

AbstractID: 5223 Title: A novel neighborhood for local search and simulated annealing methods in beam orientation optimization in IMRT

Purpose: To select quality coplanar solutions to the beam orientation optimization (BOO) problem in intensity-modulated radiation therapy (IMRT) treatment planning, and to demonstrate that high-quality treatment plans can be obtained using fewer beams than typically used in equi-spaced plans.

Method and Materials: We consider the problem of obtaining quality 3- and 4-beam coplanar radiation treatment plans. Two methods to obtaining these solutions are tested: the simulated annealing (SA) algorithm, which provides a global approach to the problem, and the Add/Drop heuristic, which provides a locally optimal solution. In the algorithms, a novel neighborhood is considered wherein a beam's neighborhood consists of a number of beams adjacent to the current beam plus a number of beams adjacent to the parallel-opposed beam, which we call the "flip neighborhood". For the SA algorithm, several methods of obtaining neighboring solutions and different cooling schedules are considered. The algorithms were tested on six head-and-neck cases using coplanar beams on a 5° grid. The resulting treatment plans were compared to the 5- and 7-beam equi-spaced plans typically used in practice.

Results: While the 3-beam treatment plans were poor in quality, the 4-beam treatment plans obtained using both the SA method and the Add/Drop heuristic had comparable or improved quality to the 5- and 7-beam equi-spaced plans typically used in head-and-neck treatment.

Conclusion: For head-and-neck cases, quality plans with fewer beams than standard 5-7 beam treatment plans can be obtained if BOO is applied. We also show that although the flip neighborhood increases run time for the Add/Drop heuristic (the run-time of the simulated annealing algorithm is unchanged), it improves the FMO value for both the simulated annealing algorithm and the Add/Drop heuristic.

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