AbstractID: 13542 Title: The implementation of auto-optimization method to determine photon energy spectrums and dose profiles with various field sizes for collapsed cone convolution algorithm.

Purpose: As a part of developing treatment planning system, auto-optimization method was designed to determine photon energy spectrum and the shape of dose profile with various field sizes.

Method and Materials: The initial distribution of energy spectrum was designed using approximate formulation. Multi-spectrum kernels were constructed with the determine photon energy fluence using published mono-energy kernel, and collapse cone convolution algorithm was implemented to calculate PDDs and dose profiles by considering the effects of beam hardening with depth, kernel tilting, beam softening with off axis distance, off axis ratio, and finite beam source size. Objective function was defined with the sums of differences between measured PDD or dose profiles and calculated PDD or dose profiles. Auto-optimization method based on steepest decent method was used to minimize objective function by calculating gradient values at each iteration.

Results: Determined energy spectrums were not similar to rear photon spectrums, but calculated PDDs showed good agreements with measured data. The dose error beyond build-up depth was less than 2 % at any depth. Some under-estimated results (>5%) were showed at the build- up regions (<2cm depth) at large field (>30 x30 cm^2) because not considering electron contamination. Calculated dose profiles were also well agreed with measured dose profiles (<3% errors) up to 10x10 cm^2, but some discrepancies at penumbra region were appeared at large field.

Conclusion: Determined energy spectrums of photon beam with various field sizes were useful to simulate the variation of PDDs. Multi-spectrum model with field sizes based on auto-optimization was good approximated method to simulate measured dose distribution, and it seemed to compensate the limitation of classical convolution/superposition algorithm using finite radius of kernel.