AbstractID: 8885 Title: Use of Synchronized Beam Switching for Real-Time 3D kV-MV Internal Marker Tracking with Step-and-Shoot IMRT

PURPOSE
Combined kV-MV imagining can provide real-time 3D tumor position information during the actual radiotherapy delivery. Since the treatment delivery beam is used for tracking, only one kV x-ray source is required for full 3D localization, offering total diagnostic dose reduction and cost savings in comparison to other stereoscopic based methods. Currently, kV-MV tracking requires simultaneous imagining by both kV and MV imaging systems for real-time 3D marker positioning. However, with step-and-shoot IMRT, treatment beam interruption can result in loss of geometric information, preventing accurate 3D localization. This work uses controlled kV beam switching, together with a correlation algorithm, to maintain continuous real-time 3D internal marker tracking with step-and-shoot IMRT.

METHODS
A Varian Trilogy, equipped with both kV and MV imaging systems, was used to deliver step-and-shoot IMRT prostate plans to a pelvic phantom containing embedded gold cylindrical markers. A correlation algorithm, designed to interconnect detected fiducial locations between the kV and MV imagers, was used for spatial estimation. Actual 3D prostate motion data artificially segmented with kV and MV beam interruptions typical to a step-and-shoot IMRT plan was tested with the technique.

RESULTS
Application of the correlation function to prostate motion data containing artificially placed beam interruptions results in a tracking accuracy of less than < 2 mm RMS in comparison to the actual motion. For kV source-to-detector distances < 70 cm MV scatter interference on kV images is significantly reduced with synchronized kV/MV beam switching.

CONCLUSIONS
In the presence of beam interruption, correlation can be used to compensate for missing spatial information allowing for full real-time 3D kV-MV tracking with step-and-shoot IMRT. Additionally, controlled kV beam switching is effective in increasing kV image quality by reducing MV scatter interference.