Clinical Implementation of Wedge Filter Optimization in 3D Radiotherapy Treatment Planning

Previous approach of optimizing the wedge filters in 3D radiotherapy treatment planning is to decompose each incident beam into an open and two nominal wedged fields, and then to optimize their weights based on the concept of the omni wedge. A serious limitation of the approach to clinical application is that one has to pre-select the signs of the nominal wedges. In this work, a new algorithm was developed to automate fully the 3D treatment planning process. The approach optimizes the beam weights, wedge angles and orientations directly using a simulated annealing algorithm, and no planner intervention was required in the process. A dose-based objective function which incorporated the relative importance of structures was adopted. The technique was demonstrated by using a phantom study and a clinical case. For the phantom case, the classical wedge pair result was obtained, providing a useful test of the algorithm. Sensible dose distributions and dose-volume histograms for the target and surrounding organs were obtained for the clinical case. It was also shown that dose homogeneity to the target could be compromised by increasing the relative importance factors to the surrounding organs. Field restrictions, such as restricting the wedge orientation(s) and/or wedge angle(s) for one or more fields, can be applied. The technique has the potential to fully automate the selection of wedges in 3D radiotherapy treatment planning. In addition, treatment planning time and efforts were reduced.