AbstractID: 2048 Title: 4D IMRT Optimization accomodating respiratory motion using image mapping.

The advent of 4D respiratory correlated CT scanning has enabled the development of 4D radiation treatment planning within PlanUNC in which respiratory motion of organs are explicitly accounted for. Given a 4D CT scan consisting of 3D CT image sets acquired at different respiratory phases, a large-deformation CT-to-CT image registration algorithm is used to explicitly determine lung tumor motion. The deformable image registration provides a dense correspondence of every voxel in each of the CT sets from the peak-inhale respiration phase to the subsequent respiration phases. Total accumulated 4D dose in the presence of motion is calculated by mapping individual dose distributions calculated at each of the phases back on to the peak-inhale phase, using the correspondence generated. Using 4D dose we define a 4D-DVH accommodating organ motion. We have also developed a 4D IMRT optimization algorithm that explicitly accommodates organ motion by optimizing this accumulated dose. The 4D optimization algorithm calculates, at each iteration, a complete 4D dose distribution that is then mapped back to the peak-inhale phase, and used to update the current modulation profile for specifying a computer-milled compensating filter. As the registration algorithm tracks the non-linear deformation of all the structures simultaneously no assumptions except that breathing cycle is reproducible need be made. We show that in applying this technique to a real 4D RCCT data set, significant normal tissue sparing is achieved. In this study, the V20 lung volume is reduced from 440cc to 274cc, for comparable tumor coverage achieved with conventional 3D planning.