

Abstract:

Radiotherapy with charged heavy particle beams becomes increasingly available for clinical practice. Successful application of this costly treatment modality requires the development of strategies of treatment planning, which fully exploit the physical advantages of charged particle beams. The concept of inverse treatment planning is employed to investigate new strategies for the planning of IMRT with charged particles.

To achieve optimal dose conformity, charged particles allow the simultaneous modulation of beam intensity and energy. Thus far, these degrees of freedom have been employed by using the concept of the spread out Bragg peak (SOBP). A different approach, the method of 'distal edge tracking', employs the variation of beam energy to track the distal target edge with the Bragg peak. The idea of inverse treatment planning is applied to the concept of 'distal edge tracking' for a model problem in rotation therapy. The formulation of this inverse problem is extended for irradiations with arbitrary depth dose curves, and solved for Bragg peaks of proton and heavy ion beams. The results obtained are compared to the standard SOBP techniques.

It was found that 'distal edge tracking' can only be physically realized up to a certain target size. Additional energy modulation of the charged particle beam is required for a combination of narrow Bragg peaks and large targets. If dose delivery with 'distal edge tracking' can be realized a decrease of the integral dose delivered to healthy tissues in the order of 30% was observed in comparison to the conventional SOBP technique.