AbstractID: 3466 Title: Multicriteria IMRT planning with equivalent uniform dose (EUD) objectives: tumor dose homogeneity vs. critical structure sparing

Purpose: To quantify the tradeoff between target dose homogeneity and critical structure sparing in two typical IMRT situations (prostate, para-spinal). Furthermore, to determine the sensitivity to the response model used for critical structures (maximum vs. mean dose).

Methods and Materials: An EUD-based multicriteria linear programming environment has been developed. In this work, we enforce a tumor minimum dose and compute solutions which efficiently tradeoff the tumor maximum dose and organ-at-risk (OAR) EUD (α·max dose+(1 - α) ·mean dose). Pareto surfaces resulting from different OAR α values are compared. The technique is applied to the RTOG horseshoe target and circular OAR geometry (varying the OAR's size and location), and to two clinical cases.

Results: Mathematically, if the maximum and mean doses of a structure are correlated then the choice of α does not affect the shape of the Pareto frontier. We demonstrate that this correlation is stronger for smaller OARs (a single voxel has a large impact on the mean), and also for symmetrically located OARs, which have a large set of outer ring voxels near the maximum level, as opposed to asymmetrically located OARs where the maximum dose is more localized. As the dose requirements in the tumor get more strict, we see less variance with α, since the feasible solution space is smaller. We consistently see little to no difference between Pareto surfaces for α from 0.5 to 1.

Conclusions: By characterizing the conditions under which the Pareto frontier is insensitive to α, we highlight situations where it may not be necessary to know the best value of α, i.e., the exact tissue organization between purely serial and purely parallel. In general we see smooth Pareto surfaces but in some cases there were kinks pointing to outstanding treatment plans.