AbstractID: 6550 Title: Monte Carlo-based treatment planning for modulated electron beam radiation therapy

A Monte Carlo-based treatment planning system for modulated electron radiation therapy (MERT) is presented. This new treatment modality utilizes an electron MLC to deliver non-uniform intensity maps at several electron energies, thus allowing conformal treatment of shallow targets. For the inverse planning process, electrons beamlets are collimated by a 'virtual aperture' and transported with in-air scattering into the phantom. Optimized intensity maps are then generated by a gradient search optimization. Step-and-shoot leaf sequences are generated for these maps and dose distributions recalculated using Monte Carlo simulations. These simulations included leaf effects such as scatter, leakage and bremsstrahlung production. The weights for individual segments of the leaf sequence are reoptimized based on these new simulations, thus correcting for leaf effects. This gives the final optimized plan, which agrees well with the beamlet plan, despite the non-idealities introduced by the leaves. If leaf effects are ignored, the delivered target and critical structure doses are shown to differ from the planned dose by more than 5%. A leaf leakage approximation is presented and shown to be accurate within 1% and reduce simulation time by a factor of 8 for small static fields. The planning scheme is used to generate plans for a water phantom and intact breasts. For the right breast, the maximum lung dose was 13 Gy, a 70% reduction compared to tangential photon beams. For the left breast, the maximum lung dose was reduced by more than 40% and the maximum heart dose reduced by 80% compared to photon beams.