Scatter-integration for Monitor-Unit Calculation with Nonuniform Fields.

Simple programs for calculation of dose per monitor unit (MU) for high-energy x-rays often use the equivalent-square concept. This is not valid when the incident fluence is non-uniform, e.g. for wedged beams. To calculate MU correctly, one has to perform the scatter-integration with proper weights to account for the primary fluence distribution. In our PC-based MU-calculation program, the scatter for a 2-D non-uniform field is calculated as a sum of two terms: $SF = SF_0 + \Delta SF$, where

$$\Delta SF(x, y, d) = \int_x \int_y \left(\frac{OAR(x', y')}{OAR(x, y)} - 1\right) \cdot \frac{ad^2}{(w \cdot r + d)^2 \cdot 2\pi r} dx'dy',$$

with $r = \sqrt{(x - x')^2 + (y - y')^2}$ and *OAR* off-axis ratio. The scatter factor SF_0 is calculated as a Clarkson integral of the expression: $SF(r) = 1 + ard/(wr+d)$, valid when primary fluence is uniform. The parameters *a* and *w* characterize the phantom scatter properties and can be determined from measured *PDD*. We compared measured *OAR* to values calculated at depth with and without the correction ΔSF. The discrepancies increase with increasing depth and are about 3% and 6% at depth of 20 cm with and without ΔSF, respectively. We conclude that ΔSF improves the accuracy of dose calculation. The remaining difference is tentatively attributed to beam softening off axis. ΔSF is calculated on an Intel Pentium 200MHz PC for 0.5-cm grid size in less than a second. We also studied the gradient-induced *TPR* change on the central axis for wedge beams and found it to be less than 1% for depth up to 40 cm. This change decreases with increasing photon energy.