AbstractID: 13015 Title: Enhanced accuracy of IMRT photon fluence profile surveillance: iterative resolution correction of the DAVID chamber

Purpose: The DAVID system (PTW-Freiburg, Germany) is a multiwire ionization chamber placed in the accessory holder, capable of continuously monitoring treatment delivery. The system supplements the pre-treatment dosimetric plan verification for advanced radiotherapy techniques such as IMRT and rotational therapy. Each detection wire signal is associated to the opening width of the MLC leaf pair it is surveying. The blurring of the lateral transport of secondary electrons within the chamber is corrected by an iterative deconvolution algorithm hence achieving enhanced error detection efficiency.

Method and Materials: The measured signal profile $S(x)$ is regarded as the result of a convolution of the true photon fluence profile $P(x)$ with the lateral response function $f_\xi(x)$ (ξ = sequential number of a wire). The $f_\xi(x)$ was measured for each detection wire by opening only the MLC leaf pair it is associated with. The iterative algorithm consists in a sequence of approximations for $P_n(x)$ which quickly converges towards the desired true $P(x)$. Each $P_n(x)$ is numerically convolved with $f_\xi(x)$ and from the comparison of the result with $S(x)$, the next approximation $P_{n+1}(x)$ is derived.

Results: The fine structure of the fluence profile is restored through the deconvolution. The lateral resolution of the DAVID system has been improved and error detection efficiency of the DAVID system can be enhanced by a factor of 2. The deconvolution of each IMRT segment can be performed in less than 1 sec.

Conclusion: The developed iterative deconvolution method is capable of correcting for the blurring of the DAVID chamber signal profiles due to the lateral transport of scattered electrons within the chamber. The short computational time needed makes the algorithm feasible to be implemented in the daily routine to gain an increased specificity in IMRT photon fluence profile surveillance.