DESIGN AND APPLICATION OF MULTIPARAMETERS CONTRAST DETAIL PHANTOM USING CYLINDRICAL DOUBLE HOLE ACRYLIC BLOCK FOR RADIOGRAPHIC QUALITY CONTROL TOOL

BY

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ABSTRACT

The consistency of contrast detail performance of imaging system can be evaluated by using Contrast Detail phantom. The analysis is always based on the human visual perception which leads to intraobserver perception bias. In addition, the wall of single drilled hole concept in commercial Contrast Detail phantom gives effect to the penetration of x -ray beam divergence to pass through the base of each hole. This effect will lead to false appearance of image but it is not visualised in the radiograph. In this study, cylindrical double hole acrylic block of Multiparameters Contrast Detail phantom has been developed which differs from the single drilled hole concept, whereby it consists of combination of different holes' diameters and thicknesses. Results revealed that, the new design of cylindrical double hole acrylic block is able to visualise the effect of image displacement from the x-ray focal length plus measuring the off-position of anode stem, blurring effect, image distortion in terms of real shape and size, also addressing the contrast detail characteristics parameter in terms of real hole depth. The influencing factors of source-image-distance, object thickness, position of object from center beam in x-axis, sizes of hole diameter and hole depth contribute to the changes in parameters' outcome. The measurement of pixel intensity by using software and development of algorithm for data analysis basically can reduce the human perception bias and increase the validity of the results.

خلاصة البحث

اتساق النقيض من أداء التفاصيل من نظام التصوير يمكن تقييمها باستخدام التباين التفاصيل الوهمية . ويستند التحليل دائما على الإدراك البصري البشري الذي يؤدي إلى ضمن مراقبة التحيز التصور. بالإضافة إلى ذلك، جدار واحد حفر حفرة في مفهوم تجاري على النقيض من التفاصيل الوهمية يعطي تأثير إلى تغلغل الشعاع السيني المختلف لتمرير من خلال قاعدة كل حفرة . و هذا التأثير يؤدي إلى ظهور خيالية من الصورة ولكن لا يتم تصور ذلك في صورة شعاعية . و بناء على ذلك في هذه الدراسة، تم وضع أسطواني مزدوج حفرة الاكريليك تصميم كتلة من تعدد المعلمات التباين التفاصيل الوهمية التي تختلف من واحد حفر حفرة مفهوم ، حيث أنه يتكون من مزيج من أقطار حفرة مختلفة و سمك متغير من حفرة مزدوجة التصاميم كتلة الاكريليك أسطواني . واستنتجنا من الدراسة أن التصميم الجديد للإسطوانة مزدوج تصميم ثقب كتلة الاكريليك قادر على تصور تأثير صورة النزوح من البعد البؤري الأشعة السينية بالإضافة إلى قياس خارج موقف الجذعية الأنود ، وضوح تأثير ، وتشويه صورة من حيث الشكل الحقيقي والحجم، و أيضا معالجة التباين الخصائص التفاصيل المعلمة من حيث عمق حفرة الحقيقي . فالعوامل المؤثرة من مصدر الصورة عن بعد، و سماكة جسم، موقف كائن من شعاع المركز في محور س والأحجام من حفرة قطرها وعمق حفرة تساهم التغييرات في نتائج المعلمات. قياس كثافة بكسل باستخدام البرمجيات و تطوير خوارزمية لتحليل البيانات أساسا يمكن أن تقلل من التحيز الإدراك البشري والزيادة صحة النتائج .

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Health Sciences

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DECLARATION

I hereby declare that this thesis is the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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In the name of Allah, the Most Precious and the Most Merciful.

Praise is to Allah who sustains every living thing in this world and peace be upon to Prophet Muhammad s.a.w, his families and his companions and also peace be upon to all Muslimin and Muslimat all over the world and also in Hereafter.

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LIST OF ABBREVIATIONS

^{0}F / in	Degree Fahrenheit per inch
2D	Two Dimension
3D	Three Dimension
AAPM	American Association of Physicists in Medicine
ACR	American College of Radiology
ADC	Analog-to-Digital Converter
AEC	Automatic Exposure Control
ALARA	As Low As Reasonably Achievable
BaFI:Eu	Europium activated Barium Fluoroiodide
BaFx:Eu2+	Europium-doped Barium Fluorohalide Crystals
BRMD	Bureau of Radiation and Medical Devices
BRTES	Breast-Tissue Equivalent Series
Ca-alg	Calcium Alginate
CD	Contrast Detail
cm	Centimeter
cm^3	Centimeter Cubic
CD	Contrast Detail
CDMAM	Contrast Detail Mammography
CDR	Contrast Detail Radiography
CIRS	Computerised Imaging Reference System
CNR	Contrast Noise Ratio
CR	Computed Radiography
CT	Computed Tomography
dB /cm	Decibel per centimeter

DICOM	Digital Imaging and Communication in Medical
DDIR	Department of Diagnostic Imaging and Radiotherapy
DR	Digital Radiography
eV	electronVolt
FCR	Fuji Computed Radiography
FOV	Field of View
g / cm	gram per centimeter
$GdCl_3$	Gadolinium Trichloride
H&D	Hurter- Driffield
HIFU	High Intensity Focused Ultrasound
IIUM	International Islamic University Malaysia
IP	Imaging Plate
IPO	Intellectual Property Organisation
keV	kilo electron volt
kV	kilovolt
kVp	kilovoltage Peak
lp / mm	line pair per millimeter
LUT	Look Up Table
mA	milliAmperage
MAM	Mammography
mAs	milliAmpere second
MeV	Mega electron volt
mm	millimeter
m / min	Meter per minute
MRI	Magnetic Resonance Imaging
ms	millisecond
m / sec	meter per second

MTF	Modulation Transfer Function
NaCl	Natrium Chloride
NaN_3	Sodium Azide
NIH	National Institute of Health
OFD	Object Focus Distance
OID	Object Image Distance
ORINS	Oak Ridge Institute of Nuclear Studies
PACS	Picture Archiving Computerised System
PBC	Plastic Buffing Compound
PDA	Personal Digital Assistant
PMMA	Polymethylmethacrylate
PMT	Photomultiplier Tube
PSP	Photostimulable Phosphor
QC	Quality Control
ROC	Receiver Operating Characteristics
ROI	Region of Interest
RSD	Radiology Support Devices
SAR	Specific Absorption Rate
SID	Source Image Distance
SMPTE	Society of Motion Picture and Television Engineers
SNR	Signal Noise Ratio
TOR	Test Object Radiography
UV	Ultraviolet
VGA	Visual Grading Analysis

LIST OF EQUATIONS