AbstractID: 7292 Title: A convolution method to evaluate setup uncertainties in external radiotherapy

Purpose: We are going to evaluate the setup uncertainty in external radiotherapy using a convolution method, comparing the processed dose matrix with the original one. Confidence intervals in dose volume histograms and dose to points can be made and visualized.

Method and Materials: The dose matrix calculated with Philips Pinnacle (v. 7.4f) treatment planning system is exported in binary format. Using OREX CR portal image system the setup uncertainty of different localizations has been determined and approximated by Gaussian probability distributions N(0,σ). These distributions are used as a convolution kernel. $D_c(r) = D_p(r) \otimes N(r) = \iiint D_p(r')N(r'-r)dV$ .The convolution of this kernel and the dose matrix estimates the setup uncertainty. We also calculate the standard deviation , $\sigma^2_{D_C}(r) = D_p^2(r) \otimes N(r) - (D_p(r) \otimes N(r))^2$, and applying the central limit theorem, we can establish 95% confidence intervals on dose to points and dose volume histograms. The new calculated dose matrix, $D_{+2\sigma}$, $D_{-2\sigma}$, and $|2\sigma|/D_C$ are introduced in the treatment planning system for comparison purposes. The process of convolution and auxiliary calculations is performed with a home made Fortran program that can be executed directly by the treatment planning system using a script.

Results: We applied this method to several localizations. The approximation of setup uncertainties to Gaussian distribution must be assessed previously, in other case the user must use a different convolution kernel. The convolution method fails near the surface because the differences between calculated doses and setup doses are not valid, but bearing in mind this, the method shows an useful estimation of the uncertainty.

Conclusion: With this method the estimation of the setup uncertainty, with real site data, can be evaluated directly in the treatment planning system. The margins to organ at risks and PTVs could be evaluated, and confidence intervals in dose volume histogram could be established. The comparison of the uncertainty between treatment plans could support a clinical choice.