AbstractID: 11032 Title: Inverse treatment planning for volumetric modulated arc therapy using total-variation regularization and angular smoothing

Purpose:

The volumetric modulated arc therapy (VMAT) includes the field angle as another degree of freedom in the treatment planning and is therefore able to achieve a superior dose performance. Due to the increased computational complexity and the hardware constraints of beam segments, however, an optimal inverse planning of the VMAT is yet to be found and its advantages are not fully exploited in practice. The conventional beamlet-based algorithms obtain high-complexity fluence maps which are not suitable for delivery in the VMAT, and the segment-based algorithms are computationally intensive with no guarantee on the optimality of the final solution. In this work, a novel VMAT inverse planning algorithm is proposed to overcome the drawbacks of the existing planning methods.

Method and materials:

Using a framework of quadratic optimization, we include a term of total-variation in the optimization objective to achieve a small number of beam segments. An additional quadratic term of angular smoothing is also added on to distribute the necessary incident radiation dose more evenly over different field angles.

Results:

The performance of the proposed algorithm is demonstrated using a prostate patient study. As compared to the fixed gantry radiation therapy and the conformal Arc therapy, our approach achieves a much improved target conformity and dose sparing of the sensitive structures, and truly gains the advantages of the VMAT.

Conclusion:

A general framework of VMAT planning is proposed in this work. As compared to other existing algorithms using empirical (often unjustified) search schemes, our method guarantees an optimal solution with a high efficiency. As arc-based radiation therapy becomes more commonly used, the proposed algorithm is very attractive in clinic.