AbstractID: 1617 Title: A Fast Fluence Modulation Optimization Algorithm for IMRT, and Comparison of its Efficacy to Global Fluence Optimization

Intensity Modulated Radiotherapy (IMRT) treatment planning systems employ various fluence optimization algorithms which, in the interest of computation time, are faster non-global optimization schemes. However, it has been shown that non-global schemes can provide sub-optimal results due to being trapped in local optima, especially when used in conjunction with dose-volume type constraints. In this work, a fast heuristic fluence optimization scheme was developed, and formally compared to global optimization schemes. The heuristic optimization scheme modulates fluence by iteratively reducing beamlet fluences in proportion to the dose violation of critical structure voxels, and in inverse proportion to the consequent loss of target dose, while simultaneously raising the fluence of beamlets that do not cause dose violations. In application, this heuristic scheme has been shown to even be capable of effectively optimizing dose distributions dictated by complicated non-uniform target and critical structure dose prescriptions based on functional image guidance. To verify the efficacy of the heuristic scheme, a global optimization scheme was developed that combines simulated annealing and gradient descent optimization. The heuristic and global optimization schemes were each tested on IMRT breast cancer cases, with 2, 3, and 5 beam orientations. Dose-volume constraints were imposed on opposite breast, heart, and lungs. In all cases, the heuristic and global optimization schemes produced equivalent dose-volume histogram results for target and critical structures, though the spatial dose distributions differed. In conclusion, the heuristic fluence modulation scheme presented here appears to have great potential in providing fast solutions that are comparable to global optimization results.