

#### Purpose:

To investigate the correlation between the respiratory motion of implanted internal markers (IM) and external RPM traces for lung cancer patients in dynamic imaging.

#### Methods:

Under an IRB-approved research protocol, 3 patients with VISICOIL marker (10 mm long) implants near/in their lung tumor were scanned with a daily single-slow gantry rotation arc 4D-CBCT acquisition. The Varian Real-time Position Management system (RPM) was used as an external respiratory motion surrogate, with the marker block placed on the patient abdominal surface near the diaphragm. The IM motion was segmented in all 2D projections with an in-house built Matlab program. The positions in the 3D spatial domain of the markers were extracted to (LR: left-right, CC: cranial-caudal, AP: anterior-posterior).

A Pearson-type auto-correlation function of the RPM AP trace and cross-correlation functions between RPM AP motion and the IM motions in three orthogonal directions was used to analyze the time series.

#### Results:

Our data shows that there is a strong positive correlation between the RPM AP motion and the IM motion in the CC direction. The correlation between the external motion and the IM motions in LR and AP directions varied from fraction to fraction. In addition, phase shift is observed in LR and AP directions.

Different implanted markers in the same patient presented the very similar correlations, especially in the CC direction. This result suggests that multiple implanted markers can be used to provide supplementary information of the tumor motion.

When the patient coughs during their respiratory cycle, internal motion and external motion may become uncorrelated.

#### Conclusions:

The RPM respiratory trace provides a good surrogate of the internal respiratory motion in the CC direction when the patient maintains a normal breathing pattern.

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