algorithms/softwares that optimally split any intensity-modulated fields of large widths into multiple subfields under the MLC maximum leaf spread constraint such that the total beam-on time for delivering the resulting subfields is minimized.

Methods and Material:
Due to the maximum leaf spread (MLS) constraint of MLCs, intensity-modulated fields used in IMRT whose widths exceed a given threshold must be split into multiple subfields. This results in increased beam-on time of the treatment. We studied two versions of the field splitting problems:
1) Splitting a large field into non-overlapping subfields along paths that are orthogonal to the MLC leaf motion direction (this is a generalization of field splitting along straight lines); (2) splitting with overlapping, allowing adjacent subfields to overlap with each other.

We developed two new field splitting algorithms (called FSMP and FSO) for these two problem versions, which mathematically guarantee to minimize the total beam-on time of the splitting. Our algorithms are based on graph algorithmic techniques in computer science and linear programming tools in operations research.

Results:
We implemented our new algorithms, and experimented with them on 58 large intensity-modulated fields for 11 clinical cases obtained from the Department of Radiation Oncology, University of Maryland Medical School. We conducted comparisons with CORVUS 5.0, and with a recent field splitting algorithm (denoted by FSSL), which splits along straight lines.
For every tested field, the total beam-on times of the four methods, CORVUS 5.0, FSSL, FSMP, and FSO, are always in decreasing order. Comparing with CORVUS 5.0 and FSSL, our new algorithms showed considerable improvements (on average, 21% and 12%, respectively) in the total beam-on time.

Conclusion:
We developed two new field splitting algorithms under the MLS constraint of MLCs to minimize the total beam-on time. Our algorithms improved the previous field splitting approaches considerably.