

IMAGE REGISTRATION – PRECISE QUALITY ASSESSMENT OF RADIOTHERAPY WITHOUT NECESSITY OF SHOWING CORRESPONDING POINTS IN SIMULATION AND PORTAL IMAGES*

Piotr Gut¹, Leszek Chmielewski¹, Paweł F. Kukołowicz², Andrzej Dąbrowski²

*⁽¹⁾Institute of Fundamental Technological Research, PAS
Świętokrzyska 21, 00-049 Warsaw, Poland www.ippt.gov.pl
⁽²⁾Medical Physics Department, Holycross Cancer Centre, Kielce, Poland
Artwińskiego 3, 25-734 Kielce, Poland www.onkol.kielce.pl*

Purpose: Enabling the quality assessment of radiotherapy to be made in daily practice, using the new software tool to analyze the simulation and portal images.

Motivation: The process of comparison of the realized geometry recorded in portal images and the planned geometry recorded in a simulation image is tedious due to the inevitably lower quality of the portal image and the presence of various geometrical distortions between the images, besides the differences which should be measured. Therefore, the assessment of the quality of radiotherapy is usually performed only selectively, rather than for all the therapeutical sessions. In the majority of the existing software tools supporting such an assessment, either manual registration of the images is used, or the corresponding points of the images must be known, and these not always can be found automatically. In the papers on the registration of the portal and simulation images usually some special features of the shapes of the irradiation fields are made, like the rectilinearity of the edges or the existence of fragments of the similar curvature between the registered images.

Method: In the registration of the anatomical structures as well as the irradiation fields, the features used as landmarks are the edges. The significant edge fragments must be chosen manually, but **without showing any specific corresponding points**. Field edges marked with wires in the simulation image are found fully automatically with the original combination of a dedicated line edge detector and a version of hierarchical, combined Hough transform. The registration is guided by the robust accuracy criterion using the modified Hausdorff distance measure. The only parameter of the measure – quantile rank, or share of data used in comparison – is not fixed, but evolves from 1 to 0 during the optimization of the accuracy. This has two advantages. 1: The user can choose the result found for the share corresponding to the actual share of erroneous data in the images, which can be seen only after the results for all the possible ranks are known. 2: The algorithm can avoid the local minima. The registration takes few seconds on a typical PC.

The method has been implemented in a software tool which supports the complete process of measurement, and has been tested in clinical trials with positive result.

Conclusion: The modified Hausdorff distance measure with evolving rank is a good and efficient registration accuracy measure for quality assessment of radiotherapy based on the comparison of portal and simulation images.

Acknowledgement The work was partly supported by the Committee for Scientific Research, Poland, within the grant no. KBN 4 P05B 064 18.

* Abstract published in Polish in: *Proc. 4th Symposium on Image Processing Techniques (TPO 2002) – Information and Abstracts*, Serock, Poland, Nov 21-23, 2002, p. 35. Division of Image Processing, IMiO, Warsaw University of Technology. Oficyna Wydawnicza Politechniki Warszawskiej, Warsaw 2002.