

AbstractID: 5131 Title: Internal-External Correlation Investigations of respiratory induced motion of lung tumors

Purpose: In respiratory-gated treatments, the successful delivery of the planned dose distribution and sparing of the health tissue is highly dependent upon the assumption of a strong correlation between the external motion and the internal tumor motion. We will present a new internal/external correlation study based on a unique data set.

Method and Materials: Radiopaque fiducial markers inside or near the target were implanted and visualized in real time by means of stereoscopic diagnostic x-ray fluoroscopy. The fluoroscopic images were recorded continuously in synchronization with an external respiratory motion monitoring system. A data analysis methodology was developed in order to assess the correlation of the external breathing motion with the internal 3D position of the implanted fiducials. The methodology is based on a dynamic correlation technique and used to extract global correlation parameters as well as to reveal their instantaneous behavior.

Results: We have found that in some cases, the poor internal/external correlation is caused by a time mismatch between the motion of the internal fiducial markers and the external breathing motion. For some cases, there is a sizeable time delay between the internal tumor motion and the external motion of up to 0.8 seconds, revealing that internal-external motion coupling is dependent on the tumor position. We have also found that the time delay itself is time-dependent.

Conclusion: The proposed technique reveals one of the causes for poor internal-external correlation and it could be used to improve the current gated treatment methodology by combining the amplitude gating technique with the measured time-delay. In the course of these investigations, we also found that our technique can reveal difficulties in extracting the underlying time delay (due to its own time dependence) and that one has to be careful of how the time delay is implemented for gating.