Optimization of Multileaf Collimator Geometric Parameters to Improve VMAT Plans in Radiation Therapy

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The development of volumetric modulated arc therapy – or VMAT – plans for radiotherapy treatments require the optimization of parameters such as gantry angles and multi-leaf collimator (MLC) positions in order to deliver the prescribed radiation dose distribution to the tumor. Usually calculated by commercial software such as Eclipse, these parameters are transferred to the control systems of medical linear accelerators to deliver the treatment to the patients. MLC positions define the tissue shape exposed to radiation at each gantry angle, and their post-Eclipse adjustment may allow further improvement of these treatments. Using a simulated annealing algorithm, we have created a Matlab script capable of representing the optimization of the MLC positions to correspond to certain constraints, for example, a maximum aperture area for a given perimeter. The evaluation of the objective function was implemented efficiently using a table-driven approach. When evaluated by the SA algorithm, the results turned out to be sensitive to the initializations – or starting positions. If a perimeter restriction of 30cm was set, the solution outputted a 7.5cm^2 square; the optimal area to perimeter shape in this case.

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