



中華民國醫學物理學會

Chinese Society of Medical Physics, Taipei

Software-Based Routine QC for Diagnostic Imaging: current status

陳建全 醫學物理師

2026 年會繼續教育課程

ACR QA Resources

Medical Physics Resources

ACR > Clinical Resources > Clinical Tools and References > Specialties > Medical Physics Resources

Draft SBB QC Manual for Public Comment

Access the draft manual and forms



Manuals

Get insights and guidance into the best practices for clinical medical physics in computed tomography, magnetic resonance imaging, mammography and more.

Computed Tomography (2017)

This manual provides a standardized QC program for CT.

Download now

Mammography (2018, 2020rev)

This manual provides a standardized QC program for digital mammography, including DBT.

Download now

Positron Emission Tomography QC Manual (2025)

This manual provides a standardized QC program for PET.

Download now

ACR Manual on Contrast Media (2024)

This manual is a guide for safe and effective use of contrast media.

Download now

Mammography (1999)

This is the ACR QC manual for screen-film mammography, including the Clinical Image Quality section.

Download now

Magnetic Resonance Imaging (2015)

This manual provides a standardized QC program for MRI.

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Nuclear Medicine (2024)

This manual provides a standardized QC program for nuclear medicine (PET not included).

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ACR Manual on MR Safety (2024)

This manual provides comprehensive guidance for operating a safe MR environment.

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Radiation Safety Officer Resources (2021)

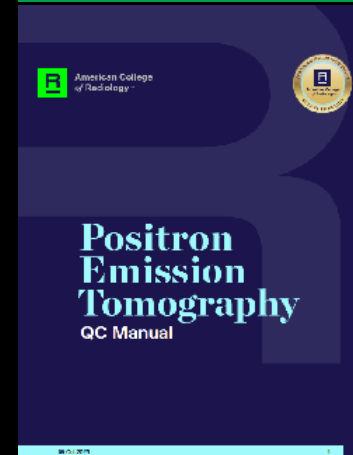
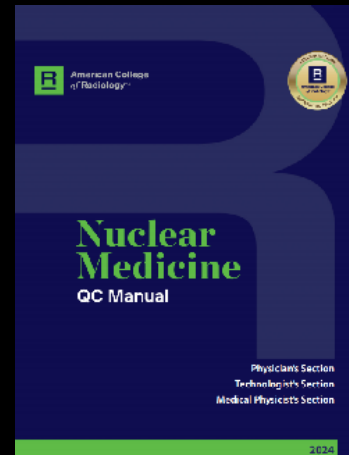
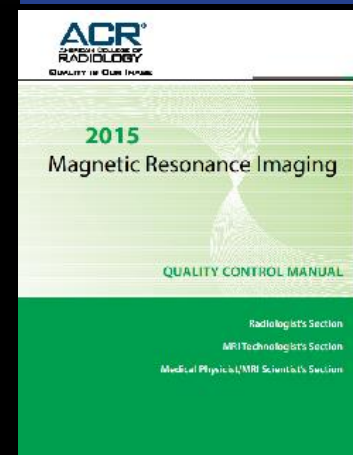
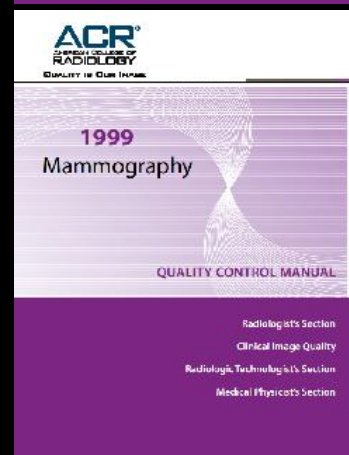
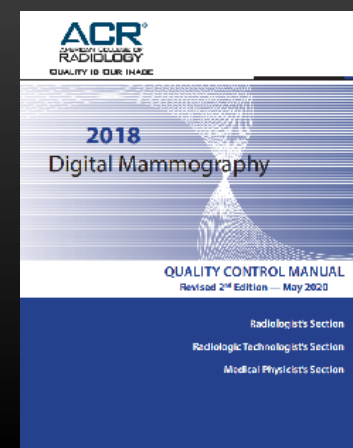
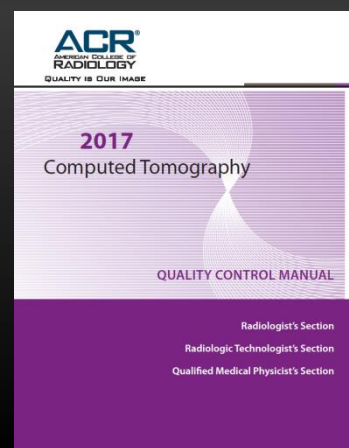
This manual is a guide for medical physicists, radiologists, radiation oncologists, and nuclear medicine physicians who provide radiation safety officer services.

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Stereotactic Breast Biopsy (1999)

This manual is the original ACR standardized QC manual for stereotactic breast biopsy.

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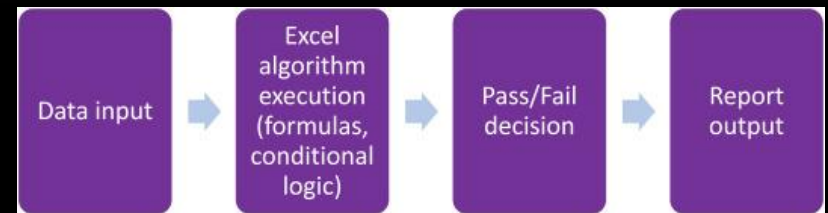


General QC / QA Tests in Diagnostic Imaging

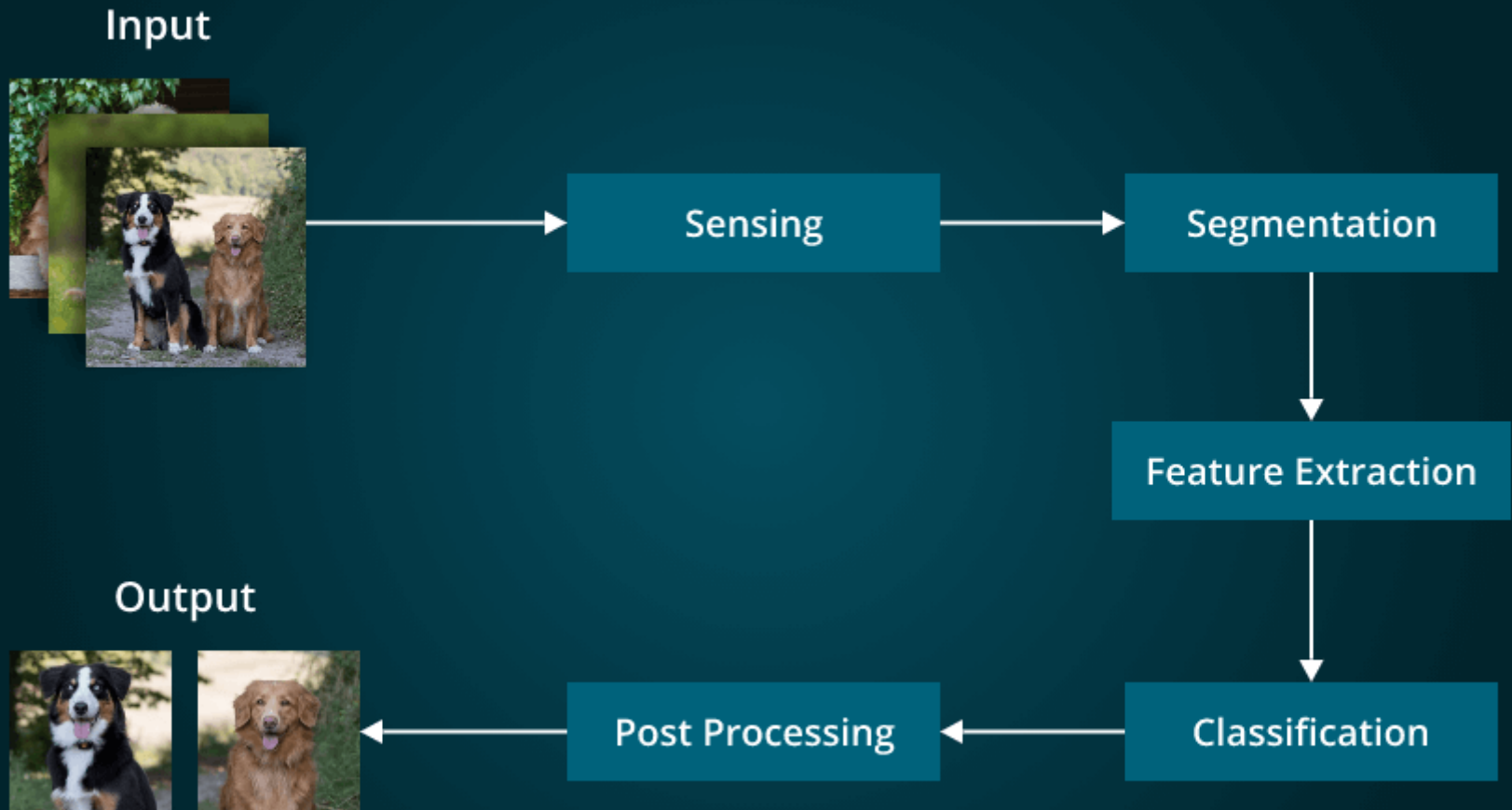
- Image quality
 - Spatial resolution
 - High contrast
 - Low contrast
 - Noise
 - Signal-to-noise ratio
 - Contrast-to-noise ratio
 - Geometric accuracy
 - In-plane distortion
 - Slice thickness / position
 - Pixel value accuracy
 - Artifacts
 - Defects
 - Uniformity
 - Ghosting pattern
- Radiation features
 - Tube voltage
 - Accuracy
 - Stability
 - Exposure time
 - Accuracy
 - Stability
 - Radiation output rate
 - Stability
 - Beam quality
 - Automatic Exposure Control
 - Field assessment
 - Alignment
 - Radiation profile

Found relevant published articles

- Enhancing quality control in radiography systems through automated algorithms
 - Herdi Firdaus Jamal, et. al. Nuclear Engineering and Technology, 2026
 - Microsoft Excel based program
 - The QC test performed include:
 - repeatability of radiation output test,
 - accuracy kVp,
 - accuracy of exposure timer,
 - coefficient of linearity,
 - x-ray beam filtration (HVL measurement),
 - collimation light field illumination,
 - x-ray beam/light field alignment,
 - beam perpendicularity,
 - x-ray beam/light field centering (at 1 m of FID),
 - resolution,
 - contrast,
 - focal spot size measurement,
 - leakage radiation,
 - scattered radiation test.



Pattern recognition and Image analysis



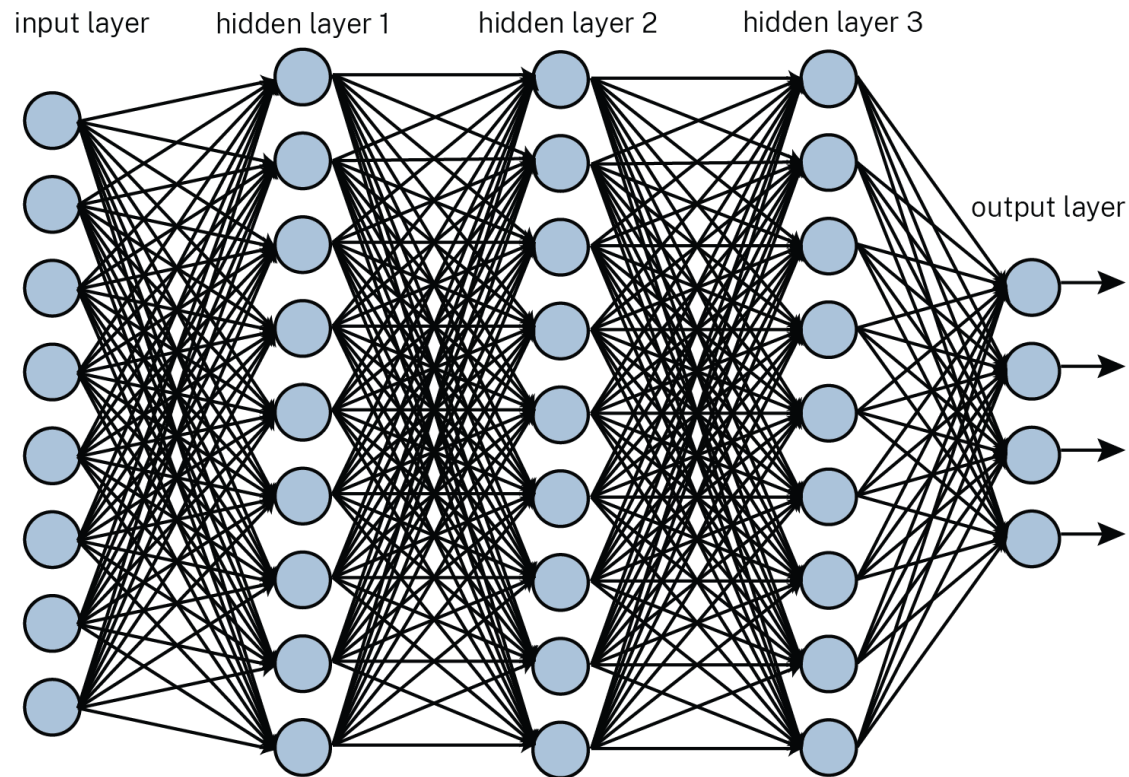
Pattern recognition and Image analysis

- **Pattern recognition**
 - **Statistical Model**
 - This model determines the placement of a specific piece, such as categorizing whether it is a cake or not. It relies on **supervised machine learning** to achieve its outcomes.
 - **Syntactic/Structural Model**
 - Designed to establish **complex relationships** between elements, this model is often applied to tasks like identifying parts of speech. Its methodology involves **semi-supervised machine learning**.
 - **Template Matching**
 - This model involves matching an object's features with a predefined template, allowing the identification of the object by proxy. Plagiarism checking is one application where this model finds utility.
 - **Neural Networks**
 - The neural network method stands out for its reliance on artificial neural networks, showcasing greater flexibility compared to conventional algorithms.

Artificial Neural Network



An Artificial Neural Network Diagram



SOURCE: National Energy Research Scientific Computing Center document Peter Harrington and Steven Farrell, "Scientific Deep Learning on Perlmutter," National Energy Research Scientific Computing Center, January 7, 2022, p. 3, <https://www.nersc.gov/assets/Uploads/Deep-Learning-on-Perlmutter.pdf>.

NOTE: Adapted from the original by National Energy Research Scientific Computing Center.

Commercial Products for Automatic QC

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Automate Quality Checks for Reliable Medical Imaging

Diagnomatic analyzes test results automatically, detects issues early, and keeps your imaging equipment compliant, saving you time and reducing errors so you can focus on patient care.

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AN IMPRESSIVE RANGE OF PRODUCTS

RADIOLOGICAL IMAGING TECHNOLOGY

MACHINE QA MLC QA PATIENT QA IMAGING QA

Radia Diagnostic

Radia is an à la carte-based software for comprehensive imaging QC at your facility. Easily customize your Radia software by adding the diagnostic modules needed to perform automated analyses on your facility's phantoms.



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FULL MEDICAL IMAGING QA SOLUTIONS
DETECTION - IMAGE QA - DISPLAY QA - PATIENT DOSE QA

Software

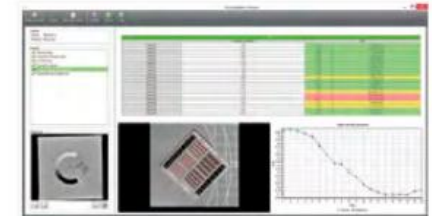
IQ Analyzer Primus v00203530

Software which performs quality checks on images taken with Primus in three simple steps:
Select - Analyze - Results.

The IQ Analyzer Primus can perform automatic, fast, quantitative and reproducible constancy measurement on multiple imaging modalities.

Specifications:

- Automated analyze of DICOM images from various modalities, including CR, DR, DX, XA and RF systems.
- Efficient selection of DICOM images through easy menu
- Automated analyze of Image Quality by determining: Positioning, SNR, dynamic, distortion and resolution (MTF)
- Generate reports and archive in both PDF and Microsoft® Excel® formats.



Technical Specifications / System requirements:

- Processor : Intel® Core 2 Duo
- Memory : 1 Go DDRAM
- Minimum screen resolution : 1024*768
- Windows based system (XP, Vista, 7, 8)



Remote Automated quality control in Radiology

Diagnostic Radiology

<https://www.iaea.org/resources/hhc/medical-physics/diagnostic-radiology/remote-automated-quality-control-in-radiology>

IAEA

RADIOGRAPHY PHANTOM

5mm
PMMA

5 mm PMMA

2mmCu
@ 3"

2 mm Cu

4mm
Al

4 mm Al

IAEA

MAMMOGRAPHY PHANTOM

0.2 mm Al

0.2mm
Al

5 mm PMMA

5mm
PMMA

1mmCu
@ 3°

1 mm Cu



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[RIT EPID MLC](#)[RIT EPID MLC WITH
ISOCENTER: PICKET FENCE
QA, EPID MLC QA](#)

OEM CUSTOM SOLUTIONS

[PRODUCT
MAINTENANCE
PROGRAM \(PMP\)](#)

ADVANCED QA SOFTWARE

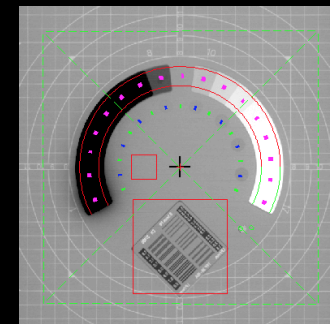
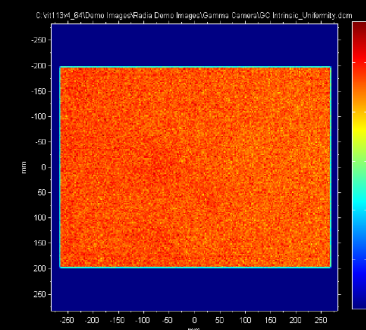
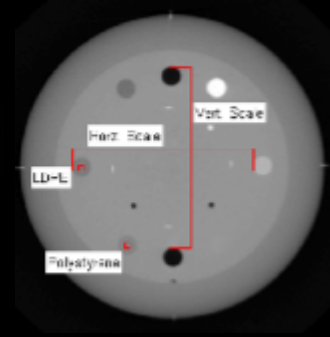
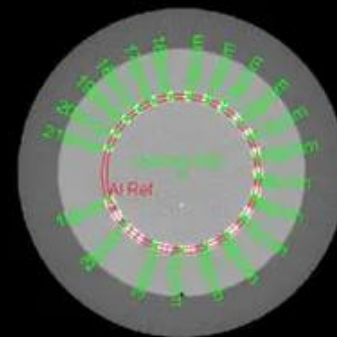
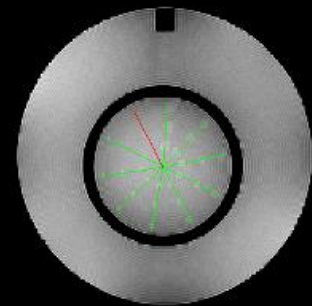
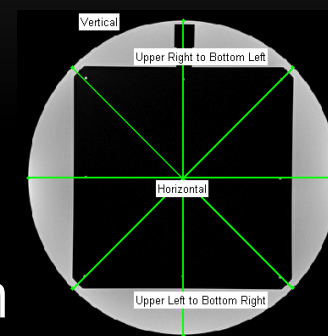
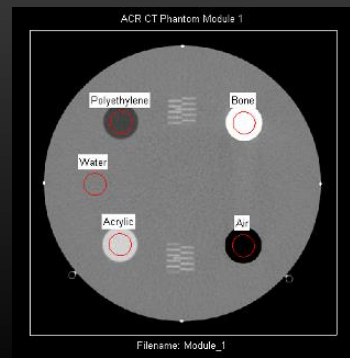
For over 30 years, Radiological Imaging Technology has been engineered to ensure proper compliance with therapeutic and diagnostic physics. RIT provides advanced QA and imaging QA for linear accelerators for TomoTherapy® (TG-148) and CyberKnife® (TG-135), and automated phantom analysis for diagnostic imaging.

TomoTherapy® and CyberKnife® are registered trademarks of Accuray, Inc.

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RIT Radia

- Diagnostic Modules
 - ACR CT Module
 - ACR FFDM Module
 - Gammex / CIRS
 - ACR MRI Module
 - ACR Large / Medium MR Phantom
 - ACR Small MRI Module
 - (Extremity & Breast)
 - Catphan/OBI Module
 - CT Uniformity Module
 - Gamma Camera Uniformity Module
 - GE CT Module
 - IEC 62464 MRI Module
 - kV Imaging Module

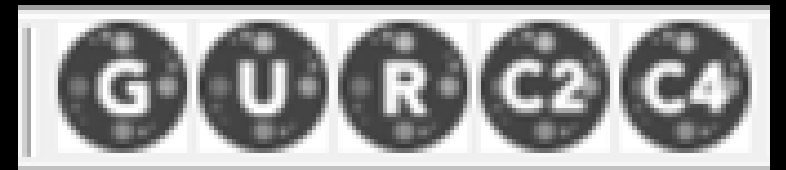
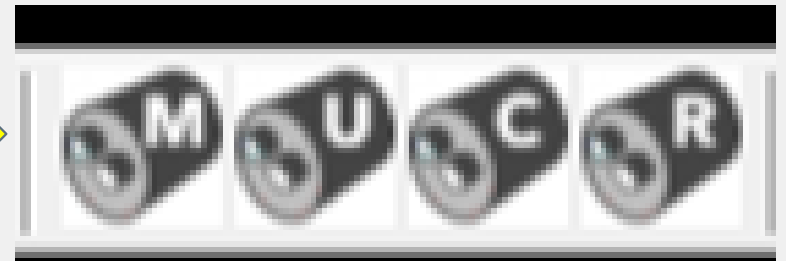
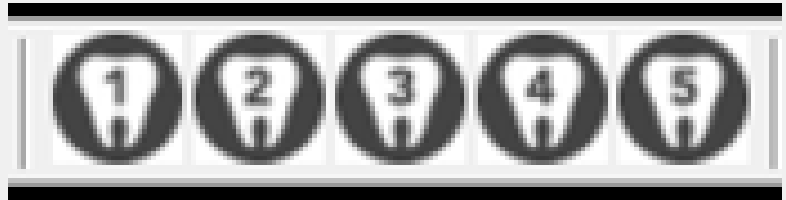


The image shows the RIT Complete Version 6.7.1.64.000 software interface. At the top, there is a menu bar with options: File, Edit, Calibration, Patient QA, Machine QA, MLC QA, Image QA (which is highlighted with a blue box), Database Management, and Help. Below the menu bar is a toolbar containing various icons for file operations and analysis. The main window is split into two panes. The left pane contains several settings sections: 'Units' set to 'Pixels' and 'Palette' set to '2'; 'Filter Type' set to 'none' and 'Size' set to '3 x 3'; 'Current Rotation' set to '0' and 'None'; and 'Normalization' set to '1' and 'None(1)'. The right pane contains an 'ROI' section with fields for 'X Min', 'X Max', 'Y Min', and 'Y Max', and buttons for 'Select ROI...', 'Remove ROI', and 'Calibrate to:'. The 'Calibrate to:' dropdown menu shows a file path: 'C:\Users\Gaurav\Desktop\Test Images\DeLeary\pxi_sa_calibration...'. Below this are buttons for 'Embed CAL' and 'Get CAL File'. The 'Phantom Analysis' button in the toolbar is highlighted with a blue box.

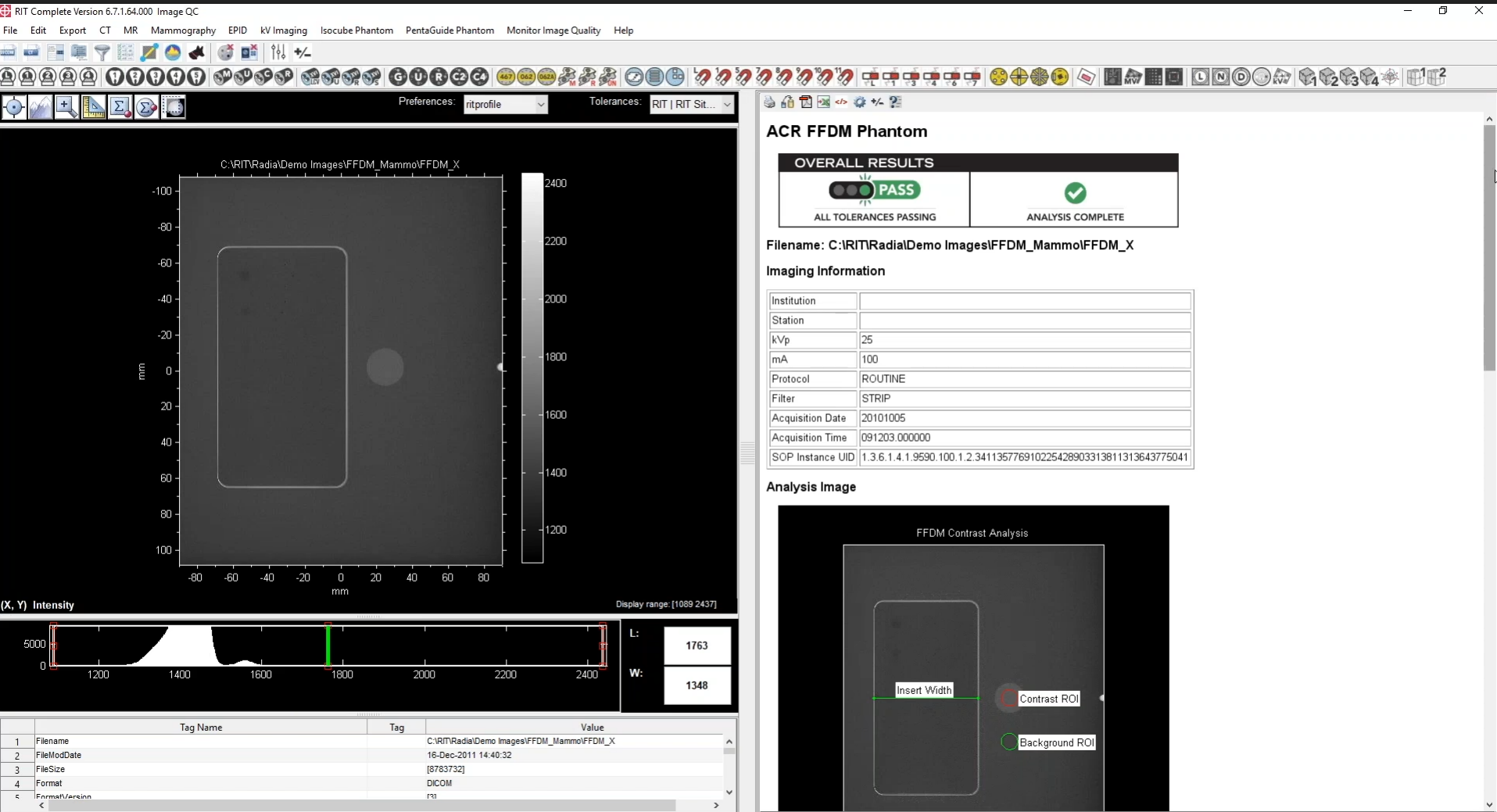
The screenshot shows the RIT Complete Version 6.7.1.64.000 Image QC software interface. The main window displays a large black area with a coordinate system (X, Y) and a color bar at the bottom. A yellow arrow points to the 'ACR CT' label. Another yellow arrow points to the 'Catphan' label. The right side of the interface shows a series of test patterns, including a grid of numbers (1-5), a grid of letters (M, U, C, R), and a grid of letters (G, U, R, C2, C4).

ACR CT

Catphan

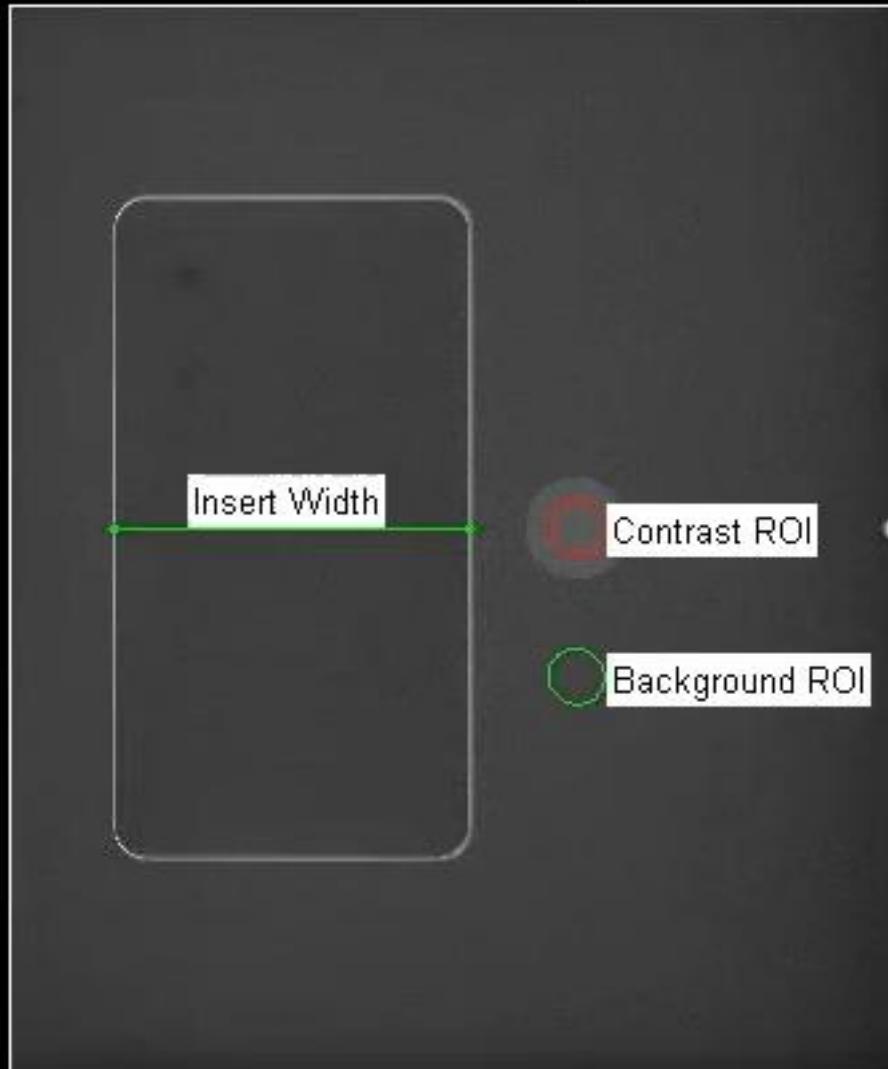


ACR FFDM QA



ACR FFDM QA

FFDM Contrast Analysis



Filename: FFDM_X

Insert Width

Insert Width (mm)	70.49
ACR Minimum (mm)	63.00
ACR Maximum (mm)	77.00
Pass-Fail	Pass

Contrast Analysis

Measurement	Value	Minimum	Pass-Fail
Contrast to Noise Ratio	7.20	5.00	Pass
SNR Contrast Object	55.59	50.00	Pass
SNR Background	63.26	50.00	Pass

Insert Analysis

Object	Number Passing	Minimum	Pass-Fail
Fibers	3	2	Pass
Specks	4	3	Pass
Masses	5	2	Pass

Mammography QA

FFDM Insert Analysis

Analysis Settings

CNR Threshold	1.2
CNR Area mm ²	100
Mass Detection Threshold	0.25
Fiber Detection Threshold	0.6
Small Speck Detection Threshold	0.5
Large Speck Threshold	0.2
Speck Detection Threshold	0.5
Fiber Length Threshold	0.4
Full Point Major/Minor Axis Ratio	1.5
Half Point Major/Minor Axis Ratio	2
Mass Roundness Ratio	0.5

Speck Detail

Group	1	2	3	4	5	6
# of Specks Detected	6	6	6	6	1	1
Speck Group Pass-Fail Min. Specks/Group = 4	Pass	Pass	Pass	Pass	Fail	Fail

ACR CT QA #1

ACR CT Phantom - Module 1 Report

CT Material Values

OVERALL RESULTS



ALL TOLERANCES PASSING



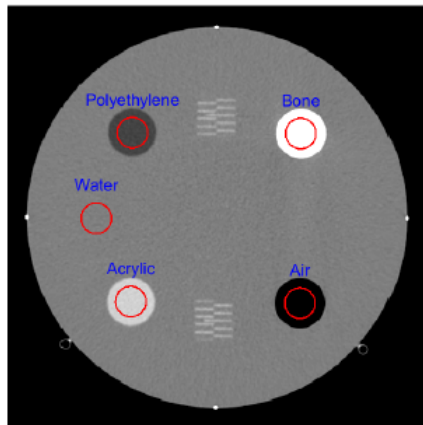
ANALYSIS CT

Material	Mean(HU)	SD(HU)	ACR Min.	ACR Max.	Pass-Fail
Water	0.51536	5.0623	-7	7	Pass
Polyethylene	-90.5471	4.7447	-107	-84	Pass
Bone	915.7423	6.1209	850	970	Pass
Acrylic	127.9663	5.7235	110	135	Pass
Air	-993.2289	4.0089	-1005	-970	Pass

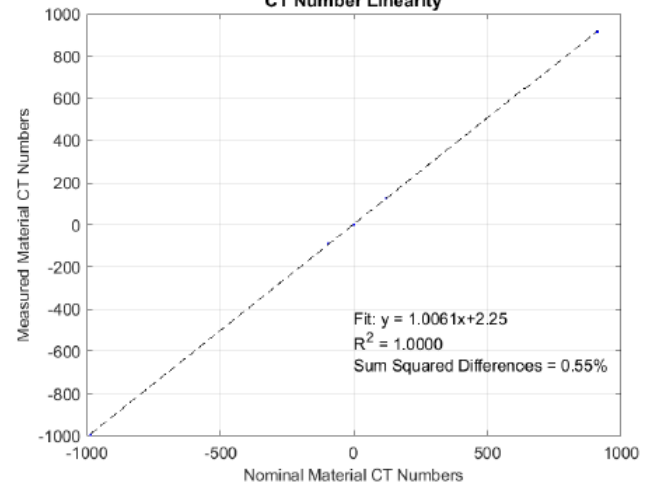
Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\ACR_CT\Module_1
Institution	Univ. of Va. Hospital 02
Station	uvaradct02
kVp	120
mA	280
mAs	195
Protocol	10.4 LEVEL 2 QA ACR
Filter	BODY FILTER
Convolution Kernel	STANDARD
DICOM Slice Thickness(mm)	5
SOPI Instance UID	1.2.840.113704.7.1.0.1307918185175.1249655180.62
Slice Location	-1
ACR Protocol	Adult Abdomen

Analysis Image



CT Number Linearity

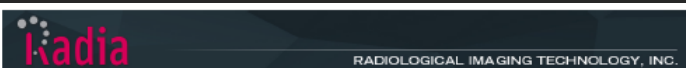


Analysis Settings

Allowable Bone Tolerance	400
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault

No slice thickness check
No scan position check

ACR CT QA #2



ACR CT Phantom - Module 2 Report

OVERALL RESULTS



ALL TOLERANCES PASSING

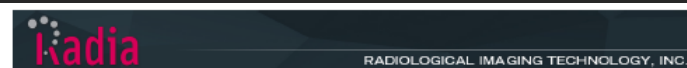
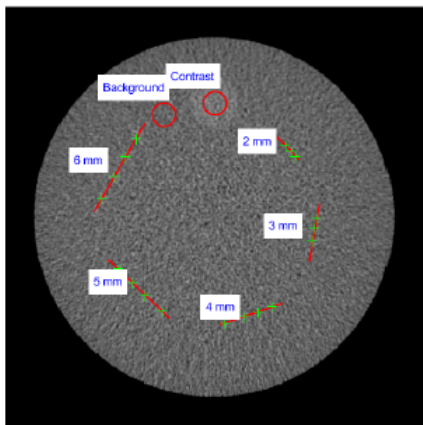


ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\ACR_CT\Module_2
Institution	Boulder Community Foothills Hosp
Station	CT01_OCO
kVp	120
mA	300
mAs	2259
Protocol	6.1 ABDOMEN/PELVIS
Filter	BODY FILTER
Convolution Kernel	STANDARD
DICOM Slice Thickness (mm)	5
SOP Instance UID	1.2.840.113619.2.55.1.1762897610.2203.1179930891.806.7
Slice Location	30
ACR Protocol	Adult Abdomen

Analysis Image



Contrast to Noise Ratio (CNR)

Contrast to Noise	1.29
ACR Minimum CNR for Adult Abdomen	1.00
CNR Pass-Fail	Pass

Contrast Statistics

Contrast Cylinder Mean	96.35
Contrast Cylinder Standard Deviation	4.89
S/N Contrast Cylinder	19.69
Background Mean	90.13
Background Standard Deviation	4.80
S/N Background	18.79

Rod Detection

Rod Size (mm)	Num. Rods Detected
6	4
5	4
4	4
3	3
2	3

Analysis Settings

Filter Size	9
Large Rod Threshold	1.6
2 mm Rod Threshold	1.3
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault



ACR CT QA #2

Contrast to Noise Ratio (CNR)

Contrast to Noise	1.29
ACR Minimum CNR for Adult Abdomen	1.00
CNR Pass-Fail	Pass

Contrast Statistics

Contrast Cylinder Mean	96.35
Contrast Cylinder Standard Deviation	4.89
S/N Contrast Cylinder	19.69
Background Mean	90.13
Background Standard Deviation	4.80
S/N Background	18.79

Rod Detection

Rod Size (mm)	Num. Rods Detected
6	4
5	4
4	4
3	3
2	3

ACR CT QA #3

ACR CT Phantom - Module 3 Report

Uniformity

OVERALL RESULTS



ALL TOLERANCES PASSING

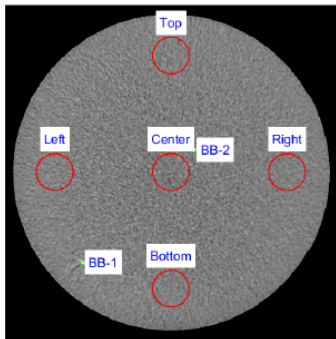


ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\ACR_CTModule_3
Institution	Boulder Community FootHills Hosp
Station	CT01_000
KVp	120
mA	300
mAs	2.259
Protocol	6.1 ABDOMEN/PELVIS
Filter	BODY FILTER
Convolution Kernel	STANDARD
DICOM Slice Thickness (mm)	5
SIP Instance UID	1.2.840.113619.2.55.1.1762897610.2203.1179930891.816.17
Slice Location	80
ACR Protocol	Adult Abdomen

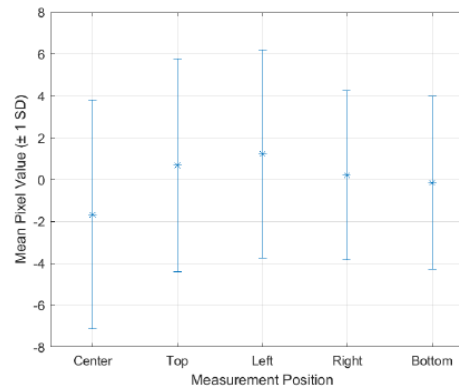
Analysis Image



Uniformity Measurements

Area	Area Mean	Uniformity vs. Center	ACR Min.	ACR Max.	Uniformity Pass-Fail	Area SD
Center	-1.67	0.00	-5.00	5.00		5.45
Top	0.70	2.36	-5.00	5.00	Pass	5.08
Left	1.22	2.89	-5.00	5.00	Pass	4.97
Right	0.21	1.88	-5.00	5.00	Pass	4.03
Bottom	-0.14	1.53	-5.00	5.00	Pass	4.13

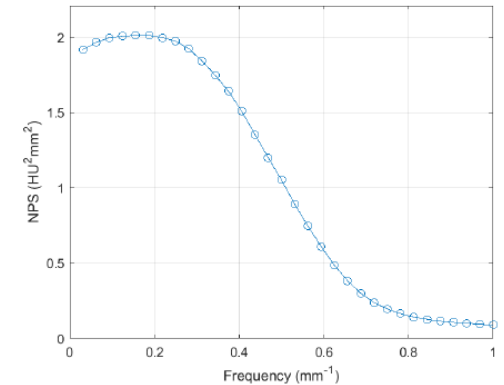
Mean Pixel Value and SD by Measurement Position



BB Distance

Distance between BBs (mm)	99.55
Delta from 100 mm (mm)	-0.45

NPS Plot



Noise Power Spectrum

Noise Power Peak ($HU^2 mm^{-2}$)	2.02
Peak Frequency (mm^{-1})	0.16

Analysis Settings

BB Threshold	2
Outer Radius Mask	257
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault

No noise (SD) value

Uniformity Measurements

Area	Area Mean	Uniformity vs. Center	ACR Min.	ACR Max.	Uniformity Pass-Fail	Area SD
Center	-1.67	0.00	-5.00	5.00		5.45
Top	0.70	2.36	-5.00	5.00	Pass	5.08
Left	1.22	2.89	-5.00	5.00	Pass	4.97
Right	0.21	1.88	-5.00	5.00	Pass	4.03
Bottom	-0.14	1.53	-5.00	5.00	Pass	4.13

ACR CT QA #4

ACR CT Phantom - Module 4 Report

OVERALL RESULTS



ALL TOLERANCES PASSING

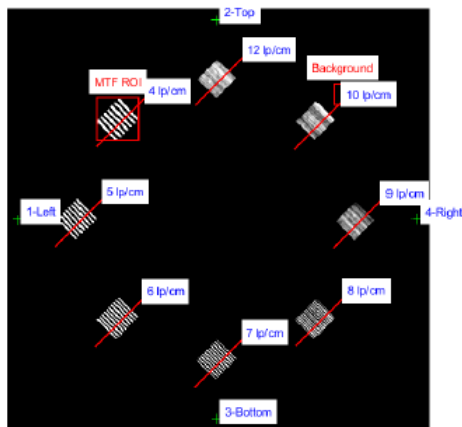


ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\ACR_CT\Module_4
Institution	Boulder Community Foothills Hosp
Station	CT01_OCO
kVp	120
mA	300
mAs	2259
Protocol	6.1 ABDOMEN/PELVIS
Filter	BODY FILTER
Convolution Kernel	STANDARD
DICOM Slice Thickness (mm)	5
SOP Instance UID	1.2.840.113619.2.55.1.1762897610.2203.1179930891.824.25
Slice Location	120
ACR Protocol	Adult Abdomen

Analysis Image



Visibility of 5 lp/cm Lines

The 5 lp/cm lines are visible: Pass

The 5 lp/cm pattern pass/fail is informational only and does not count toward overall pass/fail status.

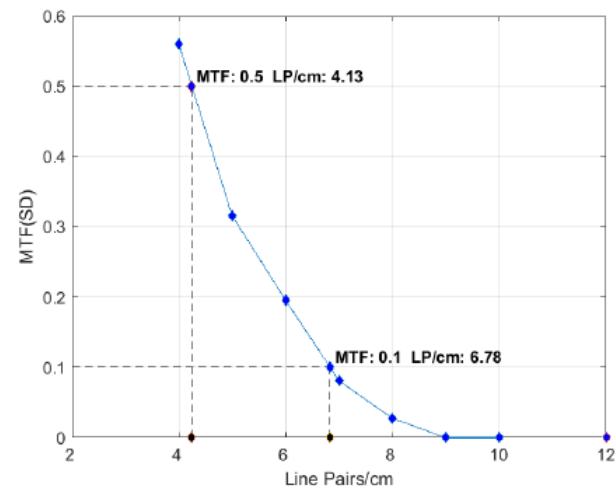
Modulation at 5 lp/cm

Bar	Modulation	Minimum Tolerance	Pass/Fail
5 lp/cm	621	600	Pass

MTF (Based on Standard Deviation)

Bar	MTF(SD)
4 lp/cm	0.56
5 lp/cm	0.32
6 lp/cm	0.20
7 lp/cm	0.08
8 lp/cm	0.03
9 lp/cm	0.00
10 lp/cm	0.00
12 lp/cm	0.00

MTF Curve



ACR CT QA #4



RADIOLOGICAL IMAGING TECHNOLOGY, INC.

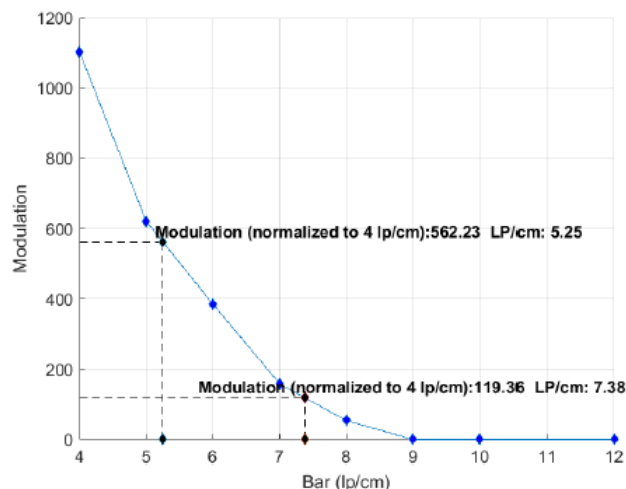
Interpolated LP

MTF	Interpolated lp/cm
0.5	4.13 lp/cm
0.1	6.78 lp/cm

Modulation

Bar	Modulation	Comments
4 lp/cm	1102.00	
5 lp/cm	621.00	
6 lp/cm	385.00	
7 lp/cm	159.00	
8 lp/cm	54.00	
9 lp/cm	0.00	Incorrect number of bars detected in this pattern.
10 lp/cm	0.00	Incorrect number of bars detected in this pattern.
12 lp/cm	0.00	Incorrect number of bars detected in this pattern.

Modulation



Interpolated LP (normalized to 4 lp/cm)

Modulation	Interpolated lp/cm
562.23	5.25
119.36	7.38



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BB Measurements

Number of BBs found	4
Max. BB Area (pixels)	12
Min. BB Area (pixels)	8
Top to Bottom Distance (mm)	196.88
Left to Right Distance (mm)	196.72
Phantom Angle (degrees)	0.04

Analysis Settings

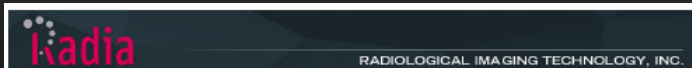
BB Threshold	2.5
Outer Radius Mask	257
Allowable Missing Bars	2
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault

常規成人腹部掃描模式可清楚分辨每公分六組線對（6 line pair/cm）以上，高解析度肺部掃描模式可清楚分辨每公分八組線對（8 line pair/cm）以上

或以常規成人腹部及高解析度肺部掃描模式下，其 MTF 百分之十之值與基準值差異為百分之二十以下



Catphan CT 528



CATPHAN Resolution - 528 Module Report

OVERALL RESULTS

PASS

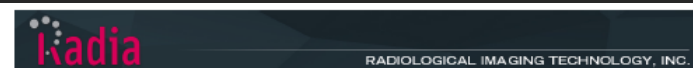
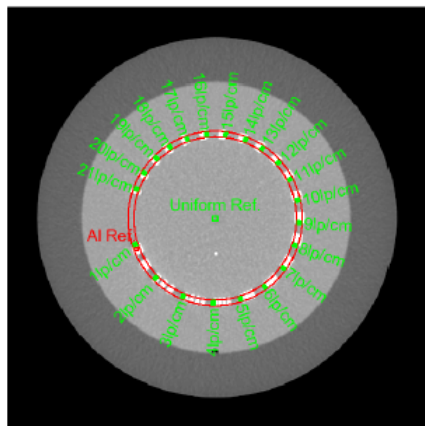
ANALYSIS COMPLETE

ALL TOLERANCES PASSING

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\CATPHAN\CTP528
Institution	
Station	
kVp	120
mA	442
mAs	110
Protocol	
Filter	BODY FILTER
Convolution Kernel	STANDARD
DICOM Slice Thickness(mm)	2.5
SOP Instance UID	1.2.840.113619.2.55.3.279721844.514.1284471618.226.23
Slice Location	60.5

Analysis Image



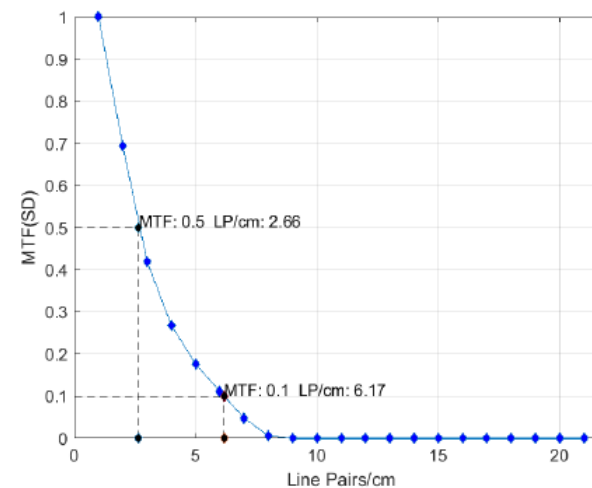
Line Pairs Detected

Spatial Resolution (lp/cm)	Minimum Resolution (lp/cm)	Pass/Fail
8 of 21 detected.	7	Pass

MTF (Based on Standard Deviation)

Bar	MTF(SD)
1 lp/cm	1.00
2 lp/cm	0.69
3 lp/cm	0.42
4 lp/cm	0.27
5 lp/cm	0.18
6 lp/cm	0.11
7 lp/cm	0.05
8 lp/cm	0.01
9 lp/cm	0.00
10 lp/cm	0.00
11 lp/cm	0.00
12 lp/cm	0.00
13 lp/cm	0.00
14 lp/cm	0.00
15 lp/cm	0.00
16 lp/cm	0.00
17 lp/cm	0.00
18 lp/cm	0.00
19 lp/cm	0.00
20 lp/cm	0.00
21 lp/cm	0.00

MTF Curve



Catphan CT 528



RADIOLOGICAL IMAGING TECHNOLOGY, INC.

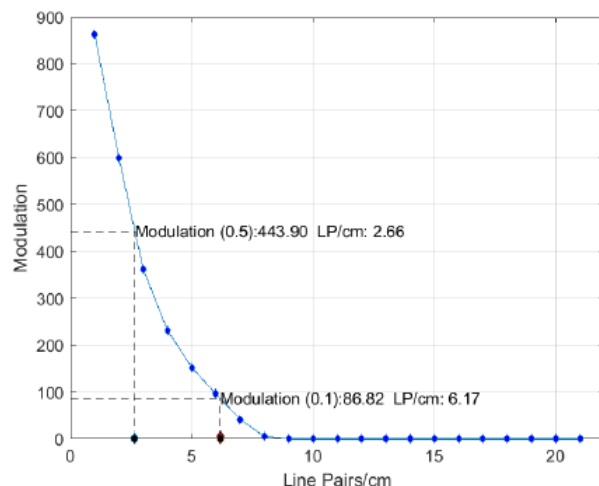
Interpolated LP

MTF	Interpolated lp/cm
0.5	2.66 lp/cm
0.1	6.17 lp/cm

Modulation

Bar	Modulation	Comments
1 lp/cm	863.80	
2 lp/cm	599.66	
3 lp/cm	362.79	
4 lp/cm	231.78	
5 lp/cm	152.88	
6 lp/cm	96.25	
7 lp/cm	41.88	
8 lp/cm	5.25	
9 lp/cm	0.00	Incorrect number of bars detected in this pattern.
10 lp/cm	0.00	Incorrect number of bars detected in this pattern.
11 lp/cm	0.00	Incorrect number of bars detected in this pattern.
12 lp/cm	0.00	Incorrect number of bars detected in this pattern.
13 lp/cm	0.00	Incorrect number of bars detected in this pattern.
14 lp/cm	0.00	Incorrect number of bars detected in this pattern.
15 lp/cm	0.00	Incorrect number of bars detected in this pattern.
16 lp/cm	0.00	No bars or spaces detected.
17 lp/cm	0.00	No bars or spaces detected.
18 lp/cm	0.00	No bars or spaces detected.
19 lp/cm	0.00	No bars or spaces detected.
20 lp/cm	0.00	No bars or spaces detected.
21 lp/cm	0.00	No bars or spaces detected.

Modulation Calculation



RADIOLOGICAL IMAGING TECHNOLOGY, INC.

Interpolated LP (normalized to 1 lp/cm)

Modulation	Interpolated lp/cm
443.90	2.66
86.82	6.17

Analysis Settings

Peak Threshold	2
Minimum Pulse Distance	4
Low Value Gap	6
Detection Threshold	0.3
Minimum Bars to Detect	2
Bar Threshold Delta	25
Max Objects	3
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault



Catphan CT Uniformity

CATPHAN Uniformity Report

OVERALL RESULTS



ALL TOLERANCES PASSING

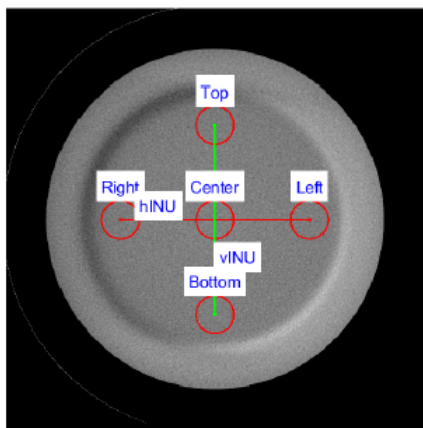


ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\CATPHAN\CTP486
Institution	
Station	
kVp	
mA	80
mAs	75200
Protocol	
Filter	
Convolution Kernel	Ram-Lak
DI(OM Slice Thickness(mm)	2.5
SOP Instance UID	1.2.246.352.63.1.5046098762953074145.16031764751980778884
Slice Location	-37.5

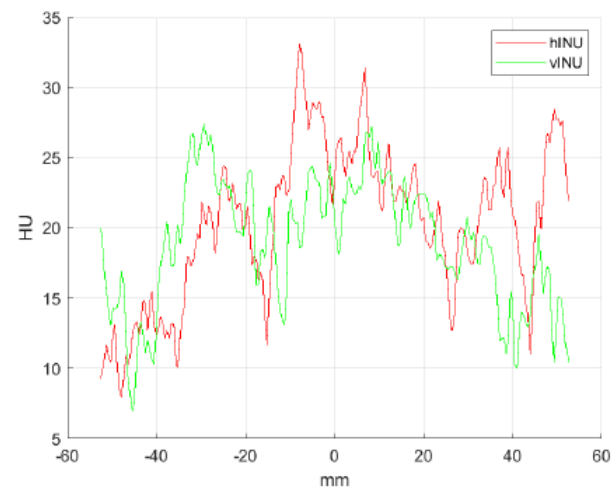
Analysis Image



CT Uniformity

Area	Mean(HU)	SD(HU)	Uniformity (Mean Ctr - Mean Area)	Pass-Fail (Range: -30.00 to +30.00)
Center	+21.39	+15.82	+0.00	NA
Top	+10.88	+15.49	+10.51	Pass
Right	+8.82	+16.68	+12.57	Pass
Left	+14.46	+16.20	+6.93	Pass
Bottom	+15.07	+16.80	+6.32	Pass

Integral Uniformity Profiles



CT Uniformity

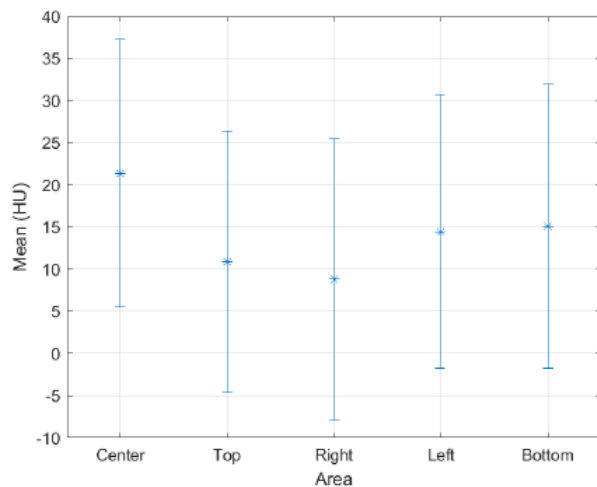
Area	Mean(HU)	SD(HU)	Uniformity (Mean Ctr - Mean Area)	Pass-Fail (Range: -30.00 to +30.00)
Center	+21.39	+15.82	+0.00	NA
Top	+10.88	+15.49	+10.51	Pass
Right	+8.82	+16.68	+12.57	Pass
Left	+14.46	+16.20	+6.93	Pass
Bottom	+15.07	+16.80	+6.32	Pass

Catphan CT Uniformity



RADIOLOGICAL IMAGING TECHNOLOGY, INC.

CT Uniformity Area by Mean (HU)



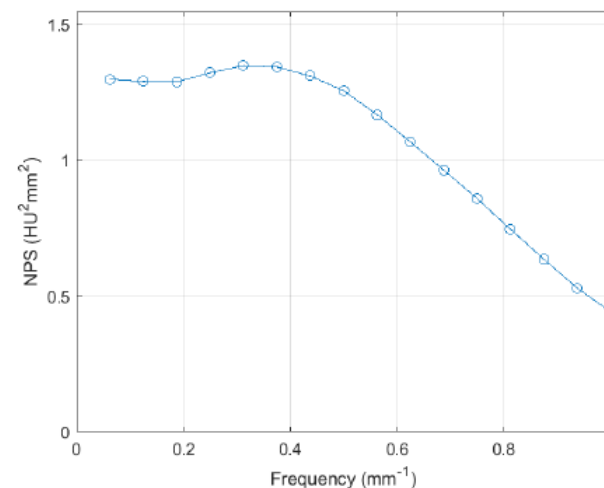
Integral Non-Uniformity

Orientation	Unfiltered	Filtered
Horizontal Integral Non-Uniformity	+3.39	+0.61
Vertical Integral Non-Uniformity	+2.67	+0.60



RADIOLOGICAL IMAGING TECHNOLOGY, INC.

NPS Plot



Noise Power Spectrum

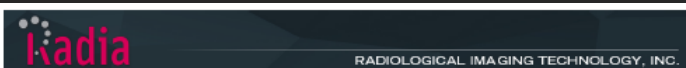
Noise Power Peak (HU ² mm ⁻²)	1.35
Peak Frequency (mm ⁻¹)	0.31

Analysis Settings

Profile Filter Size	15
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault



Catphan CT 404



CATPHAN Materials - 404 Module Report

OVERALL RESULTS



ONE OR MORE TOLERANCE(S) FAILING

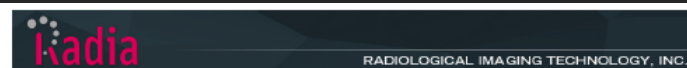
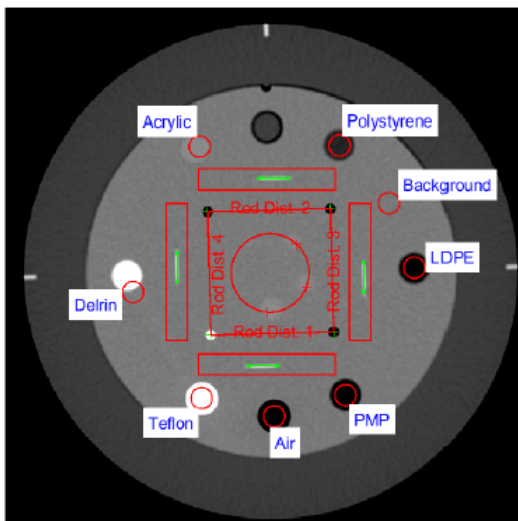


ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\CATPHAN\CTP404W.dcm
Institution	Boulder Community Hosp Foothills
Station	Is01
kVp	120
mA	510
mAs	63
Protocol	1.1 HEAD WO 10/12
Filter	MEDIUM FILTER
Convolution Kernel	STANDARD
DICOM Slice Thickness(mm)	5
SOP Instance UID	1.3.6.1.4.1.9590.100.1.2.404831530410950045510946454151688670357
Slice Location	0

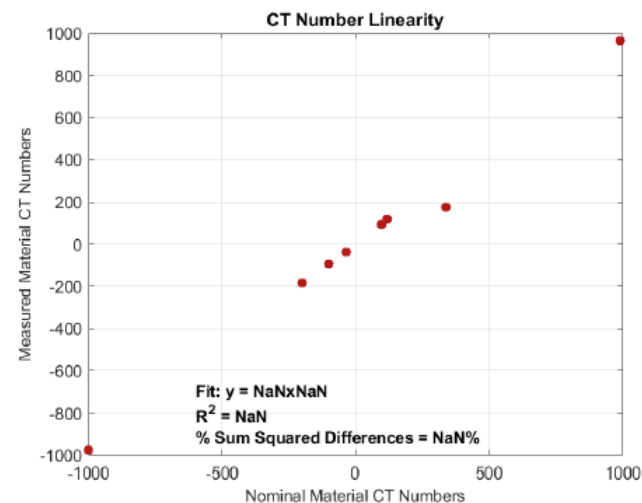
Analysis Image



CT Material Values

Material	Mean(HU)	SD(HU)	Min. (HU)	Target (HU)	Max. (HU)	Pass-Fail
Air	NaN	NaN	-1030	-1000	-970	Fail
Polystyrene	-37.85	3.77	-45	-35	-25	Pass
Background	91.80	3.49	90	100	110	Pass
LDPE	-93.07	3.43	-110	-100	-90	Pass
PMP	-183.07	4.17	-220	-200	-180	Pass
Air	-976.15	3.82	-1030	-1000	-970	Pass
Teflon	966.20	4.29	890	990	1090	Pass
Delrin	174.58	110.64	305	340	375	Fail
Acrylic	119.35	4.92	108	120	132	Pass

CT Number Linearity



Slice Width Measurements

Orientation	Measured Slice Width (mm)	Actual Slice Width	Minimum Measured Tolerance (mm)	Maximum Measured Tolerance (mm)	Pass/Fail
Bottom	5.05	5	4.5	5.5	Pass
Top	4.80	5	4.5	5.5	Pass
Left	5.04	5	4.5	5.5	Pass
Right	4.87	5	4.5	5.5	Pass



Catphan CT 404

RADIOLOGICAL IMAGING TECHNOLOGY, INC.

Ramp Alignment

Orientation	Ramp Alignment vs. Center (mm)
Bottom	-1.05
Top	0.74
Left	-0.75
Right	0.92

Ramp Yaw & Tilt

Orientation	Ramp Alignment (Degrees)	Ramp Alignment (DMS)
Yaw	-0.0019°	0° 0 minutes -6.84 seconds
Tilt	-0.0009°	0° 0 minutes -3.24 seconds

Rod Distances

Rod Distance	Distance (mm)	Pass/Fail (Min. = 48.96 Max. = 51.04)
1	50.01	Pass
2	50.00	Pass
3	50.06	Pass
4	50.06	Pass

Low Contrast Spheres

Number of Detected Low Contrast Spheres	3
---	---

CT Number Linearity

Slope	NaN
Intercept	NaN
Correlation Coefficient (R^2)	NaN
Percent Sum Squared Differences	NaN%

Analysis Settings

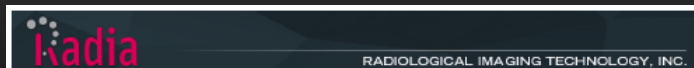
Slice Threshold	2
Estimated Background CT Number	3
Estimated Air CT Number	-1000
Air Rod Threshold	0.33
Teflon Rod Threshold	0.33
Fine-tune Centers	Enabled
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault

Produced by Radia V7.00.000

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26/7/2026 7:38:29 pm

ACR MRI Localizer image



ACR Large MR Phantom - Localizer

OVERALL RESULTS

**PASS**

ALL TOLERANCES PASSING

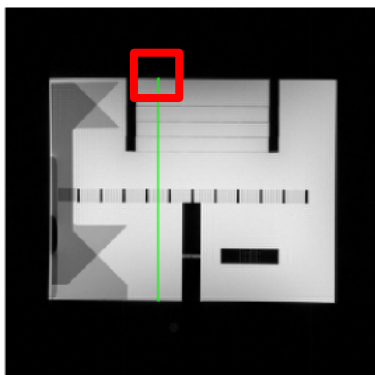


ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\ACR_MRI\Localizer
Institution	Rocky Mountain Open Scan-Golden
Station	MRC17485
Magnetic Field Strength	1.494
Protocol	Sagittal Localizer
DICOM Slice Thickness (mm)	20
SOP Instance UID	1.3.12.2.1107.5.2.6.23452.30000007020103405234300001227
Slice Location	0
Echo Time	20
Repetition Time	200
In Plane Phase Encoding Direction	ROW
Pixel Bandwidth	400
ReceiveCoilName	
Transmit Coil Name	Body
Flip Angle	90
Device Serial Number	23452
Software Version	syngo MR 2004A 4VA25A
Scan Options	
Echo Number	0
Echo Train Length	1
Operating Mode	

Analysis Image

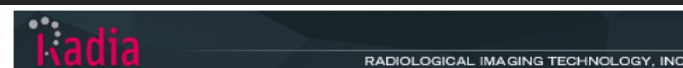


Localizer Line Length

Localizer Line Length (mm)	148.01
ACR Minimum (mm)	145.00
ACR Maximum (mm)	151.00
Pass-Fail	Pass

Analysis Settings

Localizer Phantom Threshold	0.5
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault

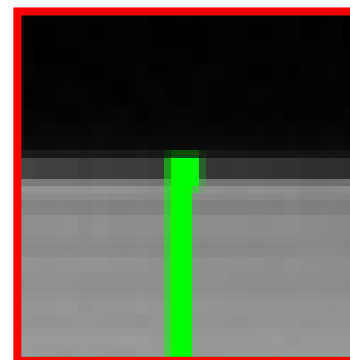


Localizer Line Length

Localizer Line Length (mm)	148.01
ACR Minimum (mm)	145.00
ACR Maximum (mm)	151.00
Pass-Fail	Pass

Analysis Settings

Localizer Phantom Threshold	0.5
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault



ACR MRI #1



RADIOLOGICAL IMAGING TECHNOLOGY, INC.

ACR Large MR Phantom - Slice 1

OVERALL RESULTS



ALL TOLERANCES PASSING

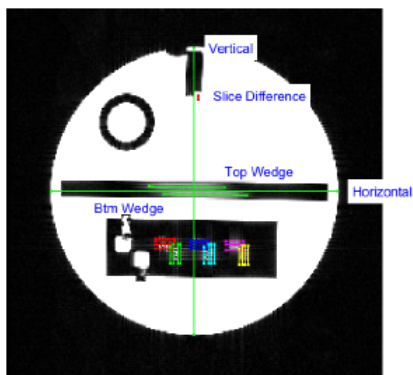


ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\ACR_MRI\Slice_1.dcm
Institution	Rocky Mountain Open Scan-Golden
Station	MRC17485
Magnetic Field Strength	1.494
Protocol	ACR_T1
DICOM Slice Thickness(mm)	5
SOP Instance UID	1.3.12.2.1107.5.2.6.23452.30000007020103405234300001230
Slice Location	-43.816
Echo Time	20
Repetition Time	500
In Plane Phase Encoding Direction	COL
Pixel Bandwidth	90
ReceiveCoilName	
Transmit Coil Name	Body
Flip Angle	90
Device Serial Number	23452
Software Version	syngo MR 2004A 4VA25A
Scan Options	
Echo Number	0
Echo Train Length	1
Operating Mode	

Analysis Image



RADIOLOGICAL IMAGING TECHNOLOGY, INC.

Geometric Accuracy

	Vertical Line	Horizontal Line
Length (mm)	191.52	191.12
ACR Minimum (mm)	187.00	187.00
ACR Maximum (mm)	193.00	193.00
Pass-Fail	Pass	Pass

Resolution

Resolution Pattern	Resolution Visibility
1.1 mm Upper Left	Visible
1.1 mm Lower Right	Visible
1.0 mm Upper Left	Visible
1.0 mm Lower Right	Visible
0.9 mm Upper Left	Visible
0.9 mm Lower Right	Visible

Minimum tolerance for Resolution Pattern visibility: 1.0 mm
Resolution Visibility pass/fail status: Pass

Slice Thickness

Slice Thickness (mm)	5.35
ACR Minimum (mm)	4.30
ACR Maximum (mm)	5.70
Pass-Fail	Pass
Top Length (mm)	51.10
Bottom Length (mm)	56.17

Slice Difference

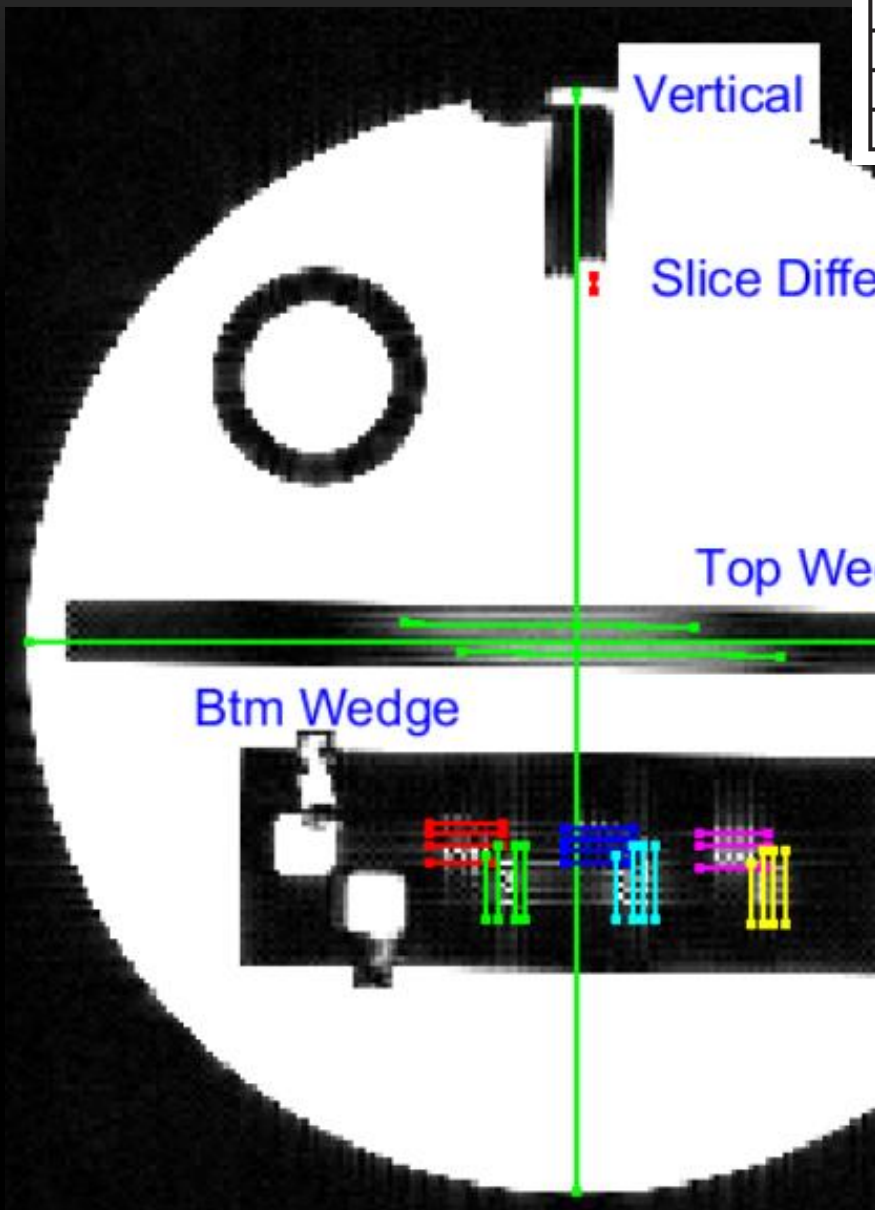
Slice Difference (mm)	-2.60
ACR Minimum (mm)	-5.00
ACR Maximum (mm)	5.00
Pass-Fail	Pass

Analysis Settings

Minimum Modulation	50
Slice 1 Phantom Threshold	0.5
Slice 1 FWHM Threshold	0.5
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault



ACR MRI #1



Slice Difference

Slice Difference (mm)	-2.60
ACR Minimum (mm)	-5.00
ACR Maximum (mm)	5.00
Pass-Fail	Pass

Slice Thickness

Slice Thickness (mm)	5.35
ACR Minimum (mm)	4.30
ACR Maximum (mm)	5.70
Pass-Fail	Pass
Top Length (mm)	51.10
Bottom Length (mm)	56.17

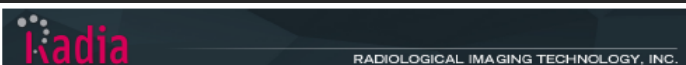
Resolution

Resolution Pattern	Resolution Visibility
1.1 mm Upper Left	Visible
1.1 mm Lower Right	Visible
1.0 mm Upper Left	Visible
1.0 mm Lower Right	Visible
0.9 mm Upper Left	Visible
0.9 mm Lower Right	Visible

Minimum tolerance for Resolution Pattern visibility: 1.0 mm

Resolution Visibility pass/fail status: Pass

ACR MRI #5



ACR Large MR Phantom - Slice 5

OVERALL RESULTS



ALERT

ONE OR MORE TOLERANCE(S) FAILING

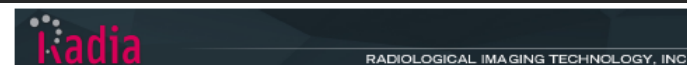
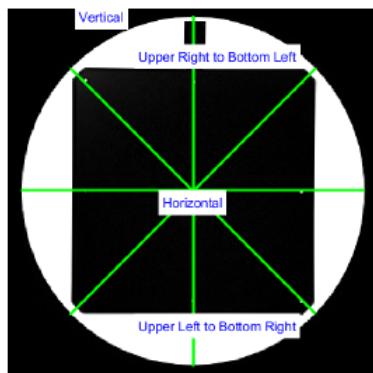


ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\ACR_MRI\Slice_5_new.mat
Institution	Policlinico San Marco
Station	AWP41179
Magnetic Field Strength	1.5
Protocol	ACR
DICOM Slice Thickness(mm)	5
SOP Instance UID	1.3.12.2.1107.5.2.18.41179.201907261627179868105154
Slice Location	-0.2343
Echo Time	20
Repetition Time	1000
In Plane Phase Encoding Direction	COL
Pixel Bandwidth	150
ReceiveCoilName	
Transmit Coil Name	Body
Flip Angle	90
Device Serial Number	41179
Software Version	syngo MR D13
Scan Options	
Echo Number	1
Echo Train Length	1
Operating Mode	

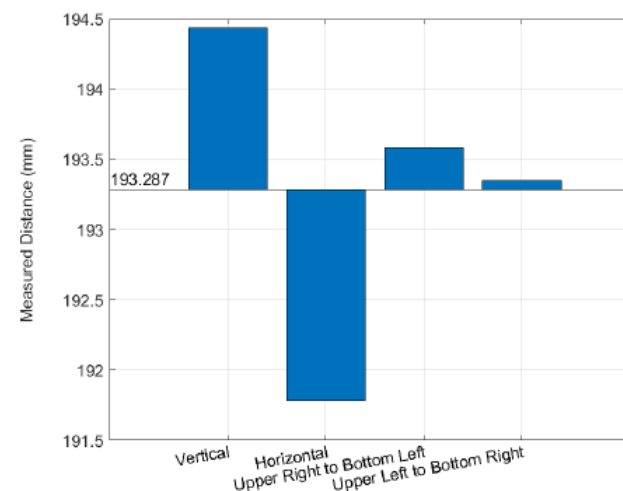
Analysis Image



Geometric Accuracy

Distance	Measured Distance (mm)	Minimum (mm)	Maximum (mm)	Pass-Fail
Vertical	194.44	187.00	193.00	Fail
Horizontal	191.78	187.00	193.00	Pass
Upper Right to Bottom Left	193.58	187.00	193.00	Fail
Upper Left to Bottom Right	193.35	187.00	193.00	Fail

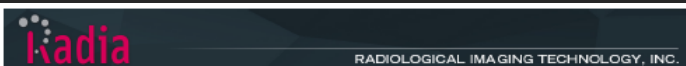
Distance



Analysis Settings

Slice 5 Phantom Threshold	0.50
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault

ACR MRI #7



ACR Large MR Phantom - Slice 7

OVERALL RESULTS



ALL TOLERANCES PASSING

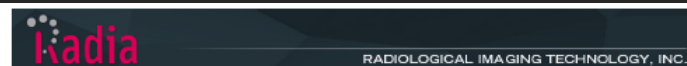
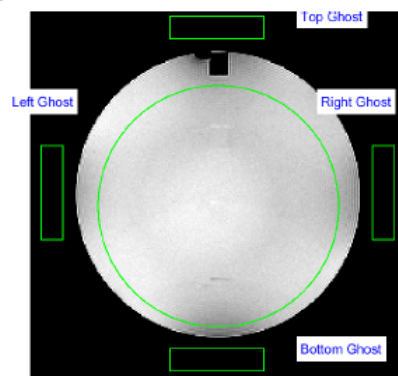


ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\ACR_MRI\Slice_7
Institution	Rocky Mountain Open Scan-Golden
Station	MRC17485
Magnetic Field Strength	1.494
Protocol	ACR_T1
DICOM Slice Thickness(mm)	5
SOV Instance UID	1.3.12.2.1107.5.2.6.23452.30000007020103405234300001233
Slice Location	16.184
Echo Time	20
Repetition Time	500
In Plane Phase Encoding Direction	COL
Pixel Bandwidth	90
ReceiveCoilName	
Transmit Coil Name	Body
Flip Angle	90
Device Serial Number	23452
Software Version	syngo MR 2004A 4VA25A
Scan Options	
Echo Number	0
Echo Train Length	1
Operating Mode	

Analysis Image



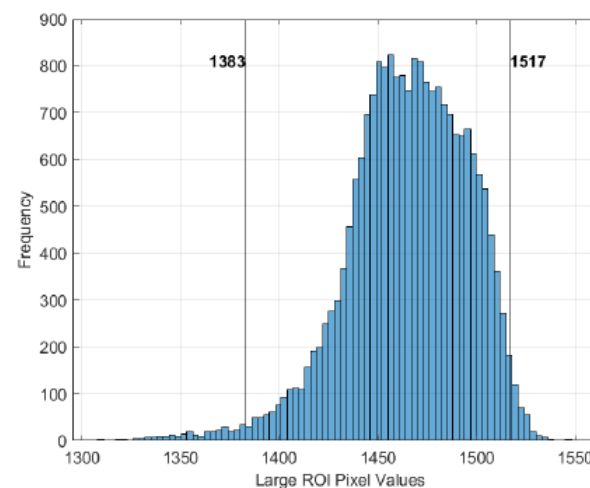
Percent Integral Uniformity

Percent Integral Uniformity	95.38
ACR Minimum	87.50
Pass-Fail	Pass

PIU Area Statistics

Mean Large ROI	1464.71
Small ROI Low Signal	1383
Small ROI High Signal	1517

Frequency of Large ROI Pixel Values



Percent-Signal Ghosting

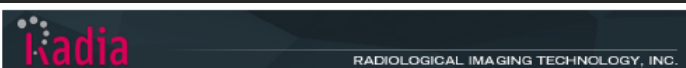
Percent-Signal Ghosting	0.0061698
ACR Maximum	0.030
Pass-Fail	Pass

Ghost Area Statistics

Area	Mean	SD
Top	+19.53	8.55
Bottom	+24.56	10.02
Left	+12.85	6.54
Right	+13.16	6.68
Large ROI	+1464.71	30.48



ACR MRI #8



ACR Large MR Phantom - Slice 8

OVERALL RESULTS



ALL TOLERANCES PASSING

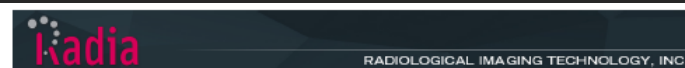
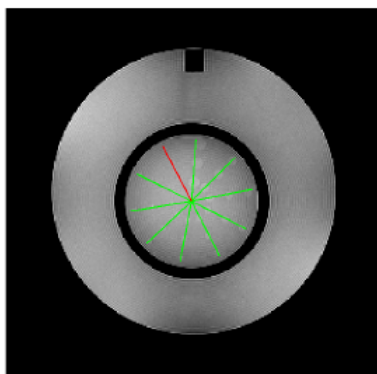


ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\ACR_MRI\Slice_8.dcm
Institution	Rocky Mountain Open Scan-Golden
Station	MRC17485
Magnetic Field Strength	1.494
Protocol	ACR_T2
DICOM Slice Thickness(mm)	5
SOP Instance UID	1.3.12.2.1107.5.2.6.23452.300000070201034052343000001251
Slice Location	36.184
Echo Time	20
Repetition Time	2000
In Plane Phase Encoding Direction	COL
Pixel Bandwidth	80
ReceiveCoilName	
Transmit Coil Name	Body
Flip Angle	90
Device Serial Number	23452
Software Version	syngo MR 2004A 4VA25A
Scan Options	
Echo Number	0
Echo Train Length	1
Operating Mode	

Analysis Image



Spokes Detected - Slice 8

Number of Spokes Detected	Minimum Nominal Number of Spokes Detected	Pass/Fail
9	8	Pass

Contrast to Noise Ratios

Spoke Number	Angle (deg)*	CNR Inner	CNR Middle	CNR Outer
1	5.00	7.13	4.77	4.72
2	46.00	3.51	2.81	2.19
3	80.00	3.81	1.94	3.97
4	117.00	5.76	3.15	1.71
5	153.00	3.34	2.37	2.30
6	191.00	4.85	3.69	3.88
7	227.00	5.88	4.03	4.27
8	261.00	3.41	2.16	3.96
9	297.00	2.17	1.47	2.82
10	333.00	1.84	1.28	2.75

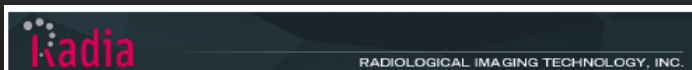
*Angles clockwise from 12:00

Analysis Settings

Slice 8 Spoke Width	9
CNR Inner Ring Slice 8	2.17
CNR Middle Ring Slice 8	1.46
CNR Outer Ring Slice 8	1.7
Structuring Element Size (Slice 8)	9
Threshold Start Slice 8	20
Threshold Stop Slice 8	35
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault



ACR MRI #11



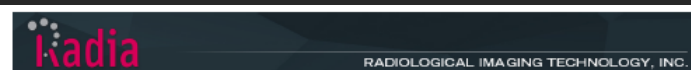
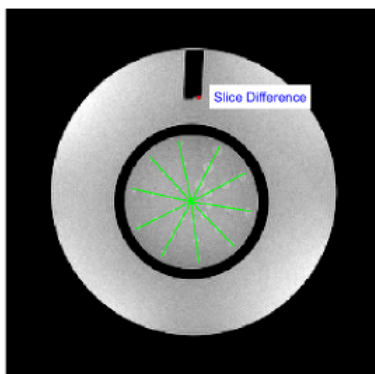
ACR Large MR Phantom - Slice 11

OVERALL RESULTS	
 ALL TOLERANCES PASSING	 ANALYSIS COMPLETE

Image Information

Filename	C:\RIT\Demo Images\Radia Demo Images\ACR_MRI\Slice_11.dcm
Institution	Rocky Mountain Open Scan-Golden
Station	MRC17485
Magnetic Field Strength	1.494
Protocol	ACR_T2
DICOM Slice Thickness(mm)	5
SOP Instance UID	1.3.12.2.1107.5.2.6.23452.300000070201034052343000001254
Slice Location	56.184
Echo Time	80
Repetition Time	2000
In Plane Phase Encoding Direction	COL
Pixel Bandwidth	80
ReceiveCoilName	
Transmit Coil Name	Body
Flip Angle	90
Device Serial Number	23452
Software Version	syngo MR 2004A 4VA25A
Scan Options	
Echo Number	1
Echo Train Length	1
Operating Mode	

Analysis Image



Spokes Detected - Slice 11

Number of Spokes Detected	Minimum Nominal Number of Spokes Detected	Pass/Fail
10	10	Pass

Slice Difference

Slice Difference (mm)	-1.23
ACR Minimum (mm)	-5
ACR Maximum (mm)	5
Pass-Fail	Pass

Contrast to Noise Ratios

Spoke Number	Angle (deg)*	CNR Inner	CNR Middle	CNR Outer
1	28.00	3.74	3.24	1.92
2	63.00	4.12	2.63	2.24
3	99.00	3.68	2.36	2.14
4	136.00	2.76	1.59	1.47
5	173.00	2.80	1.81	2.29
6	209.00	4.39	3.25	2.30
7	244.00	3.79	2.56	2.74
8	283.00	1.71	1.63	1.62
9	318.00	1.92	1.42	1.49
10	349.00	1.50	1.99	1.56

*Angles clockwise from 12:00

Analysis Settings

Slice 11 Spoke Width	9
CNR Inner Ring Slice 11	1.4
CNR Middle Ring Slice 11	1.37
CNR Outer Ring Slice 11	1.43
Structuring Element Size (Slice 11)	9
Threshold Start Slice 11	20
Threshold Stop Slice 11	35
Preferences Profile	radiaprofile
Tolerances Profile	RITSiteGroup RITSite RITVault

Slice Difference

Slice Difference (mm)	-1.23
ACR Minimum (mm)	-5
ACR Maximum (mm)	5
Pass-Fail	Pass





RIT 流程自動化：Sequencer

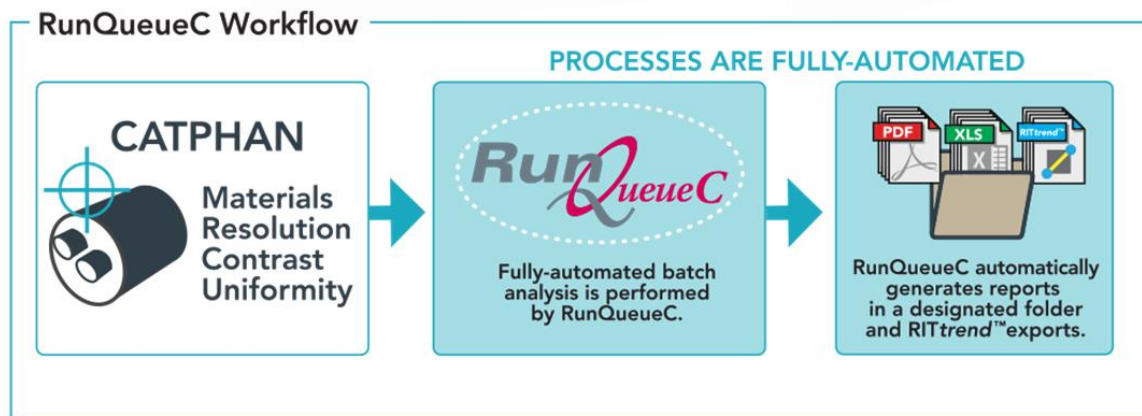


"One-Click" Analysis

批次執行：放射師只需單擊一下，即可選擇接收到的 DICOM 系列並執行完整的分析例行程序

自動對齊：自動定位假體標記、居中 ROI 並計算參數，無需手動定位。

多模態 Sequencer：標準化跨 MRI、CT、CBCT 及數位攝影設備的測試佇列。





RIT Cerberus: 更進一步 零點擊自動化

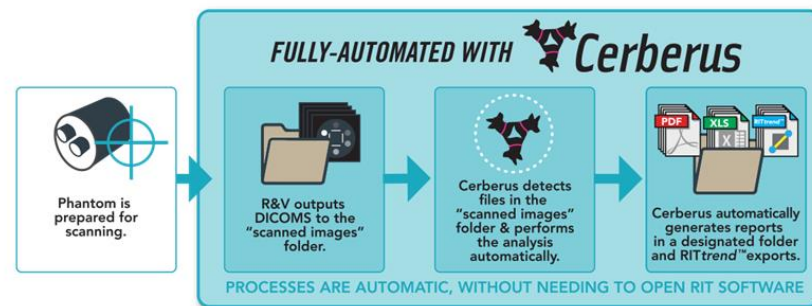
背景資料夾監控

無需啟動 **GUI**：在背景靜默運行，不需要放射師啟動桌面應用軟體。

資料夾監控器：持續監控目標網路目錄，接收來自掃描儀或 PACS 的 DICOM 匯出檔案。

自動執行：自動比對傳入檔案與 ACR MRI 及 Catphan CT 假體的預先配置測試佇列。

即時輸出：自動產生結構化的 PDF/XLS 報告並更新 RIT Trend 資料庫。





RITtrend™ 資料追蹤與超出容忍度警告

統計製程管制與警報追蹤

歷史趨勢：自動儲存並繪製長時間的 QA 測量值，以追蹤掃描儀效能漂移。

容許度管理：雙向同步確保在 Radia 中設定的自訂容忍度會自動更新至 RITtrend。

主動警報：當分析資料超出控制極限時，立即向物理師發送電子郵件警告。



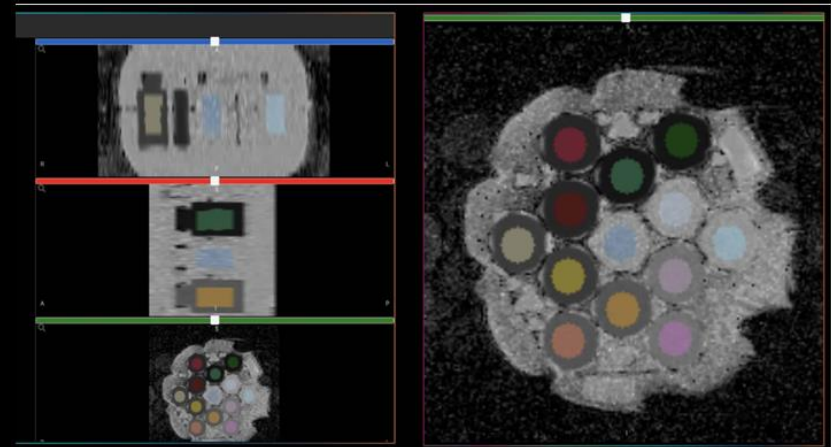
Standardizing Diffusion-Weighted Imaging (DWI) & ADC Values

Phantom Construction & Tissue Mimics:

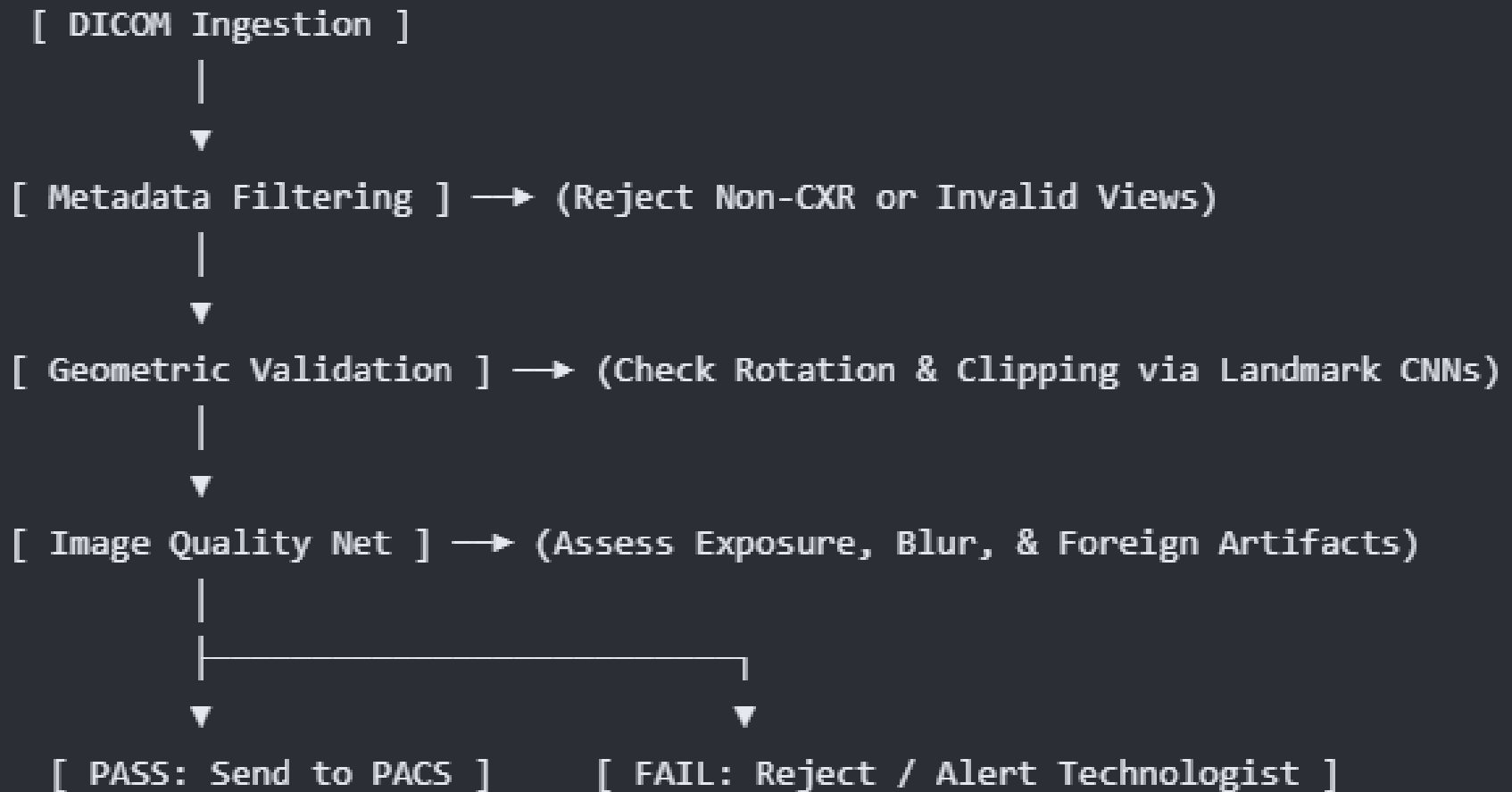
假體構造與組織模擬：不同濃度的聚乙烯吡咯烷酮 (PVP) 聚合物溶液，模擬人腦組織中的水分子相互作用。包含 30 mL 蒸餾水參考瓶及 5 mL 基準瓶。專利整合型液晶溫度計允許在擷取期間進行 15°C 至 24°C 的精確溫度標準化（至關重要，因為 ADC 值會隨溫度漂移）。

Clinical & Biomarker Applications:

臨床與生物標記應用：標準化 1.5 T 與 3.0 T 掃描儀的擴散指標，用於中風檢測、腫瘤分期及腦腫瘤監測。為多站點定量影像生物標記建立真值校準。



Automated AI-based quality pipeline for chest radiograph



Step-by-Step AI Quality Pipeline

► Eur Radiol. 2022 Nov;32(11):7680-7690. doi: 10.1007/s00330-022-08771-x. Epub 2022 Apr 14.

Automated quality assessment of chest radiographs based on deep learning and linear regression cascade algorithms

Yu Meng ^{1 2}, Jingru Ruan ³, Bailin Yang ⁴, Yang Gao ⁵, Jianqiu Jin ⁴, Fangfang Dong ⁶, Hongli Ji ⁷, Linyang He ⁷, Guohua Cheng ⁷, Xiangyang Gong ^{8 9}

Affiliations + expand

PMID: 35420306 DOI: [10.1007/s00330-022-08771-x](https://doi.org/10.1007/s00330-022-08771-x)

1. Ingestion & Metadata Filtering (DICOM Parsing)

Action: The pipeline automatically intercepts the raw image from the acquisition scanner.

AI Mechanism: Natural Language Processing (NLP) or rule-based models read the DICOM headers. They verify that the body part is "CHEST" and filter the projection type (e.g., separating Posteroanterior [PA] from Anteroposterior [AP]). Non-matching images are instantly routed away from the main chest pipeline.

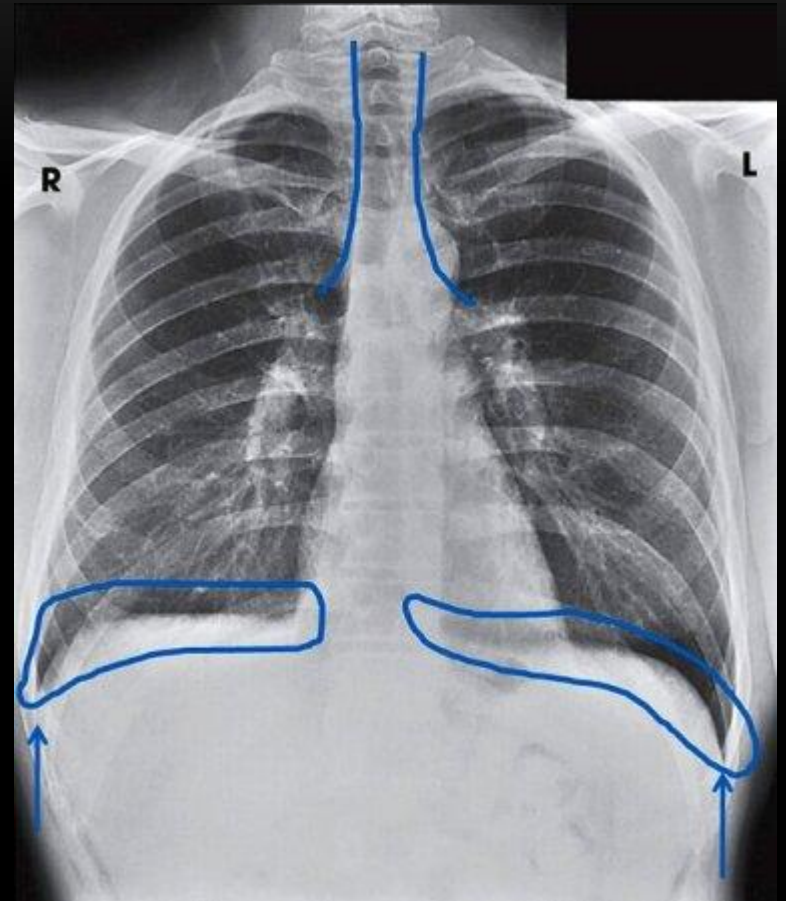
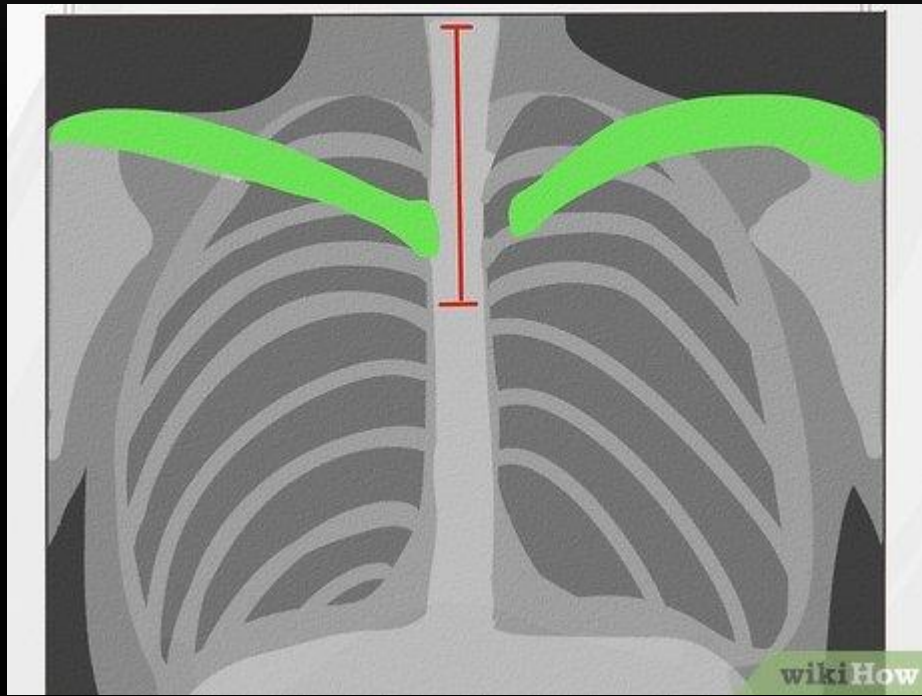
2. Geometric Validation (Anatomical Landmark Detection)

Action: Checks patient positioning, rotation, and whether any critical anatomy is cut off (clipping)

AI Mechanism: Regression-based Convolutional Neural Networks (CNNs) or segmentation models like SAR-Net map key landmarks:

Rotation: Measures the pixel distances between the medial clavicle tips and the spinal processes.

Clipping: Automatically traces the bounding box of the thorax. If the costophrenic angles or lung apices touch the image boundaries, it flags the image for "anatomy truncation"



Step-by-Step AI Quality Pipeline

3. Deep Learning Quality Assessment (Classification Network)

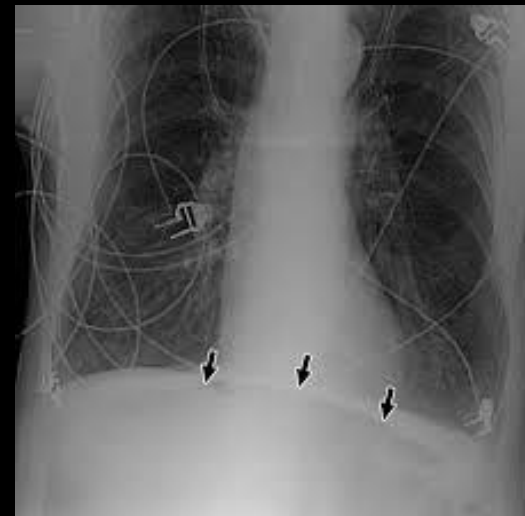
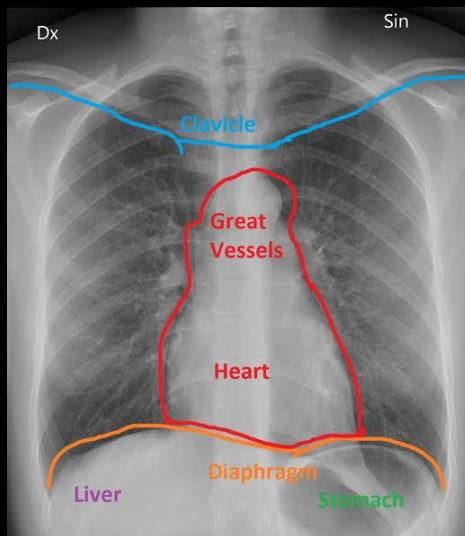
Action: Checks exposure faults (over/under-penetration), motion blur, and the presence of foreign artifacts.

AI Mechanism: ResNet or EfficientNet backbones trained on thousands of multi-center, expert-annotated datasets evaluate the image matrices:

Inspiration: Counts the visible ribs above the diaphragm line.

Penetration/Contrast: Analyzes histogram data alongside feature extraction layers to check if the thoracic vertebrae are visible behind the heart.

Artifacts: Identifies foreign metallic or physical objects (e.g., jewelry, ECG leads, external tubes) obscuring vital lung fields



Step-by-Step AI Quality Pipeline

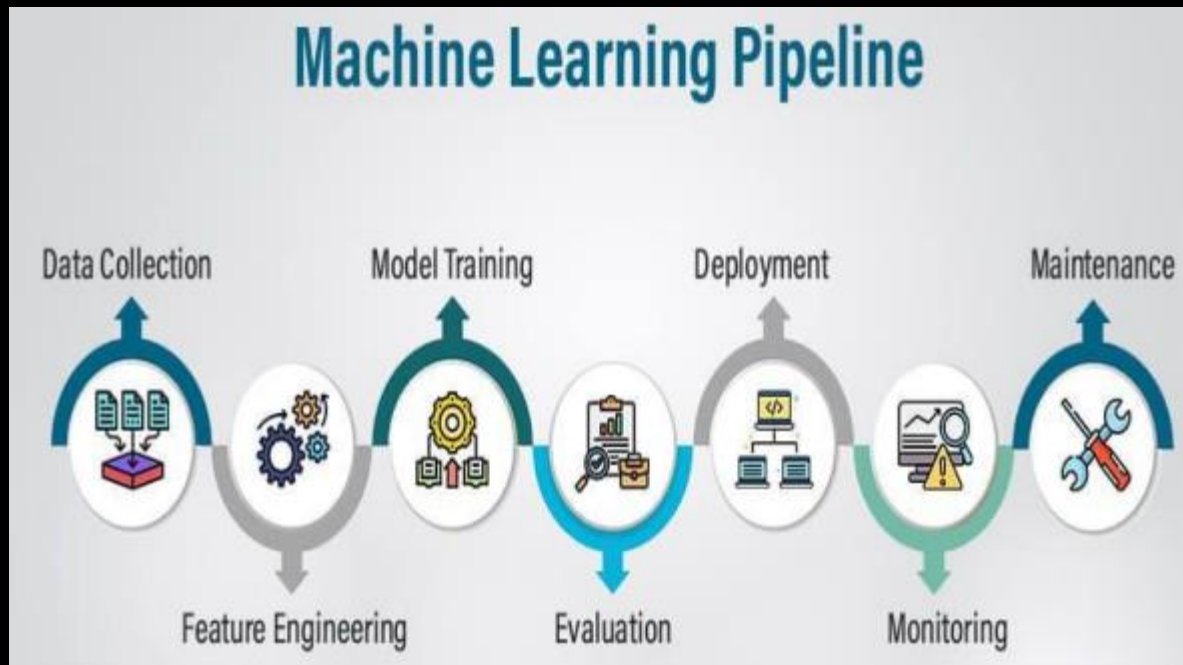
4. Automated Gating & Feedback Action

Action: Generates a unified quality metadata profile and acts as a firewall

Outputs:

Pass: Image passes into PACS for immediate clinical evaluation.

Fail/Warn: The system generates a low-latency alert on the technologist's console, providing precise reasons (e.g., *"Warning: Left costophrenic angle clipped; repeat scan recommended"*)



謝謝