

AbstractID: 9588 Title: An optimization algorithm for aperture-based IMRT treatment planning

We have developed a method to directly optimize the shapes and weights of field segments in step-and-shoot IMRT using simulated dynamics. With preset number of segments in each beam, the objective function can be defined as a function of the MLC leaf positions and segment weights. The objective function is considered as the potential energy of a dynamics system of many interacting particles. The optimization process for aperture-based IMRT planning is then performed by numerical simulation of a set of dynamic equations derived from the objective function. This is accomplished by iteration with two decoupled processes. First, the aperture shapes are optimized with fixed weights. The MLC leafs are considered as interacting particles, and they relax to equilibrium positions as their kinetic energy dissipated by damping. Secondly, the segment weights, as considered position variables of virtual particles, are optimized with fixed apertures. Initial kinetic energies for the virtual particles are introduced so that the system can escape from local minima that most likely exist due to the non-convex objective function. A realistic dose distribution obtained by pre-optimization of intensity profiles is used for construction of voxel based objective function and appropriate constraints for aperture-based optimization. The method has been tested successfully using cases with simple geometry and produces comparable results with standard IMRT planning. The aperture-based inverse planning can eliminate the inaccuracy due to segmentation from optimized intensity profiles to field segments. The number of segments can be limited for improving IMRT delivery efficiency.