The need for Monte Carlo or convolution/superposition as the routine photon dose calculation engine for radiotherapy planning systems has been a subject of discussion at recent conferences. Monte Carlo is generally easier to use to model the incoming phase space, and transports particles microscopically, however suffers from statistical noise. Convolution codes modify energy deposition kernels macroscopically, which is known to give errors near density interfaces. However, convolution essentially is noise-free, and is computationally faster than Monte Carlo. The aim of this research was to determine the magnitude and significance of any differences exist between the two methods for both conventional and inverse planned dose calculations.

Both methods are used to calculate dose distributions in (i) a geometric phantom set-up, (ii) a 2-field CT-based lung treatment, and (iii) an inverse planned intensity modulated CT-based lung treatment.

The Monte Carlo code used was EGS4, and the convolution code calculated dose in 3D, and calculated the primary and scattered dose separately. Both methods used the same photon spectra and beam model. For the inverse planned examples the initial bixel weights were the same. Simulated annealing was used to obtain the optimum distribution in each case.

Differences of 3% (6 MV) and 6% (18 MV) were observed in the 2-field set up. Differences were also found in the beam intensity profiles and dose distribution for the intensity modulated plans. The clinical significance of the difference in dose calculated by the two methods is uncertain, and needs to be biologically assessed.