AbstractID: 1636 Title: 4D Computed Tomography: image formation and clinical protocol

4D Computed Tomography[1,2] provides several spatio-temporal coherent, volumetric datasets of a patient during respiration. Compared to standard CT data acquisition, motion artifacts are significantly reduced or even eliminated. 4DCT data can be incorporated into treatment planning[2], e.g. to design patient-specific target volumes accounting for motion or to calculate dose distributions under organ motion. To use 4DCT data for treatment planning, a data acquisition protocol providing accurate volumes has to be established. Furthermore limitations of the method have to be studied to quantify residual uncertainties. 4DCT image and volume formation was evaluated quantitatively in several phantom studies. Partial projections affect single reconstructed images. The impact of partial projections is minimized by choosing appropriate windowing and level. Volume formation additionally depends on the regularity of the breathing pattern and the temporal sampling, given by the number of reconstructed images per couch position. Based on phantom experiments, a data acquisition protocol has been validated for clinical use. For near-regular motion patterns and a sufficient number of reconstructed images per couch position (~30) typical tumor volumes can be imaged within few percent accuracy. Motion trajectories are imaged within the resolution of the CT data, usually given by the slice thickness. In a pilot study 20 patients were scanned to prove clinical applicability of the data acquisition protocol. 4DCT has been clinically used for treatment planning since October 2003.

[1]Pan et al., Med Phys 31(2), 2004.
[2]Rietzel et al., Int J Radiat Oncol Biol Phys 57(2), 2003.