AbstractID: 13419 Title: Tumor specific reconstruction of motion probability density function from 4DCT

Purpose: The actual delivered dose to a moving tumor can deviate from prescribed dose not only during each fraction, but during each IMRT field. This deviation can be anticipated and incorporated into a treatment plan if the tumor specific motion probability density function (PDF) is accurately identified. In this study, a novel technique in determining the actual, tumor specific PDF of a moving gross tumor volume (GTV) is described and confirmed through phantom experiments using a quantitative approach of 4DCT imaging. **Methods and Materials:** We hypothesize that a PDF of the GTV can be obtained through weighted sums of phase-sorted 4DCT images. Experimental validation is performed using a lung phantom attached to a programmable motion platform. The ground truth motion PDF of the targets was calculated through convolution of the motion pattern and the GTV dimension along the direction of motion. These PDF convolutions are compared to the normalized, reconstructed CT numbers obtained from averaging ten phase sorted 4DCT images after background subtraction. **Results:** The PDF reconstructed from averaged, weighted sets of 4DCT images was almost identical to the ground truth PDF in all comparisons made. Through sums of phase sorted 4DCT images, the resulting CT number represents a relative probability of finding some portion of the GTV in each geometric location (or voxel). In physical phantom reconstructions, the Pearson correlation coefficient between CT-based PDF and the ground truth PDF was greater than .97 in all cases considered. An actual patient PDF was also evaluated in frontal and sagittal planes. **Conclusions:** Combining phase sorted CT images is an effective method in obtaining the actual tumor PDF as seen by an IMRT field. With the patient specific PDF, treatment planning to ensure proper target coverage can be achieved through intra-field modulation, dose rate, and monitoring initial beam-on phase.