AbstractID: 1816 Title: A deterministic segment sorting algorithm to minimize delivery time of step-and-shoot Intensity-Modulated Radiation Therapy treatments

A deterministic algorithm was developed to sort the segments of a step-and-shoot Intensity-Modulated Radiation Therapy (IMRT) beam in order to minimize segment-to-segment MLC leaf motion. The algorithm initially presorts the segments by selecting an initial segment and sequentially selecting, among the remaining segments, the one that minimizes the segment-to-segment travel distance (the travel distance of the leaf that has to travel the farthest). The algorithm then optimizes the segment sequence using a deterministic iterative approach to remove blocks of segments from the current sequence and reinsert them in all possible locations within the sequence, in the forward or reverse order. All possible blocks of segments are considered. An iteration terminates when an attempt to move a block of segments produces a sequence that decreases the composite leaf travel distance (i.e. sum of the segment-to-segment travel distances). The optimization process terminates when an iteration can not find a new sequence that decreases the composite travel distance. Finally, because the final sequence is dependent on the initial sequence, the whole optimization process is repeated until convergence is achieved. The implementation allows the segment with the largest exposed area to be placed first in the sequence. A comparison with a simulated annealing segment sorting algorithm was made. Series of segments were produced by optimizing and segmenting IMRT plans. The simulated annealing and deterministic algorithms improved the composite travel distance by 55.3 % and 56.1 % on average, respectively.