Independent monitor unit calculation method for IMRT treatments

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Introduction

IMRT QA is still an issue for medical physicists. Independent calculation cannot be performed, because of the lack of information concerning the weighting of the beamlets. Therefore, IMRT QA is usually performed by comparison of the calculated dose distribution with measurements in a cubic water phantom. This operation is time-consuming and requires access to the linear accelerator. In this work, a method for monitor unit calculation using Monte Carlo calculations and a Non-Negative Least Square Fit algorithm (NNLS) in the actual patient geometry is presented.

Material and Methods

Considering an IMRT treatment composed of N beamlets. The dose $D(x,y,z)$ at a point (x,y,z) can be written as a linear combination of monitor units. Knowing the dose in M points in the patient, the following linear matrix equation can be built

$$D \cdot um = d$$

Where D is a M x N matrix (M > N). D_{ij} are the dose per monitor unit from beamlet j at the point i provided by Monte Carlo simulations, um is a vector containing the monitor units of the whole treatment and d is a vector containing the dose in every point i provided by the TPS DICOM dose file. In fact, this dose distribution is the one accepted by the radiation oncologist and is somehow a part of the prescription. This equation can be inverted by a Non-Negative Least Square Fit algorithm (NNLS) in order to recalculate the treatment monitor units. This independent calculation method was tested on 2 pelvic IMRT treatments in order check its validity. The first case is a prostate IMRT (simple PTV, weakly modulated beams) and the second case is a gynaecologic IMRT (complex PTV, strongly modulated beams).

Results

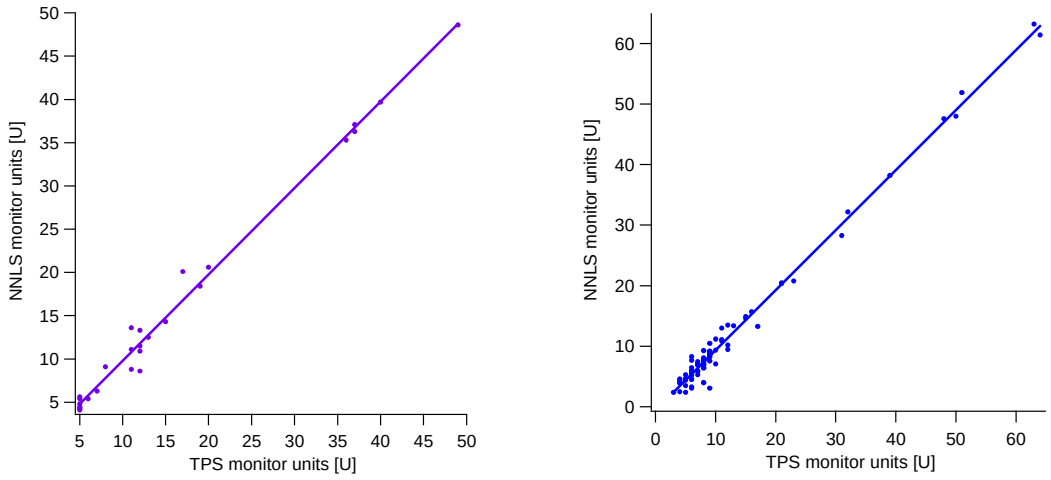

Figure 1 NNLS monitor units versus TPS monitor units for a prostate IMRT (left) and a gynaecologic IMRT (right). The straight line are linear fits.

Discussion and conclusion

A new independent calculation method for IMRT treatment verification is presented. A good correlation can be observed in pelvis clinical cases. However, The geometry in this anatomical region is quite simple. Monitor units provided by this independent calculation method in a complex area as head & neck are not so well correlated. Research still needs to be done to improve those results.