AbstractID: 9108 Title: A method for fast 3-D IMRT dose calculations: the quadrant infinite beam (QIB) algorithm

Rapid dose calculations are needed for IMRT treatment planning research. The Monte Carlo method, though highly accurate, is also relatively slow, especially if many hundreds of beamlet dose distributions need to be computed and stored. As an adjunct to Monte Carlo calculations, we have developed a fast method of 3-D dose calculation based on Ahnesjo's approximation of kernel dose deposition patterns. Anhesjo found that the dose from an infinitesimal pencil beam could be accurately described in a homogeneous medium according to: dose(r) = A exp(-a r)/r + B exp(-b r)/r, where r is the perpendicular distance from the pencil beam, and A, a, B, and b are empirically determined coefficients which vary as a function of radiological depth. The dose from a beamlet is modeled as an integral of this kernel over the beamlet cross-section at a given radiological depth. The dose at a point is modeled as a sum of four spatially-shifted contributions from a 'quadrant infinite beam' (QIB), which is the contribution from the term exp(-r)/r filling a quadrant of the infinite plane. Hence, the dose calculation itself (apart from radiological ray-tracing) requires only four table lookups and several scaling arithmetic operations. The QIB technique has been implemented in our treatment planning research tool, CERR. It provides a rapid method for users to generate influence matrices (dose in each voxel due to each beamlet) which are useful for IMRT treatment planning research.

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