

AbstractID: 6468 Title: An algorithm for automated organ motion evaluation based on 4D-CT image analysis

Purpose: To develop a high throughput method for quantitative analysis of organ motion characterization based on 4DCT image reconstruction and identify breathing phases corresponding to the most extreme target motion.

Method and Materials: A novel algorithm was developed that utilizes subtraction of paired images obtained under 4DCT protocol and analyzes the resulting image residuals to characterize the extent of organ motion. The cumulative pixel value (CPV) of the image residual is calculated for all possible combinations of the paired image sets. The maximum CPV is associated with the greatest separation of the target in two image sets, and extreme "breathing" phases are identified. The algorithm was validated on a set of 4DCT images obtained for a dynamic phantom (CIRS, Inc., Norfolk, VA) for different target sizes and motion characteristics. Initial tests on 4 patients with different degrees of motion were conducted.

Results: The extent of target motion was correctly described for all pairs of image sets by calculated CPV values. The phases known to correspond to extremes of motion were correctly identified for the phantom study. Phantom studies using targets of different sizes (1 to 3 cm) and different amplitudes of motion (1 to 2cm) produced similar results. Using patient images, our method correctly predicted the degree of observable motion in a blinded test.

Conclusions: An automated algorithm for target motion evaluation was developed and tested using 4DCT image sets obtained with a dynamic phantom. The algorithm predictions were accurate for a range of target sizes and amplitudes of motions. The method is objective and robust and therefore may be effectively used in the clinic as a quantitative measure of organ motion. Preliminary results of using patient data are very promising.