

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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2009

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

لَمْ يَأْيَهَا النَّاسُ اتَّقُوا رَبَّكُمُ الَّذِي خَلَقَكُمْ
مِّنْ نَّفْسٍ وَاحِدَةٍ وَخَلَقَ مِنْهَا زَوْجَهَا
وَبَثَّ مِنْهُمَا رِجَالًا كَثِيرًا وَنِسَاءً وَاتَّقُوا
اللَّهَ الَّذِي تَسَاءَلُونَ بِهِ وَالْأَرْحَامَ إِنَّ اللَّهَ
كَانَ عَلَيْكُمْ رَقِيبًا

صدق الله العظيم

آية 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.

Acknowledgement

My acknowledgements and gratefulness at the beginning and at last is to God who gave us the gift of the mind. Profound thanks and gratitude to everyone who encouraged me to complete this thesis. My gratitude is extended to my supervisor **Dr. Mohamed Elfadal Mohamed Gar-elnabi**, all Radiation and Isotopes Center of Khartoum (RICK) for their helps. Their works have stimulated and fostered my efforts in producing this research.

My gratitude is also extended to my colleagues in Radiotherapy Department, and special thanks to **Mr. Mustafa M. Elhassan** head of Medical Physics (RICK) for the continuous help and facilitation. My gratitude extends to **Emad Mohamed** and **Hussani Ahmed** (Medical physics Department) for their continuous help and support.

My thanks to my friends and colleagues in National Cancer Institute, University of Gazeria **Dr. N. M. Elwali**, **Mr. Salam Mohamed**, **Mr. Abdalazim Ahmed** , **Mr. H. Eltom**, **Mis Fatima Abazar**, **Mis Fawzia Elsadig** and **Mis. Nada Fasial**.

Finally I would like to warmly thank of my long-suffering family for never-ending support. May almighty God bless them all.

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 $(10.3 \pm 0.11608 \text{ X } 10.3 \pm 0.099861 \text{ cm})$ and the field size that calculates by computerized score using IDL program was $(9.9 \pm 0.036049 \text{ X } 9.9 \pm 0.01123\text{cm})$. 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 الانحراف 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 الانحراف المعياري والمتوسط الحسابي في عملية التحليل وكانت النتيجة 10×10 سنتيمتر للمجال الضوئي و $10,3 \pm 0,998661$ و $10,3 \times 0,1160$ سنتيمتر ولمجال حزمة الأشعة مّقاس بواسطة الفيزيائي الطبي و $9,9 \pm 0,1123$ و $9,9 \pm 0,3604$ 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

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

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