AbstractID: 7155 Title: Inverse planning by simulated annealing minimization of dose-volume based objective function

Most approaches to intensity modulation optimization minimize a dose-based cost function by gradient algorithms. The cost function incorporates both dose objectives and dose-volume constraints in terms of dose-based penalties. However, such an approach may produce suboptimal treatment plans for the following two reasons. First, among all voxels that receive doses higher than the prescribed dose levels in the dose-volume constraints, penalties are applied only to those voxels that receive the smallest excess doses. This particular voxel selection may ignore possible optimal dose distribution arising from applying the penalties to other combinations of voxels with excess doses. Second, gradient techniques may get trapped in local minima, which have been proven to exist in cost functions that incorporate dose volume constraints. To avoid these limitations, we propose a new inverse treatment planning approach. First, we formulate a cost function that directly incorporates dose-volume constraints in terms of volumes instead of doses. Second, instead of a gradient method, simulated annealing is applied to the minimization of the volume-based cost function since there is no direct analytical relation between the intensity modulation and irradiated volumes of organs and targets. Furthermore, simulated annealing has the potential for finding the global minimum of such a cost function. The performance of this new approach is tested in prostate cases and compared to that of conventional gradient methods.