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Reducing leaf travel distance and tongue-and-groove effect for segmental IMRT

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Abstract

We introduce a method to simultaneously minimize leaf travel distance and tongue-and-groove effect for segmental intensity-modulated radiation therapy (i.e, with static MLC fields). It works with both sliding window mode and reducing level mode. The basic idea is to add enough number of openings for those leaf pairs with fewer openings than the number of segments so that all leaf pairs have the same number of openings. Openings are added by cutting an existing opening into two or more openings. The cutting positions are optimally determined by adaptive simulated annealing. The performance of the method was evaluated with clinical 19 beams. The results show that, when working with the sliding window mode, it significantly reduces both leaf travel distance (maximally by about 50%) and tongue-and-groove effect (maximally by about 70%). When working with reducing level mode, it can reduce leaf travel distance maximally by about 20%, but always increases tongue-and-groove effect. If the method is implemented clinically with the sliding window mode, it could result in 1 to 2 minutes' savings in treatment delivery time per fraction, and also result in significant reduction in the wear-and-tear of MLC mechanics.