AbstractID: 5322 Title: Continuous Intensity Map Optimization (CIMO): A Novel leaf-sequencing algorithm

Purpose:

In IMRT planning, leaf-sequencing algorithms are used to translate optimized intensity maps into deliverable aperture shapes. We have developed a novel approach to leaf sequencing called continuous intensity map optimization (CIMO). The CIMO algorithm can significantly reduce the number of segments required for IMRT delivery. A unique feature of the CIMO algorithm is that it operates directly on continuous intensity maps. Consequently, the intensity maps do not need to be divided into discrete levels.

Method and Materials:

CIMO uses a simulated annealing algorithm to optimize the aperture shapes and weights with a goal of minimizing the discrepancies between the optimized and sequenced fluence maps. We have benchmarked the performance of the CIMO sequencer against the algorithms in the Pinnacle^3 and Eclipse treatment planning systems.

Results:

When the CIMO sequencer was applied to 10 IMRT plans from the Pinnacle^3 planning system, the average number of segments was reduced from 133 to 62 (a 54% reduction). The average number of monitor units was reduced from 646 to 555 (a 14% reduction). The CIMO algorithm also provided a 36% reduction in the average root mean square errors between the optimal and sequenced fluence maps. Additionally, the CIMO sequenced plans provided more uniform PTV coverage with comparable sparing of critical structures. The average standard deviation of the PTV dose distribution decreased from 9.6 to 7.4 cGy. When the CIMO algorithm was applied to 5 IMRT patients from the Eclipse planning system, the average number of segments was reduced by 46% and the average number of monitor units was cut by 31%. Equivalent plan quality was observed.

Conclusion:

As compared with both commercial systems, the CIMO algorithm resulted in equivalent or improved plan quality while providing a significant reduction in the required number of segments and monitor units.