AbstractID: 6832 Title: A software approach to speed up collapsed cone convolution superposition dose calculation on multi-processor personal computers

Purpose: A new software technique for speeding up dose calculation for photon beams on high end personal computers is presented.

Method and Materials: The software exploits inherent parallelism in the dose calculation process using multi-threading, thus providing a reduction in computation time that is proportional to the number of processor cores. In order to multi-thread the TERMA calculation, a thread-safe function calculates the TERMA contribution from a single beamlet. Multiple threads, typically matching the number of processor cores are started and run in loops, calculating the TERMA contribution for any un-calculated beamlet. The collapsed cone convolution/superposition algorithm then works in a similar manner, with the thread function calculating the dose contribution from a single cone direction. The threads are run in loops until all directions for all beams have been computed. For both cases, the results are accumulated on a per-beam basis. The summing is done in the thread functions and a lock is required to synchronize access to the per-beam result arrays. The thread granularity is such that lock contention is not an issue and the observed speedup when increasing the number of threads with processor cores is near optimal. The recursive feature of deposition point of view dose computation is exploited to further speed up the computation process.

Results: A full dose calculation of a seven beam head and neck case with a voxel size of 3mm x 3mm x 3mm was computed in 35 seconds on a dual-core, dual-processor computer. A four field breast plan took 91 seconds to compute. No compromise in dose calculation accuracy was observed.

Conclusion: Multithreading significantly reduces the dose computation time for convolution/superposition dose calculation. Dose calculation for very large patient geometries can be performed in three minutes. With the advent of four-core processors, real-time dose calculation on PC's is a possibility.