

AbstractID: 12703 Title: Optimization of Three-Dimensional Treatment Plan in Beamlet Domain by Applying Spatial Variation Constraint of the Fluence Maps and by Compressed Sensing Method

Purpose: To establish an inverse planning framework for optimization of 3D radiation therapy (RT) treatment plan with machine delivery parameters modeled by direct constraint on the spatial variation of the fluence maps and a compressed sensing method.

Materials and Method: Different from previous wedge optimization based on deposition of the incident fields into a sum of open and nominal wedged fields, the computation here is performed in the beamlet domain. During optimization, two different but related methods are used: (i) a direct constraint that *forces* the fluence to vary monotonically with an optimal wedge angle; (ii) a total-variation (TV) regularization which encourages the final fluence to take a form of wedged field by requiring the derivatives of the field fluence maps to be piece-wise continuous.

Results: The performances of the two proposed methods are evaluated and compared by using a brain cancer case and a head and neck case. Both methods are capable of providing clinically sensible 3D RT solutions with monotonically varying fluence maps. For currently available 3D RT delivery scheme based on the use of customized physical or dynamic wedges, the constrained wedge field optimization seems to be more useful because the optimized fields are directly deliverable. The TV-regularized optimization results, on the other hand, may translate into two or more segmented wedged fields, which are readily deliverable using dynamic jaw or MLC.

Conclusion: An inverse planning framework is established to automate the 3D RT treatment planning. The proposed methods take advantage of the fact that 3D RT is a special form of IMRT and finds optimal plan by searching for fields with a certain type of spatial variations. The approach unifies the inverse planning of 3D RT and IMRT and thus makes easy the implementation of the proposed methods in an existing IMRT inverse planning platform.