AbstractID: 5219 Title: A response surface-based approach to beam orientation optimization in IMRT

Purpose: To include all noncoplanar beam directions in 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 are typically used in equi-spaced plans.

Method and Materials: Because the data storage requirements for each beam restrict the number of beams that can be considered in BOO, the majority of previous BOO research has focused on considering just coplanar angles and/or a handful of pre-selected noncoplanar directions, which comprise only a small subset of all solutions. In contrast, our approach allows for the generation of beam data for promising directions thus avoiding the data storage restriction and significantly increasing the size of the solution space, possibly leading to improved treatment plans. We use a response surface (RS) method that allows us to generate the beam data on-the-fly only as necessary. We consider the problem of adding a single (noncoplanar) beam to a locally optimal 3-beam solution, thus yielding a 4-beam plan. Several varying implementations of the RS algorithm were tested on six head-and-neck cases using gantry and couch rotations, each on a 10° grid.

Results: The 4-beam treatment plans obtained using the RS method were comparable to locally optimal 4-beam solutions, and were also comparable to the 5- and 7-beam equi-spaced plans typically used in head-and-neck treatment plans.

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. While the inclusion of noncoplanar orientations in BOO is useful in terms of improving the FMO objective function, the resulting improvements in the treatment plan are not always clinically significant.

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