Sudan University of Science and Technology

College of Graduate Studies

Computed Verification of Light and Radiation Field Size Superimposition on Cobalt-60 Machine

حوسبة تطابق حقلي الضوء والأشعاع في جهاز الكوبالت-٦٠ المشع

Submitted for partial Fulfillment of Academic Requirements for the Degree of Master in Radiotherapy Technology

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بسْمِ اللّهِ الرّحْمَنِ الرّحِيمِ

{ يأَيّهَا النّاسُ اتّقُواْ رَبّكُمُ الّذِي خَلَقَكُمْ مّن نّفْسٍ وَاحِدَةٍ وَخَلَقَ مِنْهَا زَوْجَهَا وَبَثّ مِنْهُمَا رِجَالاً كَثِيراً وَنِسَآءً وَاتّقُواْ اللّهَ الّذِي تَسَآءَلُونَ بِهِ وَالأرْحَامَ إِنّ اللّهَ كَانَ عَلَيْكُمْ رقيَباً }

صدق الله العظيم

ألأية رقم (1) ، سورة النساء

Dedication

This thesis is dedicated to my wonderful parents, who have raised me to be the person I am today. They have been with me every step of the way, through good times and bad. They have been a source of encouragement and inspiration to me throughout my life, a very special thank you for providing a ‘writing space’ and for nurturing me through the months of writing. And also for the myriad of ways in which, throughout my life, they have actively supported me in my determination to find and realize my potential, and to make this contribution to our world. Thanks for all the unconditional love, guidance, and support that they have always given me, helping me to succeed and instilling in me the confidence that I am capable of doing anything I put my mind to. Thank you for everything.

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Abstract:

Before starting conventional radiotherapy, a virtual field is usually made using light to determine the actual field of tumor under treatment. The Light and Radiation fields should be matched. This matching however, is verified by using different methods including the portal film. The decrease or increase in the two fields should not exceed 5%. If the ratio is greater than 5%, the alignment of the light and radiation beam diagram should be reviewed.

The study was conducted at the Radiation and Isotopes Center of Khartoum (RICK) during the period April to August 2009. The aim of the study was to verify the superimposition of light and radiation field size using image processing technique automatically.

As cobalt-60 machine, the portal films used in the test were scanned using digitizer scanner. The scanning analysis was made using IDL to show the superimposition in which more concentration was made on field center and borders, provided that the analysis included the four borders of the two fields.

Both the standard deviation and the mean methods were used in the analysis process. The result was as follows (10.0 X 10.0cm), Medical physicist score was (10.3 ± 0.11608 X 10.3 ± 0.099861 cm) and the field size that calculates by computerized score using IDL program was (9.9 ± 0.036049 X 9.9 ± 0.01123cm). This indicates that the result was within the acceptable limits for the automatic reading, as compared with the manual reading in which the penumbra was (8mm) which was very high and risky for the treatment process. The result showed the precision of automatic reading in terms of problem's solution of noise created in small regions that require additional processing as well as other problems. On the Contrary to the manual method that ignores those details and focuses only on the expected borders which were determined incorrect.

الملخص:

قبل عملية العلاج بالأشعة يكون هنالك حقل تجريبي باستخدام الضوء لتحديد الحقل الحقيقي للورم الذي سوف يتم علاجه بالأشعة. ولابد ان يتطابق الحقلان. و لابد من التحقق من هذا التطابق باستخدام طرق مختلفة منها طريقة استخدام افلام الأشعة بحيث لايتعدى نقصان او زيادة الأنحراف عن الطريقة المثلى ٥%. اما اذا كانت هذه النسبة اكبر من ذلك تحدد حزمة الضوء والأشعاع فيتم مراجعتهما.

اجريت هذه الدراسة في المركز القومي للعلاج بالأشعة والطب النووي- الخرطوم خلال الفترة من ابريل الي اغسطس ٢٠٠٩. والهدف من هذه الدراسة هو التحقق الألي من تطابق الحقلين المذكورين. بالنسبة لجهاز الكوبالت-٦٠ تم استخدام طريقة مسح فلم الأشعة عن طريق جهاز الناسخ الضوئي وتم تحليل المسح باستعمال برنامج تحليل الصور لمعرفة مدى التطابق علماً بأن التحليل شمل الأضلاع الأربعة لحقلي الأشعة والضوء.

استخدم الأنحراف المعياري والمتوسط الحسابي في عملية التحليل وكانت النتيجة ١٠× ١٠سنتيمتر للمجال الضوئي و ١٠,٣± ٠٩٩٨٦٦١, × ١٠,٣±٠١١٦٠, سنتيمتر ولمجال حزمة الأشعة مُقاس بواسطة الفيزيائي الطبي و ٩,٩± ٠١١٢٣, × ٩,٩±٠٣٦٠٤, سنتيمتر. وهذا يشير الى ان النتيجة في حالتي القياس و القراءة الألية في حدود المقبول.

اظهرت الدراسة دقة القراءة الألية باستخدام برامج معالجة الصور من حيث حل المشاكل المتعلقة بالوضوح والتباين والتحديد الدقيق لشبه الظل (٨ مليمتر) مقارنة مع الطريقة اليدوية. وتعتبر نتيجة شبه الظل المذكورة (٨ مليمتر) نتيجة كبيرة جدا وتشكل خطرا في عملية العلاج.

List of Abbreviations

A/P	Anteroposterior
CT	Computed Tomography
DDR	Digitally Reconstructed Radiograph
DXA	Dual X-rays Absorpometry
EPID	Electronic Portal Image Device
FFT	Finite Fourier Transform
FIR	Finite Impulse Response
IDL	Interactive Data Language
MRI	Magnetic Resonance Imaging
NCI	National Cancer Institute
NHANES II	Second National Health and Nutrition Examination Survey
OD	Optical Density
Q.A	Quality Assurance
Q.C	Quality Control
RAM	Random Access Memory
RICK	Radiation and Isotopes Center of Khartoum
SAD	Source to Axis Distance
SSD	Source to Skin Distance
TIFF	Tagged Image File Format
2D	Two Dimensions
3D	Three Dimensions
4D	Four Dimensions

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