AbstractID: 9518 Title: Multiobjective Optimization for IMRT using genetic algorithm

Purpose: To devise a multiobjective optimization (MOO) method for IMRT that would provide a decision maker with a small set of well-distributed Pareto optimal plans.

Methods: A multiobjective genetic algorithm was used; the fitness function was evaluated by a deterministic algorithm that consisted of a quadratic (BOXCQP: box constrained quadratic programming) and a non-quadratic component. Each generation consisted of 10 individuals; the chromosome consisted of the OAR objective dose parameters. For the head and neck case studied, there were 6 objectives including maximum and mean dose objectives. For each individual, the deterministic algorithm was used to calculate beamlet intensities. OAR doses are variables in multiobjective GA and the target dose was fixed to 100%. The fitness function contained terms to minimize the difference between the OAR dose for adequate target coverage and the OAR dose goal and to minimize the dose goal for each OAR. Selection and breeding strategies were designed to provide a diverse population of individuals.

Results: The algorithm was set to terminate after 100 generations or after five successive generations of no change in fitness. We compared genotypic and phenotypic distance functions and found that the phenotype provided better distribution of final plans. The decision making component was a Bayesian network coupled with a Markov cohort simulation to compute quality adjusted life expectancy and to rank plans accordingly. A set of optimal plans were also generated by varying the weighting factors for a fixed set of parameters but the distribution of plans was not as good.

Conclusion: A genetic algorithm was designed to provide a diverse set of Pareto optimal solutions to the multiobjective optimization problem of IMRT inverse planning. The dose parameters in dosimetric objective functions were the variables in the optimization. The algorithm provided a well-distributed set of plans for input to the Bayesian network.