AbstractID: 1529 Title: A Greedy Set Cover Algorithm for the IMRT Beam Selection Problem

Improved beam direction selection for IMRT treatment planning can help minimize the irradiation of critical normal structures while still providing adequate target coverage. Conventionally, beam angle selection is either trial-and-error, based on manual modifications of 'standard' working arrangements, or simplified, e.g., using equispaced beam angles. Algorithms to automate the selection of improved beam angles are typically slow. We introduce a new approach, defining any point in the target as *viewable* by a given beam if a ray from that beam, which passes through the point, does not intersect any critical structures (i.e., the point can be 'viewed' by that beam). A point viewable by k beams is termed k-viewable. We define, for each beam, the set of points viewable by that beam. Next, we show that the beam selection problem can be generalized to the multi-set cover problem, a difficult (NP-hard) computer science problem, for which fast heuristic solution algorithms have been developed. Our algorithm, which extends the greedy set cover algorithm, aims to find a set of coplanar angles that will make a maximal fraction of target points at least k-viewable, for a given k. We hypothesize that adequate IMRT plans can be developed if all target points are at least 3-viewable. This algorithm determines beam angles for a typical plan in 1-2 minutes on a typical desktop computer. We compare the effectiveness of our solution to equispaced and human-selected beam angles. This work provides a theoretical basis for further research in automated beam angle selection.