2D dose reconstruction using EPID images for the *in-vivo* domestry in heterogeneous medium.

F.Younan [1 2], J.Mazurier [2], D.Franck [2], J.Camilleri [1 2], X.Franceries [1 3 4]

Introduction

In order to measure the 2D dose *in-vivo* from EPID images made on patients, an algorithm that takes into account the heterogeneity has been developed using Matlab™ v.R2015b.

Materials and Methods

The realized algorithm allowed to perform the calculations from the aS-500/2 imager of the clinac 23 iX (Varian) for a 6MV beam with a dose rate of 300UM.min^{-1}.
To overcome the lack of uniformity of the detector response and to consider the influence of the backscattered from the robotic arm, a pretreatment was applied to the images. Then the grey levels of the pixels were converted into an absorbed dose to water using correction kernels.
Afterward this dose was backprojected in the isocenter plan by applying the inverse square distances law and by taking into account the attenuation of the beams in the medium.

To calculate the attenuation factor in each pixel, an additional Matlab module has been developed.

First, a Delaunay triangulation was performed to obtain the coordinates points of the entrance and exit on the surface of the patient.

Then, the actual distances traveled by each beam in the volume has been determined using a ray-tracing algorithm adapted from the Möller and Trumbore research work. These distances were then converted into water equivalent distances using the Bresenham method.

In order to optimize the time calculation, an intermediate step which allowed to segment the patient into boxes was performed.

Our algorithm was evaluated on the CIRS thorax phantom and on 20 IMRT beams from different plans optimized for prostate and head & neck treatment.

The dose estimated from the EPID was compared to the TPS dose calculation with a γ-index evaluation : 3%-3mm in the phantom and 5%-3mm in patients.

Results

Our optimization method improved the execution time from 30 min to 26 sec. On another hand, compared to the algorithm developed in homogeneous medium, this method improved the results in a heterogeneous medium from 80% to 95% of points having a γ-index>1 with the 5%-3mm criteria.

1. *INSERM, neuroimageire clinique et cognitive, unité de recherche Inserm 1214, Toulouse, France*
2. *Service de radiothérapie, groupe Oncorad-Garonne, Clinique Pasteur, l'Atrium, 1, rue de la petite-vitesse, 31000 Toulouse, France*
3. *Université de Toulouse, UPS, INPT, LAPLACE Laboratoire Plasma et Conversion d'Energie, 118 route de Narbonne, F-31062 Toulouse Cedex 9, France*
4. *Centre de Recherches en Cancérologie de Toulouse (CRCT), 2 avenue Hubert Curien-Oncopole de Toulouse-CS 53717, 31037 Toulouse Cedex 1, France*

Conclusion

The developed dose calculation algorithm can be used to accurately reconstruct in 2D the dose delivered to the patient during treatment with IMRT from EPID images.