A leaf sequence QA tool for IMRT beam delivery

We have developed a tool to calculate leaf leakage and tongue and groove effect for beam delivery verification in intensity modulated radiotherapy (IMRT) using multileaf collimator (MLC). A ray tracing method was used to derive the fluence transmission map of an MLC field. The intercept length of a ray is the sum of the lengths intercepted by the leaves in the ray path. The intercept lengths were pre-calculated for a set of fixed leaf positions using a dual extended source model for a Varian Clinac 2100C accelerator. For an arbitrary leaf position, the intercept lengths can be obtained using the data for the nearest pre-calculated position. For photons with incident directions deviated from a ray line within small angles (< 0.2°), the intercept lengths follow a translational transformation. Therefore we could speed up the calculation by convolving a point source fluence map with an extended source representing photons from the target. The calculated fluence maps were used for inverse planning monitor unit calculation and for Monte Carlo IMRT dose verification as a simplified beam modifier. Comparisons of the fluence maps with measurements using film and a beam imaging system (BIS) showed excellent agreement. The calculated fluence map for multi-segment MLC field was used as a reference image to compare with the measured image from the BIS. The difference between the two images and the correlation coefficient for each field segment were evaluated quantitatively for IMRT leaf sequence QA.