AbstractID: 8503 Title: A study on the accuracy of MIP for irregular target motion

Purpose: For the treatment of lung cancer, internal target volume (ITV) is frequently determined utilizing Maximum Intensity Projection (MIP) images generated by 4DCT. In order to check the accuracy of MIP for various target motion, especially for targets moving irregularly, we performed phantom studies using programmable dynamic lung phantom.

Methods: House built programmable lung phantom, with cylindrical (2.5cm(D) x 2cm(H)) and cubic (2.5cm(W) x 2.5cm(L) x 1cm(H)) acrylic targets, was utilized to simulate regular and irregular sinusoidal type target motions in superior-inferior direction. Moving targets were scanned with Philips 4DCT with bellow system in helical mode. For each scan we obtained 10 reconstructed phase images and composite MIP images. Scan parameters such as pitch (0.082) and gantry rotation time (0.5 sec/rotation) were chosen as recommended by the vendor in order to minimize motion artifacts. Obtained images were imported into Pinnacle 8.0 treatment planning system for image analysis.

Results: For all regular, periodic target motions with constant ranges (10mm and 15mm, appropriately) and period (4sec), ranges of measured MIP along superior-inferior direction were accurate. For example, the MIP spanned 36-37mm for target motion of 10mm amplitude while the expected value was 35mm. For irregular target motion with various combinations of amplitudes (10mm and 20mm) but with the same period (4sec), the MIP spanned 38-40mm while the expected value was 45mm. The measured range of motion by MIP turned out to systematically underestimate the range of irregular target motion when amplitudes were varying. We associate these discrepancies with the fact that current reconstruction algorithms of commercial 4DCT are based on phase binning.

Conclusions: According to our phantom measurement, MIP reflects the range of target motion accurately for regular target motion while it generally underestimates the range of target motion when the motion is irregular, exhibiting variation in amplitude.