AbstractID: 1808 Title: Optimal leaf sequencing with elimination of tongue-and-groove underdosage

The tongue-and-groove (T&G) design found on most commercial multileaf collimators creates areas of underdosage in IMRT delivery unless a leaf trajectory is specifically designed such that for any two adjacent leaf pairs, the direct exposure under the T&G is equal to the lower of the direct exposures of the leaf pairs. In this work, we present a systematic study of the optimization of leaf-sequencing algorithms for step-and-shoot IMRT delivery that completely eliminates areas of underdosage due to T&G design. Simultaneous elimination of T&G effect and leaf interdigitation is also studied and optimal leaf sequencing algorithms were developed. Rigorous mathematical proofs are given to show that the proposed algorithms are optimal in monitor unit efficiency for unidirectional leaf movement[1]. Compared to an optimal leaf-sequencing algorithm without constraints, the new algorithms increased the number of sub-fields by approximately 21% and 25%, respectively, but are optimal in MU efficiency for unidirectional leaf movement. We compared the performance of our algorithm with a recently published algorithm[2] under the same hardware constraint using 1000 randomly generated 15 by 15 matrices. Average reductions of a factor of 2.5 were found for both the MUs and the number of segments with our optimal algorithms.

1. Kamath S. *et al*, Optimal leaf sequencing with elimination of tongue-and-groove underdosage. *Phys. Med. Biol.* **49**:N7-N19, 2004.
2. Que, W. *et al*, "Tongue-and-groove" effect in intensity modulated radiotherapy with static multileaf collimator fields. *Phys. Med. Biol.* **49**:399-405, 2004.