AbstractID: 10905 Title: Search for IMRT inverse plans with piece-wise constant fluence maps using compressed sensing techniques

Purpose:

An intensity modulated radiation therapy (IMRT) field is composed of a series of segmented beams. It is practically important to reduce the number of segments while maintaining the conformality of the final dose distribution. In this paper we quantify the complexity of an IMRT fluence map by introducing the concept of sparsity of fluence maps and formulate the inverse planning problem into a framework of compressing sensing.

Method and Materials:

In this approach, the treatment planning is modeled as a multi-objective optimization problem, with one objective on the dose performance and the other on the sparsity of the resultant fluence maps. A Pareto frontier is calculated, and the achieved dose distributions associated with the Pareto efficient points are evaluated using clinical acceptance criteria. The clinically acceptable dose distribution with the smallest number of segments is chosen as the final solution.

Results:

The method is demonstrated in the application of fixed-gantry IMRT on a prostate patient. The result shows that the total number of segments is greatly reduced while a satisfactory dose distribution is still achieved.

Conclusion:

A compressed sensing based inverse planning technique is proposed for IMRT planning. The main features of the approach include (1) the inclusion of a sparsity objective; and (2) the use of a convex optimization algorithm. Without compromising the dose performance, IMRT solutions with piece-wise constant fluence maps can be easily obtained using the proposed approach. The reduction of the number of segments in IMRT delivery reduces the total treatment time and therefore increases the dose delivery accuracy and the clinical throughput. With the focus on the sparsity of the optimal solution, the proposed method is distinct from the existing beamlet or segment-based optimization algorithms.