

AbstractID: 13301 Title: Implementation of a Near Real-Time Dose Calculation Engine for IMRT

Introduction – IMRT field dose calculation is traditionally implemented through pencil beam convolution algorithm in various treatment planning systems. For quality assurance purpose, an independent patient specific IMRT dose calculation scheme is in need. Such calculation should be performed within a short timeframe in order to be clinically implementable. We develop a dose calculation engine that serves such purpose.

Method – Once the treatment planning system finishes the dose optimization and calculation, the patient CT data and the treatment planning data are exported in DICOM format. Our calculation reads in the patient geometry and each IMRT beam/field setup including the MLC fractionated intensity map. The primary dose for each beam is calculated through patient attenuation function, output ratio considering the MLC setup, primary off-axis ratio and IMRT field intensity profile. A fast ray tracing algorithm is applied in calculating attenuation function in the primary dose. It traces the voxel density along the photon beam ray. The voxel densities are derived from patient CT numbers. The primary dose is then used to calculate the scatter dose by convolving a kernel with primary kerma. This convolution is calculated using a Fast Fourier Transform algorithm. The total dose for each beam is the sum of primary and scatter dose and repeated for each beam setup.

Results – This IMRT dose calculation is performed within seconds from an IMRT plan. The resultant dose is comparable with the output from treatment planning system.

Summary – We implemented a new IMRT dose calculation engine which is able to calculate the dose for a patient with IMRT fields. This engine takes into account of patient inhomogeneity through a precise fast ray tracing algorithm. A fast FFT convolution algorithm is used to obtain scatter dose. The calculation is performed with fast speed which allows potential real-time clinical applications.