Abstract ID: 16473 Title: Preventing Errors in Radiotherapy: a Real-Time System Using in vivo EPID Dosimetry

Purpose: In vivo dosimetry using an electronic portal imaging device (EPID) may provide a uniquely effective means for preventing errors and may allow for real-time beam interlocks. We present graphical processor (GPU)-based fast EPID dose computation and simulate the sensitivity for detecting errors caused by patient mispositioning.

Methods: We implemented an enhanced superposition convolution algorithm to compute the EPID dose. The patient was simulated using a digital cylinder phantom (15cm length and 15cm diameter) with air and bone structure built in. Setup parameters are: SAD 100cm, 12x12-cm2 open field, 1.5x1.5x1.5-mm3 dose grid, 6-MV photon and isocenter at the center of cylinder. 2D dose images were obtained at 1.6-cm depth of a water slab positioned 60-cm below the isocenter to simulate the EPID readout. To examine errors caused by mispositioning, we shifted the phantom left-and-right and up-and-down and compared dose profiles to those with no shifts. Gamma value of each pixel was calculated as an index to identify dose mismatch. Dose failure was determined as gamma > 1 using 3-mm distance-to-agreement and 3% dose difference criteria.

Results: Dose failures occur mainly in air-tissue and bone-tissue interfaces and in regions with rapid thickness change. Gamma is sensitive to the left-and-right shift, with a 3-mm shift causing dose failure in ~10% pixels; but is much less sensitive to the up-and-down shift, with dose failure detected only after a shift of several centimeters. Analysis with patient CT data sets is underway and will be presented.

Conclusions: In vivo EPID dosimetry enabled by GPU-based dose computation offers the potential for real-time beam interlocks. Future directions include simulation of other error scenarios, optimization of dose computation, improved EPID modeling and comparison with measured EPID profiles.