

AbstractID: 2028 Title: 4D treatment planning: calculation of voxel doses in the presence of respiratory motion

Temporal anatomic changes can introduce significant errors in imaging, treatment planning and treatment delivery. Ideally, accurate organ motion information is included explicitly in treatment planning on a patient specific basis. If achievable, the impact of motion on dose delivered can be determined and optimization in the presence of motion becomes possible. We have implemented a method to calculate dose to each voxel in the presence of organ motion and deformation. Patient specific respiratory organ motion is assessed by 4D Computed Tomography¹. To calculate dose to each voxel during motion, the dose-to-voxel relation between different respiratory states must be maintained to facilitate precise calculation of individual voxel doses. Therefore each voxel must be tracked between different respiratory states. We have adapted the software toolkit vtkCISG² to calculate non-rigid registrations between different 4DCT datasets. To assess the impact of respiratory motion on dose distributions, a treatment plan is applied to 4DCT volumes at different respiratory phases. All dose distributions are then mapped on one dataset using transformation parameters obtained by non-rigid registration. Dose at the voxel level can then be summed, maintaining the dose-to-voxel-relation; dose volume histograms of moving organs can also be calculated in this reference space. Furthermore, non-rigid image registration of 4DCT data facilitates studying respiratory-induced organ motion in greater detail.

¹Pan et al., Med Phys 31(2), 2004.

²Hartkens et al., BVM2002, Leipzig, Springer-Verlag, 2002.