Abstract ID: 16426 Title: Iterative Deconvolution of Dose Profile Measurements with Ionization Chambers Based On Lorentz-Type Lateral Response Functions of the Detectors

Purpose:
In this work it is shown that the volume effect of ionization chamber can be corrected by the application of a van-Cittert iterative deconvolution algorithm.

Methods:
Due to their volume effect the reading of an ionisation chamber s(x) can be considered as a convolution of the true dose distribution d(x) with the lateral response function r(x) of the detector. A prominent effect of this convolution is the broadening of profile measurements in the penumbra region. For the analysis a Lorentz-type response function a bell shaped function with wide tails and free parameter l is assumed. Representations of the “true” dose distribution are measured with a diode detector (detector with minimal spatial spread of r(x)). The free parameter for the response function l is found by systematical variation and subsequent application of an iterative deconvolution algorithm. The iterative procedure consists of a sequence of approximations for n(x) which quickly converges towards the desired true d(x). Each n(x) is numerically convolved with r(x) and from the comparison of the result with s(x), the next approximation n+1(x) is derived. The best estimate for r(x) is found for the l resulting in the best approximation of d(x).

Results:
For cylindrical ionisation chambers with different radii and volume effect the lateral response functions for 6 and 15 MV photon radiation and a variety of field sizes have been analyzed. It is shown that the penumbra broadening can be revoked with a sufficient accuracy.

Conclusions:
By an iterative deconvolution algorithm with a pre-defined Lorentz-shaped lateral response function can calculate an approximation of the true dose distribution from ionization chamber measurements. The resulting corrected dose profiles may act as the input for base data determination for treatment planning systems and may thus improve the accuracy of calculated dose distributions.