AbstractID: 12902 Title: Real-Time MR Tumor Tracking using a linac-MR system

PURPOSE:
To investigate the feasibility of direct (i.e. no surrogates), real-time MR tumor tracking using a linac-MR system.

Method and Materials:
This study is focused primarily on investigating the requirements for lung tumor tracking due to its extreme range of motion. Two MR compatible motion phantoms have been built to simulate tumor motions. Various motion patterns of lung tumors were generated and used to drive our phantoms. Algorithms have been developed to auto-contour and to track tumor motion in real-time from 4D MR phantom images and simulated tumor images. Tumor tracking is achieved by controlling an MLC in real-time. Processing time delays between the completion of MR imaging and the beginning of beam delivery in our tracking system have also been investigated.

Results:
Both phantoms showed successful MR compatibility. The phantoms were scanned with 3T MRI while in motion. The auto-contouring algorithm showed successful tumor contouring capabilities. The algorithm was applied to (1) In-vivo MR images of lung tumor; (2) MR images of healthy lung (coronal, sagittal, transverse) with 10 different tumor shapes inserted; and (3) MR images of motion phantoms. By combining the auto-contouring algorithm with an MLC controlling system, real-time MR tumor tracking was demonstrated in principle. Processing time delays of 50~400 ms were determined for our tracking system.

Conclusion:
A potential real-time MR tumor tracking system was studied. Lung tumor motions were simulated using two in-house built motion phantoms with various tumor motion patterns. Our auto-contouring algorithm was integrated within a MLC controlling system, and its real-time tracking capability and processing time delays was evaluated. We have demonstrated the feasibility of (1) real-time tumor auto-contouring; (2) real-time beam conformity to the Beam's Eye view shape of the tumor using 4D MR imaging.