AbstractID: 4718 Title: Optimizing the MLC apertures for conformal radiotherapy with a hybrid algorithm

Purpose: To develop a feasible technique to simultaneously optimize the shapes and weights of the MLC apertures for conformal radiotherapy planning.

Method and Materials: The shapes of the MLC apertures are optimized using the genetic algorithm (GA). There are several individuals in each generation of GA, and each individual includes a group of apertures, which number is equal to the number of pre-selected beams, i.e., each individual is a trial conformal plan. The initial aperture shapes are obtained by adding different margins to the target on Beam's-eye-view (BEV). The margins range from -1.0 cm (i.e., shrink) to 1.0 cm (i.e., expand), with a step of 0.2 cm. The apertures of all beams with 1.0 cm margin constitute the first individual, and the apertures with 0.8 cm margin constitute the second, etc. For the selected two individuals (parents), the crossover and mutation operation are applied to the corresponding two apertures of the two parents. After the loop of shape optimization with GA, the aperture weights are optimized with a conjugate gradient (CG) method. The shapes and weights are iteratively optimized.

Results: A five-beam conformal plan is used for a head-and-neck tumor case. In the manual plan the weights of all apertures are set to unit, and the shapes are obtained by adding a 0.5 cm margin to the target on the BEV of each beam. About 2 minutes are taken to find the optimized plan. Both the dose distributions on CT slices and the DVH curves demonstrate the improvement of the optimized plan.

Conclusion: This work indicates that the proposed GA and CG-based algorithm is feasible and efficient for the optimization of the shapes and weight of MLC apertures for conformal radiotherapy planning, and a better dose distribution could be achieved within clinically acceptable computation time.