A Method of Generating Multiple Static Fields and Delivering Intensity Modulated Radiotherapy

A process for delivering intensity-modulated radiotherapy treatments using a sequence of fixed beam directions and a multi-leaf collimator (MLC) has been implemented in our clinic. Non-uniform intensity profiles are delivered for each direction using a *stop-and-shoot* approach. One aspect of this process deals with generating a series of discrete MLC fields that will create the non-uniform intensity profile derived by the inverse planning. Beam segments are formed by first grouping all nonzero intensity values into a minimum number of levels based on a user specified error tolerance. The K-means clustering algorithm is then employed to find the optimal intensity increments to minimize discrepancies between the desired and delivered profiles. Finally, the discrete intensities are decomposed into a sequence of shapes to be formed with the MLC and independent jaws. Apart from the first segment for each gantry angle, all other segments are arranged to minimize the total travel distance of the leaves. The first segment covers the largest treatment area, and is used for patient setup verification in conjunction with electronic portal imaging. This algorithm has been in clinical use for prostate cancer patients since April of 1998. The results have demonstrated that the approach is clinically feasible in terms of accuracy and overall treatment time. The K-means clustering algorithm has the capability to reduce the discrepancy between the desired and deliverable profiles, especially for a larger error tolerance.

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