AbstractID: 6743 Title: Optimal step-and-shoot segmentation algorithm for unidirectional motion of leaves

This report presents an original algorithm for leaf sequencing in step-and-shoot multi-leaf IMRT dose delivery. The algorithm minimizes the number of segments that are used to generate a given intensity map provided the least number of monitor units per treatment is preserved and the condition of unidirectional motions of all leafs is satisfied. The algorithm under consideration is designed as follows. An intensity map for the radiation therapy field is divided into rows, each corresponding to the line of movement of one pair of blocking leaves. A restriction is imposed that each collimator leaf pair moves only in one direction. First, the proof is worked out showing that unique sequence of unidirectional movements exists that minimizes the beam time for each row. The row requiring the minimal beam time larger than any other row determines the minimum beam time for given intensity map. Multiple sequences of leaf positions for other rows can be created without requiring extending minimum beam time for given intensity map. The challenge of finding and sorting all such sequences relative to criteria of maximum correlation of segments during each monitor unit delivery is resolved by the application of methods of combinatorial analysis. The results are compared to two well-studied algorithms - Bortfeld algorithm (unidirectional) and areal algorithm (bi-directional). The number of segments and the number of monitor units for each of these three algorithms are determined (for random and clinical intensity maps) to illustrate advantages of the method endorsed in this communication.