

The multi-leaf collimator (MLC) hardware constraints are normally neglected in the process of intensity modulated beam optimization. Consequently, it is not always possible to deliver planned beam modulation using dynamic MLC. Efforts of beam optimization are wasted if the results must be approximated due to limitations imposed by the delivery device. To overcome this problem, an inverse beam optimization method which incorporates the hardware constraints has been developed. The MLC constraints including the leaf velocity, maximum leaf overtravel, dose rate, minimum leaf gap and maximum duration of beam pause were added to the usual dosimetric objectives for the tumor and critical organs. The optimization scheme assumes unidirectional leaf translation. The constraints are formulated either in beam space or dose space as convex sets. The interchange between the two domains is accomplished through a transformation which is also convex. Solutions are obtained by iteratively projecting the beam-dose vectors among the constraint sets. Convergence to a solution is guaranteed by the convex constructs. The dosimetric model is a modified convolution/superposition method using multi-resolution kernel sampling. The optimization technique was applied to a set of test cases. Comparisons were made between the solutions produced by this method and conventional optimization. The beam profiles generated by the conventional method were modified to meet the hardware specifications. The results indicate that inclusion of MLC constraints during optimization can improve the degree of conformity that is deliverable.