

AbstractID: 7756 Title: Do mobile tumors in the lung deform during normal respiration - an image registration investigation?

**Purpose:** To determine if solid tumors in lung deform by determining the differences in image registration accuracy using rigid and elastic registration.

**Methods and Materials:** Ten patients with lung tumors were retrospectively considered in this work. Patients underwent 4DCT imaging in which ten 3DCT images corresponding to equally spaced phases of the respiration cycles were reconstructed. The CT images were cropped to the neighborhood of the tumor volumes to eliminate the influence of non-tumor tissue on the registration process. The cropped end-inhale tumor images were registered to end-exhale tumor images. Three image registrations were performed: translation only, translation + rotation, and B-spline based elastic. The transformation fields from these registrations were used to map the tumor contours to the reference image. The alignment between the reference and the mapped contours was determined by calculating the overlap index and root mean square (RMS) distance.

**Results:** Prior to image registration, the average overlap index for tumor contours at end-exhale and end-inhale was  $81 \pm 14.5\%$ . After translation-only registration, the overlap index increased to  $93.0 \pm 4.3\%$  ( $p=0.03$ ). Translation + rotation and elastic image registration contributed  $< 3\%$  improvement of the overlap index. Without registration, the RMS distance was  $4.2 \pm 1.9\text{mm}$  on average. This distance reduced by 1.0mm after translation only mapping with a reduced standard deviation of 0.5mm ( $p=0.14$ ). Translation + rotation and elastic image registration reduced the distance further by only 0.1mm respectively. The difference between the overlap index and RMS distance obtained from rigid and elastic registrations was not significant, and they were statistically indistinguishable.

**Conclusions:** Deformation of tumors at different respiration phases was small. On average the overlap index of tumor at different phases was 93% after translation only registration. Translation + rotation and elastic registrations did not contribute much in the improvement of both overlap index and RMS distance.