Chapter 7
Bayesian Reconstruction of Axial Dose Maps Using the Measurements of a Novel Detection System for Verification of Advanced Radiotherapy Treatments

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Abstract In this work, a reconstruction algorithm is used to obtain axial dose map distributions for the verification of advanced photon radiotherapy treatments. The experimental data is obtained with a detection system designed, developed and constructed specifically for this purpose. This system is basically composed by two perpendicular single sided silicon strip detectors (SSSSD) placed inside a rotating polyethylene phantom. Measured data consist on mean absorbed dose in each strip at different angular positions. Dividing the dose map into pixels, statistical bayesian methods can be applied in order to estimate pixel data from measured one. These methods are applied to a hypothetical treatment plan and the results converge to a solution of a dose map distribution that agrees with treatment planning system (TPS) calculation.

7.1 Introduction

The new features of modern photon radiotherapy treatments force the treatment planning system (TPS) calculations to be far from reference conditions. Then, calculated dose map distribution may differ from the real one [1]. These treatments generally include dose escalation in the vicinity of critical organs that should be spared, so it is understood the importance of dose calculation accuracy. Thus, additional test are required to verify this.

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J.-E. García-Ramos et al. (eds.), *Basic Concepts in Nuclear Physics: Theory, Experiments and Applications*, Springer Proceedings in Physics 225,
https://doi.org/10.1007/978-3-030-22204-8_7

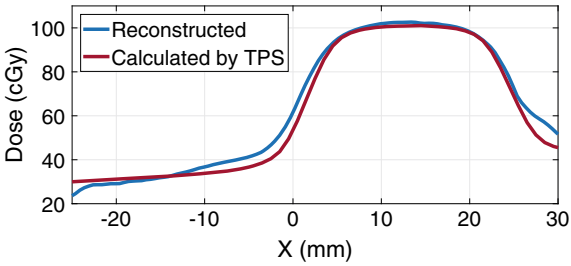

Fig. 7.1 Dose profile of 2D treatment reconstructed map and comparison with the TPS calculation

7.2 Material and method

The system [2] consists of a rotating cylindrical polyethylene phantom that houses the dual single-sided silicon strip detector (DSSSSD), that is two singled-sided silicon strip detectors positioned so that the strips of each one are perpendicular to the other. The active area of the DSSSSD is placed centred in an axial plane of the phantom, parallel in general to the beam incidence direction. Each strip works as an independent detector that is previously calibrated in dose to water. The experimental data set contains statistical uncertainties, that are taken into account by means of using reconstruction methods based on statistical estimation techniques. The issue consists on obtaining the mean absorbed dose in a grid of pixels, treating them like parameters included in the probability density function of the experimental data. Bayesian methods, as *maximum a posteriori*, provide an iterative solution in which prior information can be added to improve the results.

7.3 Results

The proposed method is applied to a theoretical treatment plan that consists of three fields pointing to a position outside the cylinder center. Reconstructed dose map of treatments show a good agreement with TPS calculated ones (Fig. 7.1).

References

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