

## AbstractID: 4414 Title: Radiographic & fluoroscopic guidance of respiratory sites

Respiratory motion is both intra- and inter-fraction. For lung and liver tumors, the magnitude of inter-fraction motion is often comparable with that of intra-fraction motion. The position of a moving organ during one fraction can be decomposed into the average position and the instant position relative to the average position. Here we introduce a concept called daily home position of a moving organ, which is often the mean position averaged over the treatment fraction. However, it may be a position corresponding to a particular breathing phase. For example, if the treatment is gated at the exhale phase, it makes sense to define the tumor home position as the exhale position.

For lung and liver tumors, image guided setup means the detection of daily tumor home position and the alignment of this position to the reference home position. If tomographic guidance is used to setup lung or liver cancer patients, either using CT on-rail or on board cone beam CT, the accurate daily tumor home position may be generated from a 4D scan, but not a 3D scan without patient breath holding. Daily breath hold 3D scan is not practical because it is difficult for patients with poor pulmonary function. For daily 4D scan, among others, how to reduce the potentially large amount of radiation dose and how to efficiently manage large amount of image data might be two major problems for its application to patient setup. For livers with implanted fiducial markers, it is easy to detect the marker positions, thus the daily tumor home position, either radiographically or fluoroscopically, using a gantry-mounted or a room-mounted x-ray imaging system. For lung patients, we usually do not have any fiducial markers implanted in the lung, due to the concern about the risk of pneumothorax. Radiographic or fluoroscopic detection of lung tumor mass is not a trivial task. For some lung tumors, their projections in the images may be identified using current imaging techniques. For others, more advanced imaging techniques are required and this is still an on-going research topic.

As to image guided delivery, the requirement on the amount of tumor location information is different, depending on the delivery technique. For beam tracking, the instant tumor position should be tracked. For gating, we only need to make sure the tumor home position is maintained within the gating window during the treatment fraction. It is difficult, if not impossible, to have tomographic guided delivery. Fluoroscopic tracking of implanted fiducial markers is relatively easy. However, we still need to pay attention to various practical issues, such as the changes in marker shape in projection images due to marker rotation for none-spherical markers, occlusion by and confusion with bony structure and air bubbles, tracking closely located multiple markers, poor image quality with MV beam interference, etc. Fluoroscopic tracking of lung tumor mass without implanted fiducial markers is challenging. Some promising results have been seen recently. However, a lot more research is needed before those techniques can be clinically useful.