AbstractID: 6941 Title: 3D CT image-based treatment planning of modulated electron radiotherapy for breast cancer

Purpose: To investigate optimizing 3D CT image-based treatment plans for energy- and intensity-modulated electron radiotherapy (MERT) using an in-house developed Monte Carlo based inverse treatment planning system.

Method and Materials: With the availability of an electron multileaf collimator (eMLC) that can be attached to a clinical accelerator, Varian Clinac 2100EX, a Monte Carlo based inverse treatment planning system is being developed, aiming at the clinic implementation of MERT. The planning procedure includes: 1. Calculating patient-specific dose deposition coefficients (DDCs) for beamlets of selected energies by Monte Carlo simulation, 2. Optimizing beamlet weights (first optimization) and generating the intensity (beamlet weight) map and step-and-shoot leaf sequences (segments), 3. Calculating DDCs of those segments with scatter and transmission from eMLC, 4. Optimizing segment weights (second optimization), 5. Resetting weights in leaf sequences for each segment and calculating final dose. To investigate treatment planning in clinic scenarios for breast treatments, MERT plans were generated for a breast phantom, which mimics the geometry and densities of the breast cancer patient and for breast cancer patient previously treated with IMRT.

Results: The results of MERT plan based on the breast phantom show that the differences in dose volume histograms (DVH) for the plans before and after the second optimization is significant due to eMLC scattering. The second optimization reduces the effect due to eMLC scatter and transmission, leading to an optimal, deliverable plan. For the patient case, dose distributions and DVHs of the MERT plan were compared with the photon IMRT and show significant advantages for sparing the organs at risk (OARs).

Conclusions: Our Monte Carlo based inverse planning procedure with two-time optimizations is capable of generating optimal and deliverable MERT plans using realistic 3D phantom/patient geometries, demonstrating the potential of MERT as an alternative treatment modality for shallow tumor treatments.