AbstractID: 4361 Title: In-vivo dosimetry using electronic portal imaging and Monte Carlo techniques

Purpose: The purpose of this work is to develop and validate an algorithm based on Monte Carlo (MC) simulations to compute the in-vivo dose given to patients during conventional treatments and IMRT from portal images.

Method and Materials: The exit fluence from primary particles is obtained from the portal image after correction for scatter radiation. The scattered radiation at the portal imager and the spectral energy distribution of the primary particles are estimated from MC simulations at the treatment planning stage. The exit fluence and the spectral energy distribution of the primary particles are then used to ray-trace the particles from the portal imager towards the source through the CT geometry of the patient. Particle weights reflecting the probability of a particle being transmitted are computed during this step. A dedicated MC code is finally used to transport back these particles from the source through the CT geometry of the patient to obtain an in-vivo dose. Only Compton interactions are considered and secondary electron transport is implemented by depositing the dose uniformly on the surface of a sphere of radius corresponding to the electron projected range. This code also produces a predicted portal image which is used as a verification tool to ensure that the dose reconstruction is reliable. The dose reconstruction algorithm was compared against MC treatment planning (MCTP) predictions and against measurements.

Results: The reconstructed doses and the MCTP predictions in homogeneous and heterogeneous phantoms agree within 1% for simple open fields except in the buildup region and in the penumbra where the agreement is within 9%. Comparison with film-measured dose distribution for IMRT fields yielded agreement within 3 mm, 3 %.

Conclusion: A novel dose reconstruction algorithm based on MC simulations has been developed and validated in homogeneous and heterogeneous phantoms for conventional and IMRT fields.