AbstractID: 9700 Title: Integrating a Monte Carlo Based Optimization Module into CERR for Designing IMRT plans

An integer-programming based optimization modeling and solution engine is integrated with CERR (Computational Environment for Radiotherapy Research, Deasy) to generate optimal treatment plans for IMRT. To set up the optimization model, Monte Carlo generated beamlets are computed using the VMC++ code running on a 24-node Linux cluster. Influence matrices (dose per unit fluence for all voxels of interest and beamlets) were stored in a sparse format for input into the optimization models, which are then subsequently optimized. The resulting plans are automatically ported back into CERR for dose display, comparison, and DVH display and analysis.

A head-and-neck tumor site is analyzed. Seven regularly-spaced coplanar ports were selected, comprised of a total of 537 1cm-beamlets. Besides the tumor volume, the left and right parotid, spinal cord, and skin (as normal tissue) are used for setting up the MIP treatment planning model. The planning directives include upper and lower dose limits for the target, mean dose restrictions on each parotid, upper dose limit for the spinal cord, and for skin. Under this set of planning directives, two objectives are contrasted -- 1) maximizing sum of target minimum- dose and mean-dose, and 2) optimizing tumor dose homogeneity. The results show that with the underlying anatomical heterogeneity, and the very accurate dose engine, the best homogeneity index obtained which satisfied all the input restrictions is 1.17, and it is achieved by optimizing the tumor dose homogeneity. The homogenity index is slightly higher(1.25) when we maximize the sum of target minimum and mean dose.