AbstractID: 9294 Title: A system for Gamma Knife radiosurgery inverse planning

An automated radiosurgery planning system was developed to optimize the number of shots, shot sizes, locations, and their corresponding weights. The system utilizes the methodology of skeletonization based shot placement which we had published before. In the previous work, shots are packed in the target volume as rigid spheres. The shot size and location are optimized simultaneously so that for a shot location chosen, the shot size is optimal for that location. However, due to limited collimator sizes available in Gamma Knife (18mm, 14mm, 8mm and 4mm, respectively), not all shot sizes could be converted to the physical collimator sizes. In this work, we overcome this limitation by modeling the shots as spherical clouds so that discrete collimator sizes are relaxed into continuous ones defined by collimator size and weighting. The complete system consists of two steps. The first step is to allocate an optimal number of shots (locations and sizes) and to assign initial collimator sizes to the shots. The second step is to fine-tune the weights using linear-programming. The objective function is to minimize the total dose to the target boundary (i.e. maximize the dose conformity). An example with ellipsoid target is presented. The dose conformity index PITV is 1.25 for the initial shot configuration, and is 1.16 after weight optimization. A distinguish feature of this system is that it allows the total number of shots to be a variable in the optimization so that there is no need to specify the total number of shots *a prior*.