AbstractID: 6920 Title: A robust method for megavoltage X-ray spectra reconstruction using attenuation measurements

Purpose: To propose a novel reconstruction algorithm which is accurate even for transmitted data affected by the usual experimental error, and therefore can be used in a typical clinical environment.

Method and Materials: Ionization chamber and radiologic films.

Results: Because the attenuation coefficients in various materials depend, in general, on the wavelength of the incident radiation, it was suggested long ago (Silberstein 1932) that attenuation measurements at various depths could be used for determination of the spectral distribution of the X-ray sources. While mathematically straightforward, the inverse problem is strongly ill-conditioned and many efforts have been since devoted to circumvent the inherent difficulties of the spectra reconstruction. The numerical instabilities of the inversion techniques are usually extremely large when the transmission measurements are affected by experimental error, of magnitude typical for a clinical environment (e.g., of the order of a few percents). For example, a solution based on Singular Value Decomposition (the Moore-Penrose Inverse) is reasonable accurate (within 5%) if computer simulated transmission data are used; however the estimated spectra are wrong by orders of magnitude when 1% random Gaussian noise are affecting the transmission data. It is shown in what follows that a novel reconstruction method, based on a Simulated Annealing algorithm, coupled with a special requirement for the continuity of the reconstructed function, generates excellent results even when relatively large levels of noise are affecting the transmission data.

Conclusion: The robustness and the simplicity of the method make it an ideal candidate to accurately estimate the X-ray spectra of the therapeutic sources in a clinical environment, using ionization chamber and radiologic films for attenuation measurements.

Conflict of Interest: NONE