

In this work, we investigate the theoretical possibility of delivering one-dimensional nonuniform dose distributions with beam intensity modulation using dynamic dose rate control. Following recent developments of add-on units that allow linac-based dose rate control, this technique may potentially be applicable to the treatment of sites that require compensators for missing tissue. A constrained nonlinear optimization problem has been formulated to determine optimal dose rate, beam slit width and velocity to deliver a one-dimensional dose profile in the minimum amount of time. The discretized version of this problem is solved by an efficient sequential quadratic programming algorithm. The applicability of this approach to a variety of non-uniform dose profiles has been investigated. We conducted numerical experiments for a sequence of double-gaussian profiles with progressively narrower standard deviations and for a clinical case of posterior field with a spinal chord block (specified thresholds were 0-2 cm/sec for the velocity, 0.1-2 cm for the width, and 0-6 Gy/min for the dose rate). In each case, it was possible to shape the desired beam profile. However, because of the maximum dose rate is limited, the sharper the dose profile fall-off, the longer the treatment will be. These preliminary results indicate the potential of this approach for generating one-dimensional nonuniform dynamic beam intensity modulated dose profiles. Its practical utility in the clinic remains to be investigated.