

AbstractID: 8187 Title: Real-Time Tracking of Implanted Fiducial Markers using Combined kV and MV Imaging

## **PURPOSE**

In the presence of organ motion, geometric target uncertainty can hamper the benefits of highly conformal dose techniques such as IMRT. A critical step in dealing with intra-fraction tumor motion is the real-time monitoring of the tumor position. The aim of this study is the first time demonstration of a real-time 3D internal fiducial tracking system based on onboard kV diagnostic imaging together with a MV electronic portal-imaging device (EPID).

## **METHODS**

A Varian Trilogy radiotherapy system equipped with both kV and MV imaging systems was used in this work. A hardware frame grabber was used to capture both kV and MV video streams simultaneously at 30 fps. An in house built support vector machine (SVM) classifier tool using prior CT based knowledge was used to locate gold cylindrical markers in the kV/MV frames. Controlled kV beam switching, synced with the 'step' part of a step-and-shoot IMRT delivery, was investigated in allowing continuous 3D tracking in the presence of beam interruption. A correlation/prediction algorithm was used to buffer lost geometric marker information during kV/MV synchronization. The geometric tracking capabilities of the system were evaluated using a pelvic phantom with embedded fiducials placed on a 3D moveable stage.

## **RESULTS**

The maximum 3D tracking speed of the kV-MV system is approximately 9 Hz. The geometric accuracy of the system is found to be on the order of less than 1 mm in all three spatial dimensions. Synchronized kV/MV switching is found to reduce MV scatter interference on kV imaging and to reduce the overall kV diagnostic dose needed for continuous tracking.

## **CONCLUSIONS**

A real-time 3D fiducial tracking system using combined kV and MV imaging has been successfully demonstrated for the first time. The technique is especially suitable for RT systems already equipped with on board kV and EPID imaging devices.