TREATMENT PLANNING IN ADAPTIVE RADIOTHERAPY

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Adaptive radiotherapy is a promising technique that is capable of modifying the treatment process based on information fed back during the dose delivery. The implementation of adaptive radiotherapy requires proper system modification scheme s for hardware components including the LINAC/multi-leaf collimator (MLC) and proper on-line imaging devices, and software components including 3D treatment planning system. In this thesis work, various aspects of the treatment planning problem associated with adaptive radiotherapy were studied.

Re-optimization: Schemes to perform a treatment plan re-optimization in adaptive radiotherapy were studied. Mathematical models were established and discussed. The effectiveness of the methods was demonstrated by case studies.

Fast Cimmino algorithm: The possibility of quickly modifying a treatment plan without re-optimization was investigated. A non-optimization scheme based on a fast Cimmino algorithm was implemented and case studies are presented. Interactive treatment planning: Interactive planning with physicians so that their clinical preferences can be incorporated during treatment plan modification is proposed. Several quadratic programming techniques were investigated and implemented to achieve this goal.

Local minima problem: The existence of local minima, especially those due to the dose volume histogram constraints in radiotherapy optimization/re-optimization was studied and their properties investigated. Both a simplified model and a clinical case study were used to help understand the local minima problem.