AbstractID: 2774 Title: Real-time Isodose Sculpting, CDVH Manipulation, and Delivery Efficiency Control in IMRT

Purpose:
We investigate the computational feasibility of tools enabling real-time adjustment of isodose contours, CDVHs, min/max statistics, and delivery efficiency in IMRT treatment plans. We are motivated to provide direct customization of the attributes used for clinical IMRT evaluation departing from the less direct, traditional prescription process.

Method and Materials:
We design an objective function to enable real-time adjustment of arbitrary dose distributions. We start from CORVUS inverse plans. To achieve each adjustment, we modify the objective function and apply gradient-based optimization within a discrete search space.

Dose planes, CDVHs, and statistics are recalculated and displayed following optimization. CDVHs and statistics are computed using stochastic estimation. Dose planes are computed on demand for three orthogonal views using multi-resolution grids.

We compare dose distributions before and after adjustment and record computation time. We use a prostate case, C-shaped thoracic case, and radio-surgical case treated with a Varian MLC, MIMiC, and BEAK respectively. We also evaluate dose accuracy by comparing the novel system's dose calculation with full CORVUS calculation.

Results:
We judged each tool to be effective in achieving its primary goal in all three cases. We note that local adjustments did induce some non-local changes. Isodose contouring, CDVH dragging, min/max adjustment, and delivery efficiency adjustment had average computing times of 6s, 14s, 30s, and 6s respectively running on a dual-processor, 2GHz PowerPC G5. Dose slices agreed so that 98% of pixels agreed within 5%, 5mm, while min/max statistics agreed to 0.65% RMS compared with CORVUS full calculation.

Conclusion:
Real-time manipulation of isodose contours, CDVHs, min/max statistics, and delivery efficiency in IMRT is feasible. Local manipulation has some long-range effects because of coupling.

Conflict of Interest (only if applicable):
The authors are employed at North American Scientific, NOMOS Radiation Oncology Division. The system studied here has become Active Rx in CORVUS 6.0.