

Fully Automatic Phantom Image Scoring

Leeds Test Objects, 2014 Distributor Meeting
York, October 7th

Who We Are

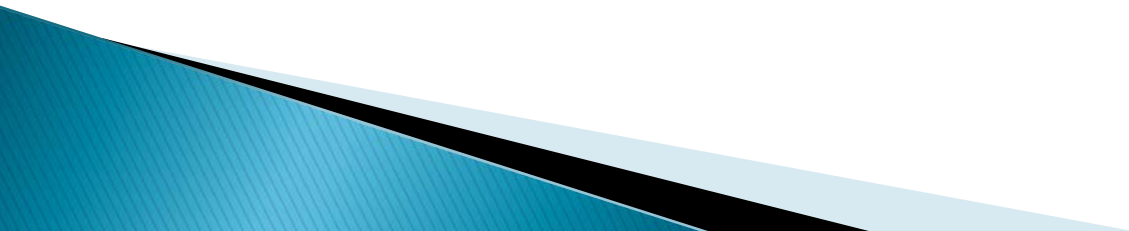
- ▶ CyberQual
 - Gorizia, Italy
 - Delivers quality control services
 - Develops products for Quality Control
- ▶ Strongly Related with Leeds Test Objects
 - Distributor in Italy
 - Software developer partner



Auto-Scoring Software

AUTOPIA

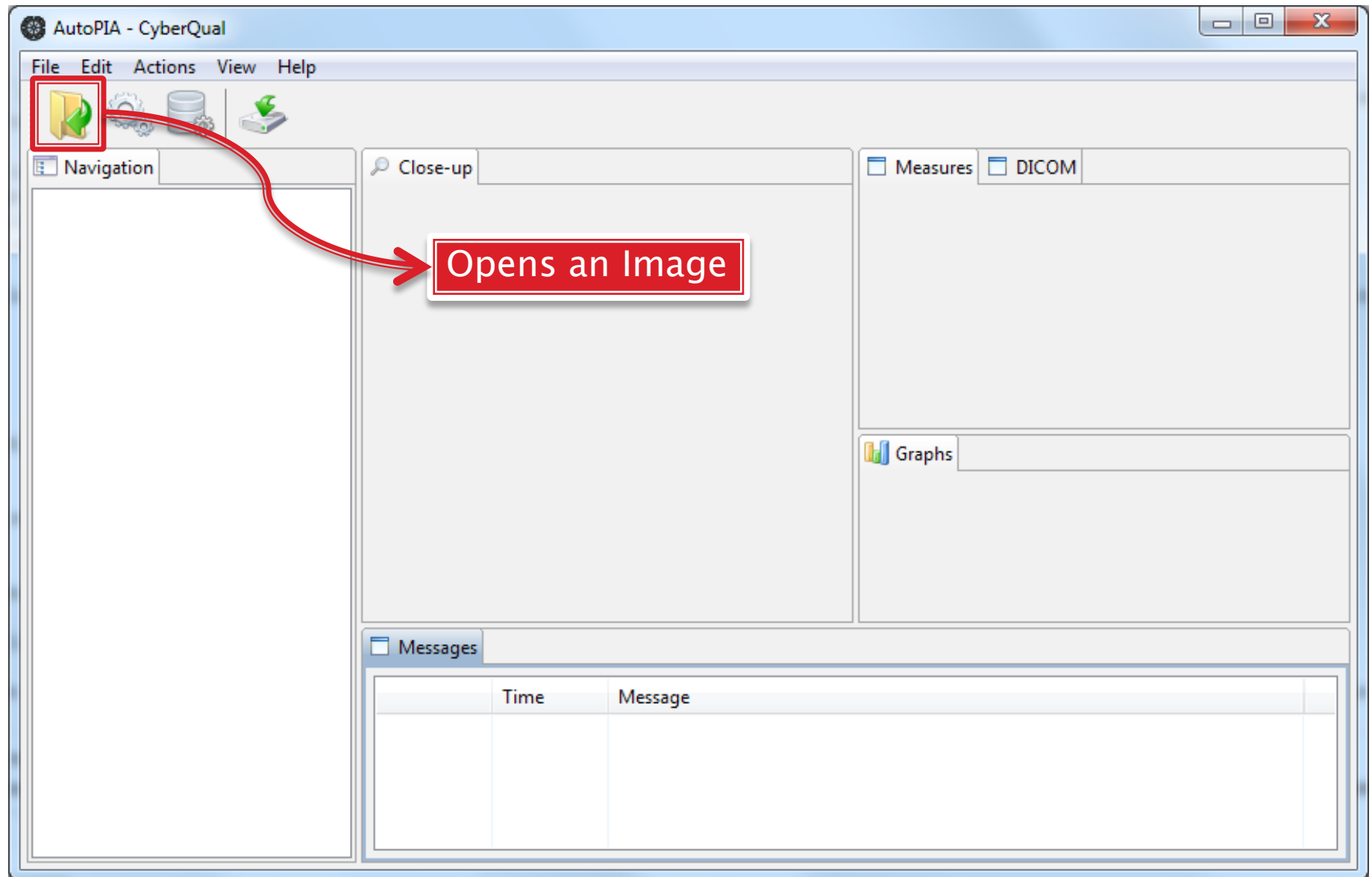
Automatic **P**hantom **I**mage **A**nalysis



AutoPIA Benefits

- ▶ Easy to use
 - Scoring is fully automatic
- ▶ Image Quality Indices are unquestionable
 - Objective
 - Standard
 - Reproducible
 - Verifiable
- ▶ Better results with less effort
 - More sensitive and precise
 - Not influenced by intra- and inter- reader variability
 - Cost effective
- ▶ Complete and open tool
 - Control charts
 - Fast detection of out of control values
 - Export of image quality indices to Excel

Standard Windows Application



Open an Image

The screenshot shows the AutoPIA - CyberQual software interface. The main window displays a medical image (X-ray) with a red box and arrow pointing to the 'Analyse the Image' button. The interface includes a menu bar (File, Edit, Actions, View, Help), a toolbar with icons for file operations, a 'Navigation' pane on the left showing the file '055_03_Nov_2011.dcm', a 'Close-up' view of the image, a 'Measures' pane on the right showing a table of image parameters, a 'DICOM' pane, a 'Graphs' section, and a 'Messages' pane at the bottom.

Navigation

055_03_Nov_2011.dcm

Close-up

Analyse the Image

Measures

Code	Name	Value
0018,1150	Exposure Time	1200
0018,1151	X-ray Tube Current	62
0018,1152	Exposure	74
0018,1153	Exposure in uAs	74500
0018,1160	Filter Type	STRIP
0018,1164	Imager Pixel Spacing	0.09409090909091\0

DICOM

Graphs

Select a detail to visualise the associated graphs

Messages

	Time	Message
i INFO	11.52.12	The image inside file 055_03_Nov_2011.dcm has been loaded

Analyze The Image

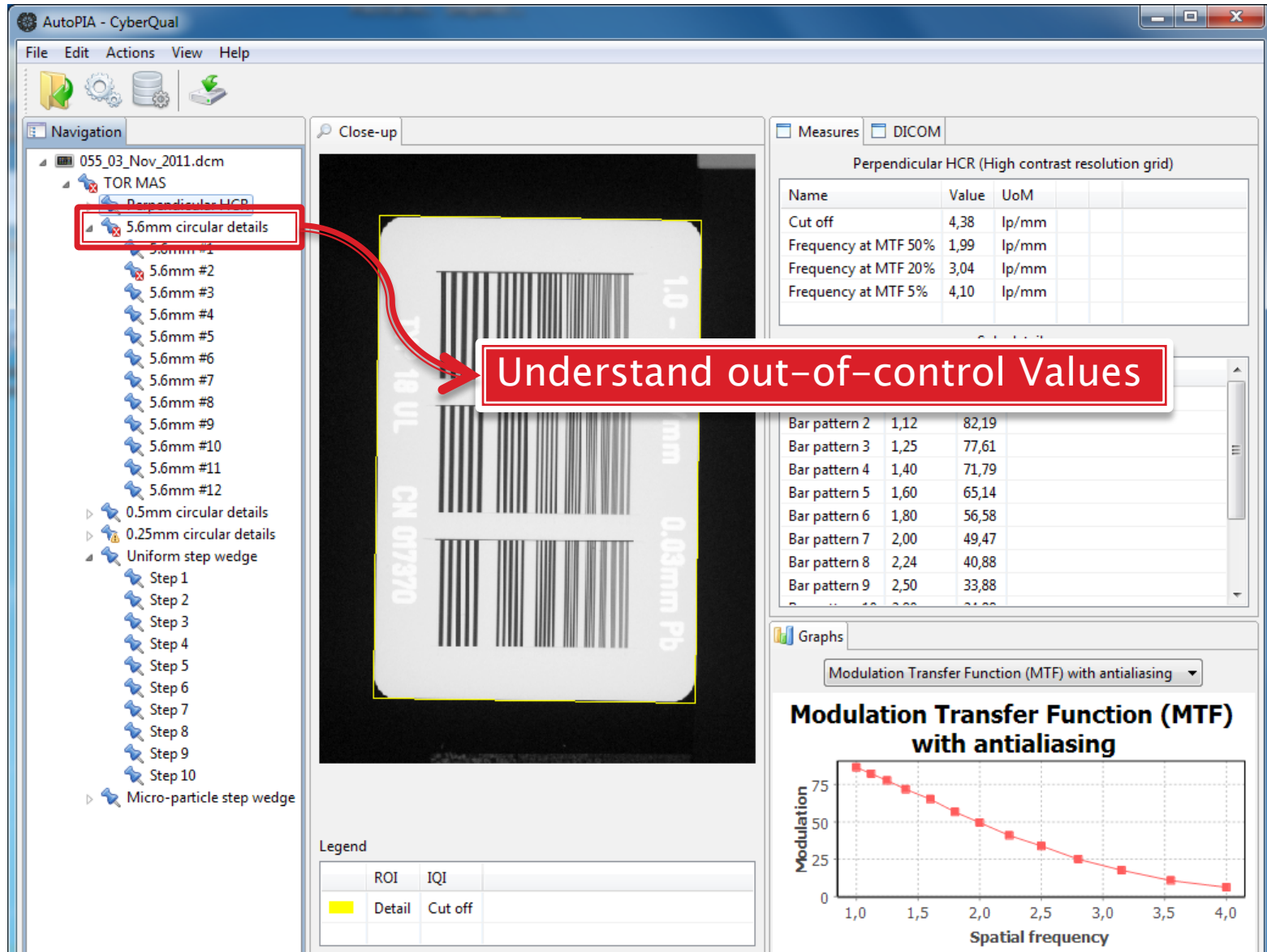
The screenshot displays the AutoPIA - CyberQual software interface. On the left, a navigation pane lists the file '055_03_Nov_2011.dcm' and its contents, including 'TOR MAS' and 'Perpendicular HCR'. A red box highlights 'Perpendicular HCR' with a red arrow pointing to a central image. The central image shows a close-up of a medical scan with various quality indicators. A red box with the text 'Visualize Image Quality Indices' is overlaid on the image. On the right, a 'Measures' panel shows a table of image quality metrics.

Visualize Image Quality Indices

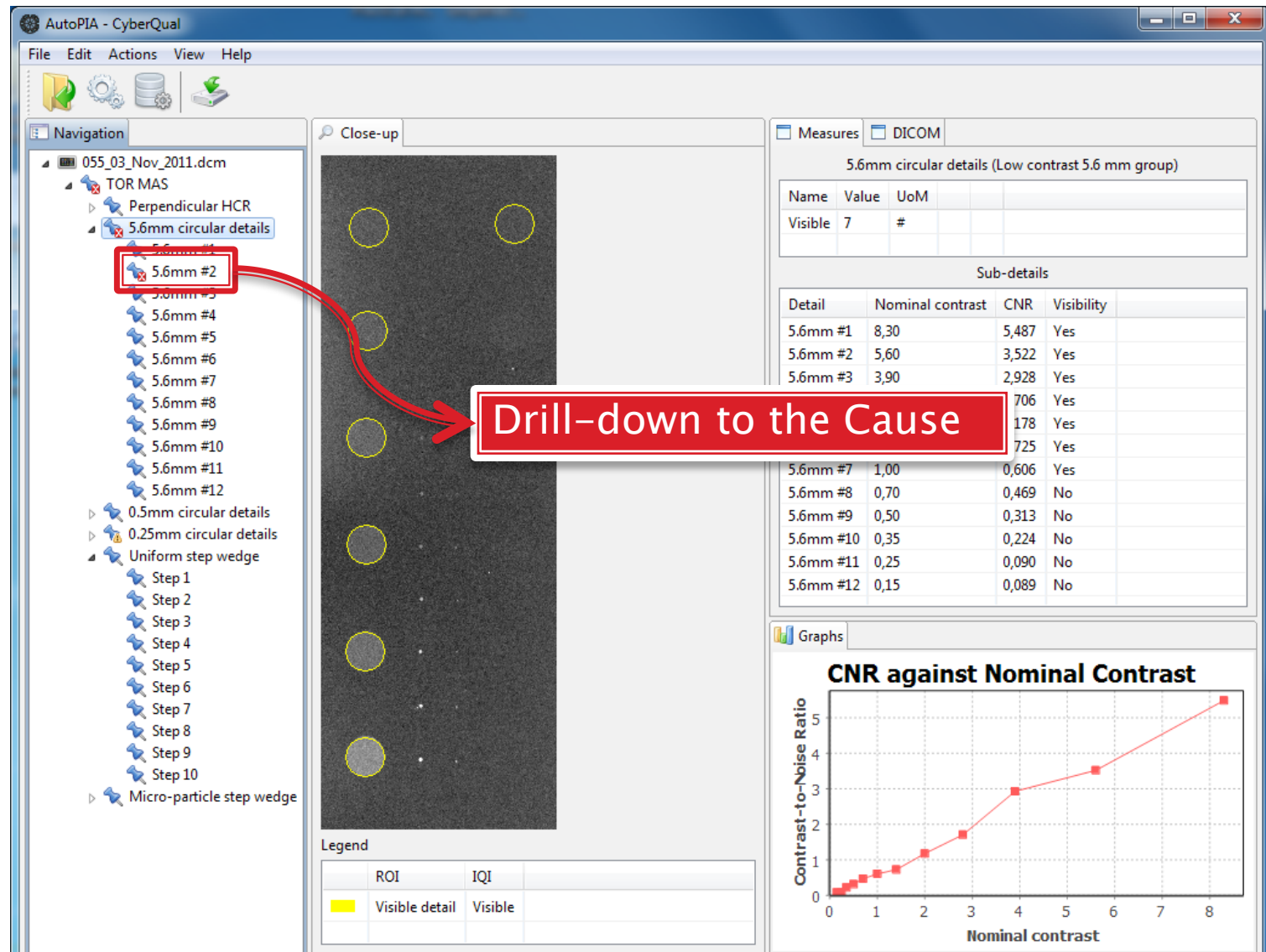
Name	Value	UoM
TOR MAS (TOR MAS)		
Sub-details		
Time	4,38	lp/mm
Frequency at MTF 50%	1,99	lp/mm
Frequency at MTF 20%	3,04	lp/mm
Frequency at MTF 5%	4,10	lp/mm
5.6mm circular details	Visible	7
0.5mm circular details	Visible	7
0.25mm circular details	Visible	7
Uniform step wedge	50% rel contrast	0,414
	100% rel contrast	0,912
Micro-particle step wedge	S2-3 ratio	2,814
	M2-3 ratio	6,764
	F2-3 ratio	15,962

Graphs
No graphs available for the selected detail

Visualize Image Quality Indices



Understand out-of-control Values



Drill-down to the Cause

The screenshot displays the AutoPIA - CyberQual software interface. The 'Navigation' pane on the left shows a tree structure with the following items:

- 055_03_Nov_2011.dcm
 - TOR MAS
 - Perpendicular HCR
 - 5.6mm circular details
 - 5.6mm #1
 - 5.6mm #2**
 - 5.6mm #3
 - 5.6mm #4
 - 5.6mm #5
 - 5.6mm #6
 - 5.6mm #7
 - 5.6mm #8
 - 5.6mm #9
 - 5.6mm #10
 - 5.6mm #11
 - 5.6mm #12
 - 0.5mm circular details
 - 0.25mm circular details
 - Uniform step wedge
 - Step 1
 - Step 2

The 'Close-up' view in the center shows a grayscale image with a green circular ROI. A red box labeled 'Show ROIs' is overlaid on the ROI, with a red arrow pointing to it.

The 'Measures' table on the right shows the following data:

Name	Value	UoM		
Nominal contrast	5.60	%		
CNR	3,522	#	✖	[3,550-4,400]
Visibility	Yes			

A red box highlights the 'CNR' row, and a red arrow points from it to the 'Show ROIs' box.

Show ROIs

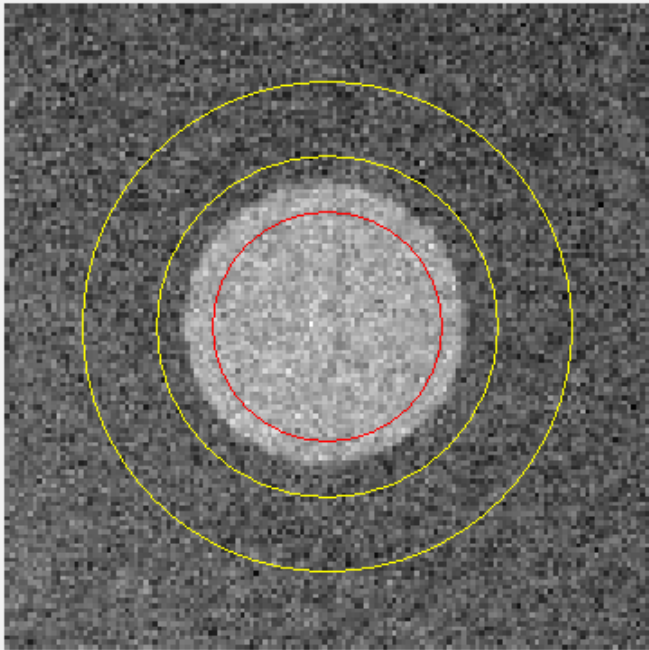
AutoPIA - CyberQual

File Edit Actions View Help

Navigation

- 055_03_Nov_2011.dcm
 - TOR MAS
 - Perpendicular HCR
 - 5.6mm circular details
 - 5.6mm #1
 - 5.6mm #2
 - 5.6mm #3
 - 5.6mm #4
 - 5.6mm #5
 - 5.6mm #6
 - 5.6mm #7
 - 5.6mm #8
 - 5.6mm #9
 - 5.6mm #10
 - 5.6mm #11
 - 5.6mm #12
 - 0.5mm circular details
 - 0.25mm circular details
 - Uniform step wedge
 - Step 1

Close-up



Measures

5.6mm #2 (Low contrast 5.6mm detail)

Name	Value	UoM		
Nominal contrast	5,60	%		
CNR	3,522	#	✗	[3,550-4,400]
Visibility	Yes			

Check Insights On The Web

Contrast-to-Noise Ratio - x

autopia.cyberqual.it/index.php/Contrast-to-Noise_Ratio

App Google CyberQual Development Images Utils Personal AutoPIA 1.3.X AutoPIA - 1.4.X Small issues of Life a...

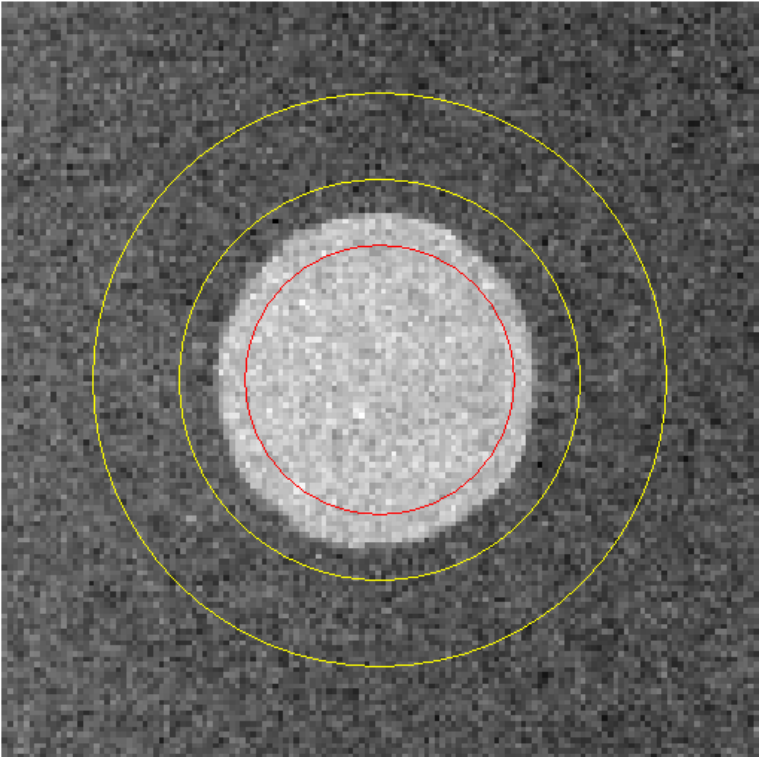
page

Contrast-to-Noise Ratio

$$CNR = \frac{|\mu_D - \mu_B|}{\sigma_B}$$

where:

- μ_D : mean pixel value of the detail ROI
- μ_B : mean pixel value of the background ROI
- σ_B : standard deviation of pixel values of the background ROI



■ Detail

■ Background

search

Go Search

navigation

- Main page
- Recent changes
- Random page

links

- CyberQual
- Leeds Test Objects

toolbox

- What links here
- Related changes
- Special pages
- Printable version
- Permanent link

Show ROIs

The screenshot displays the AutoPIA - CyberQual software interface. The main window shows a grayscale image of a circular object with two concentric circles overlaid: a red inner circle and a yellow outer circle. A red arrow points from a database icon in the top toolbar to a red box containing the text "Store Image Quality Indices".

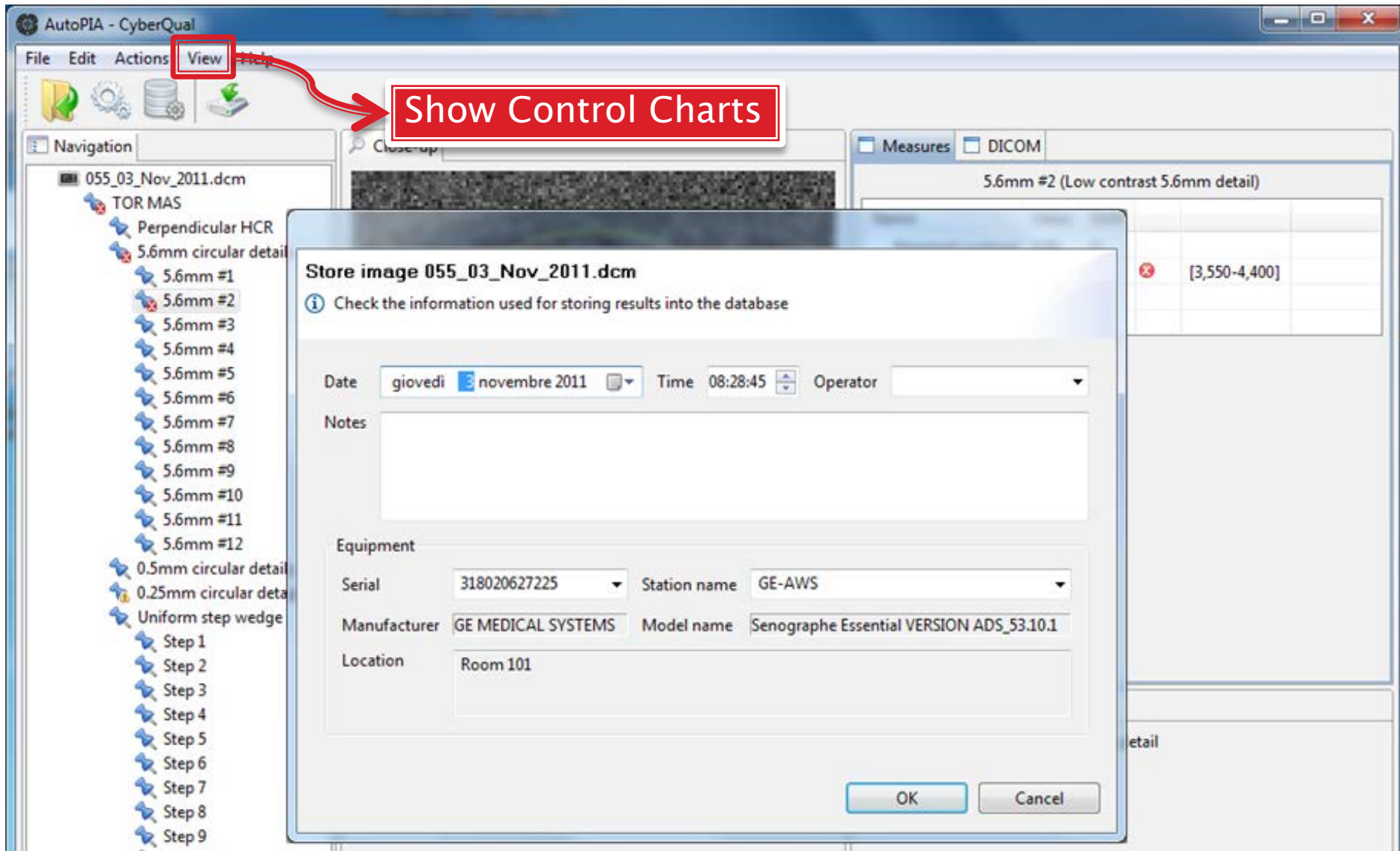
The left sidebar contains a "Navigation" pane with a tree view of the image structure:

- 055_03_Nov_2011.dcm
 - TOR MAS
 - Perpendicular HCR
 - 5.6mm circular details
 - 5.6mm #1
 - 5.6mm #2
 - 5.6mm #3
 - 5.6mm #4
 - 5.6mm #5
 - 5.6mm #6
 - 5.6mm #7
 - 5.6mm #8
 - 5.6mm #9
 - 5.6mm #10
 - 5.6mm #11
 - 5.6mm #12
 - 0.5mm circular details
 - 0.25mm circular details
 - Uniform step wedge
 - Step 1

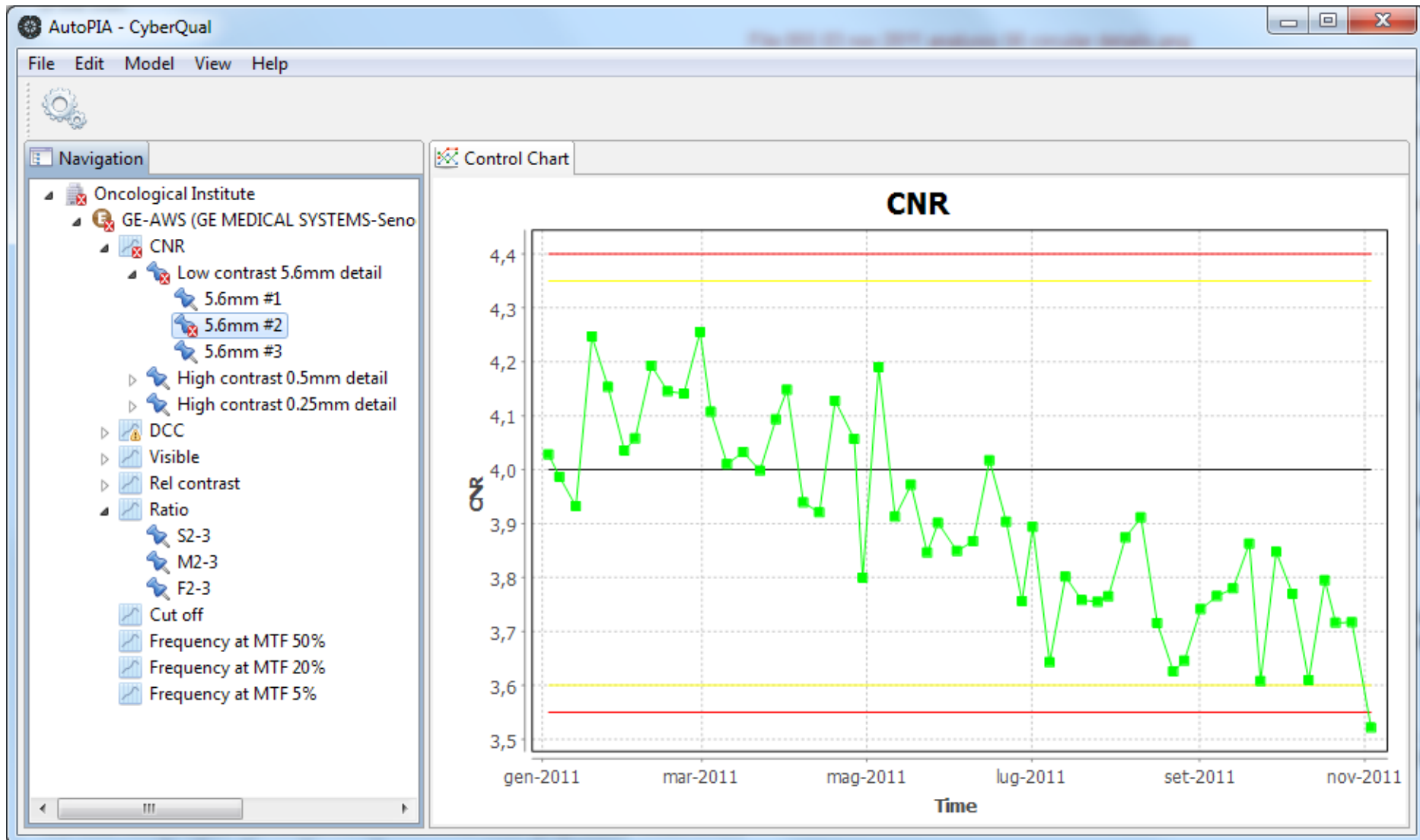
The right sidebar shows the "Measures" tab with a table of quality indices for "5.6mm #2 (Low contrast 5.6mm detail)":

	Value	UoM		
Contrast	5,60	%		
SNR	3,522	#	⊗	[3,550-4,400]
Visibility	Yes			

Store Image Quality Indices



Show Control Charts



Supported Phantoms

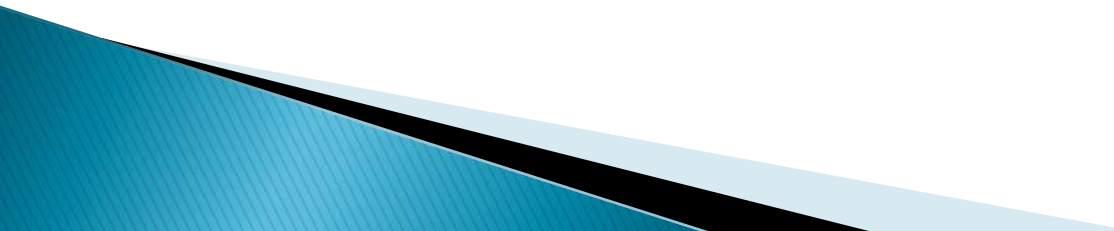
- ▶ Radiography
 - TOR CDR
 - PIX-13
- ▶ Fluoroscopy
 - TOR 18FG
- ▶ Threshold Contrast
 - TO 20
 - TO 16
 - TO 12
 - TO 10
- ▶ Dental
 - CBCT-161 **NEW**
- ▶ Mammography
 - TOR MAS
 - TOR MAX
 - TOR MAM
 - DMAM2
 - DMAM2 Gold
 - PIX MAM 250D
 - PIX MAM 300x240

Sell AutoPIA

- ▶ Order AutoPIA to Leeds Test Objects
- ▶ Receive a USB flash drive with
 - Installer (standard)
 - Instructions (on PDF)
 - License file
- ▶ Receive 30% discount on list price **NEW**
- ▶ Send USB flash drive to customer
- ▶ Customer installs AutoPIA and the license
 - On all PCs they want
- ▶ Customer uses AutoPIA
 - Plugging the USB flash drive into the PC
 - Only the serial is used to check the license



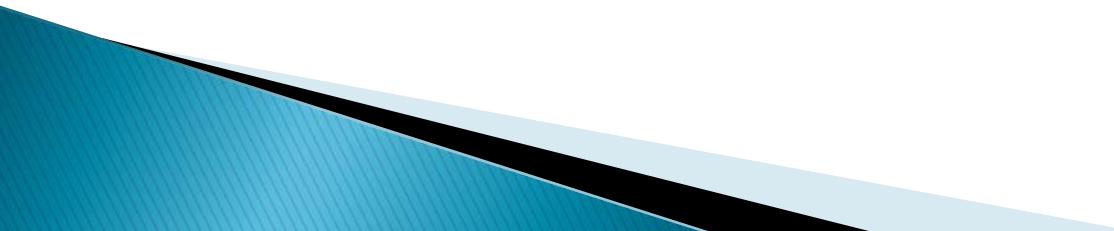
AutoPIA Cloud Edition

- ▶ AutoPIA is installed on a cloud
 - ▶ It is delivered as a service
 - ▶ AutoPIA acts as a centralized quality control centre
 - Performing analysis on uploaded images
 - Storing images and image quality parameters
 - Checking equipment state using a set of rules
 - Stability
 - Outliers
 - Trend
 - ▶ For companies delivering quality control services
- 

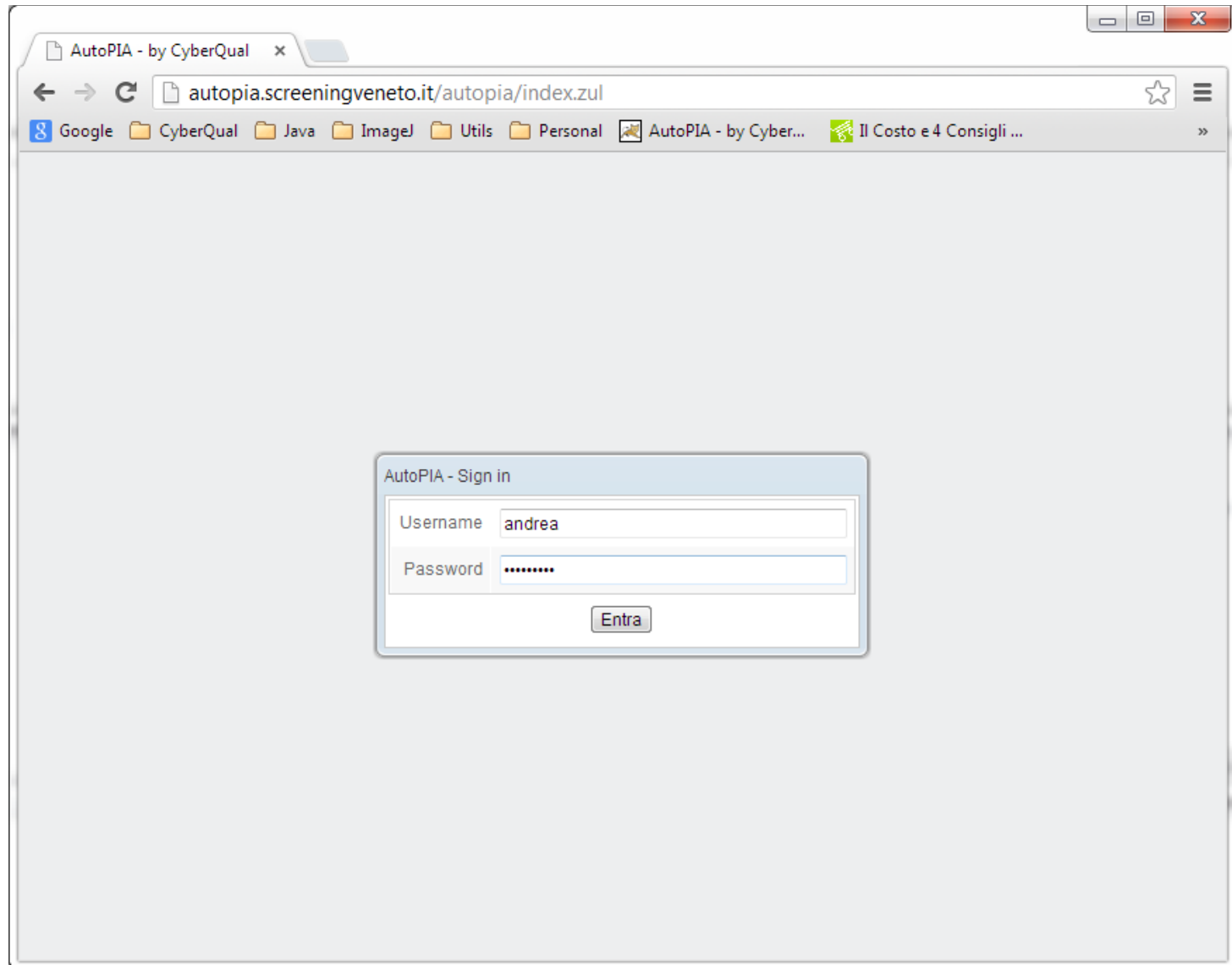
Implement Level A Tests

- ▶ Companies delivering QC service
 - Buys the service for equipments/phantoms
 - Register the equipments/phantoms of their customers
- ▶ Technicians on customers side
 - Perform exposure
 - Upload the image
 - Get immediate feedback
- ▶ Experts of QC companies
 - Get email with information about equipment state
 - Eventually investigate further
 - Descriptive information
 - Image quality indices
 - Control charts
 - Eventually download the image for custom analysis

Increased Value of Service

- ▶ Companies providing QC service
 - Offers a continuous quality control activity
 - Allows frequent quality controls (even daily)
 - Allows quality controls with complex phantoms
 - ▶ Low risk
 - Investment is split over time
 - Investment grows with the business
 - The service can be stop at any time
 - ▶ Low costs of management
 - No infrastructure
 - No installation
 - No maintenance
- 

Customer Login



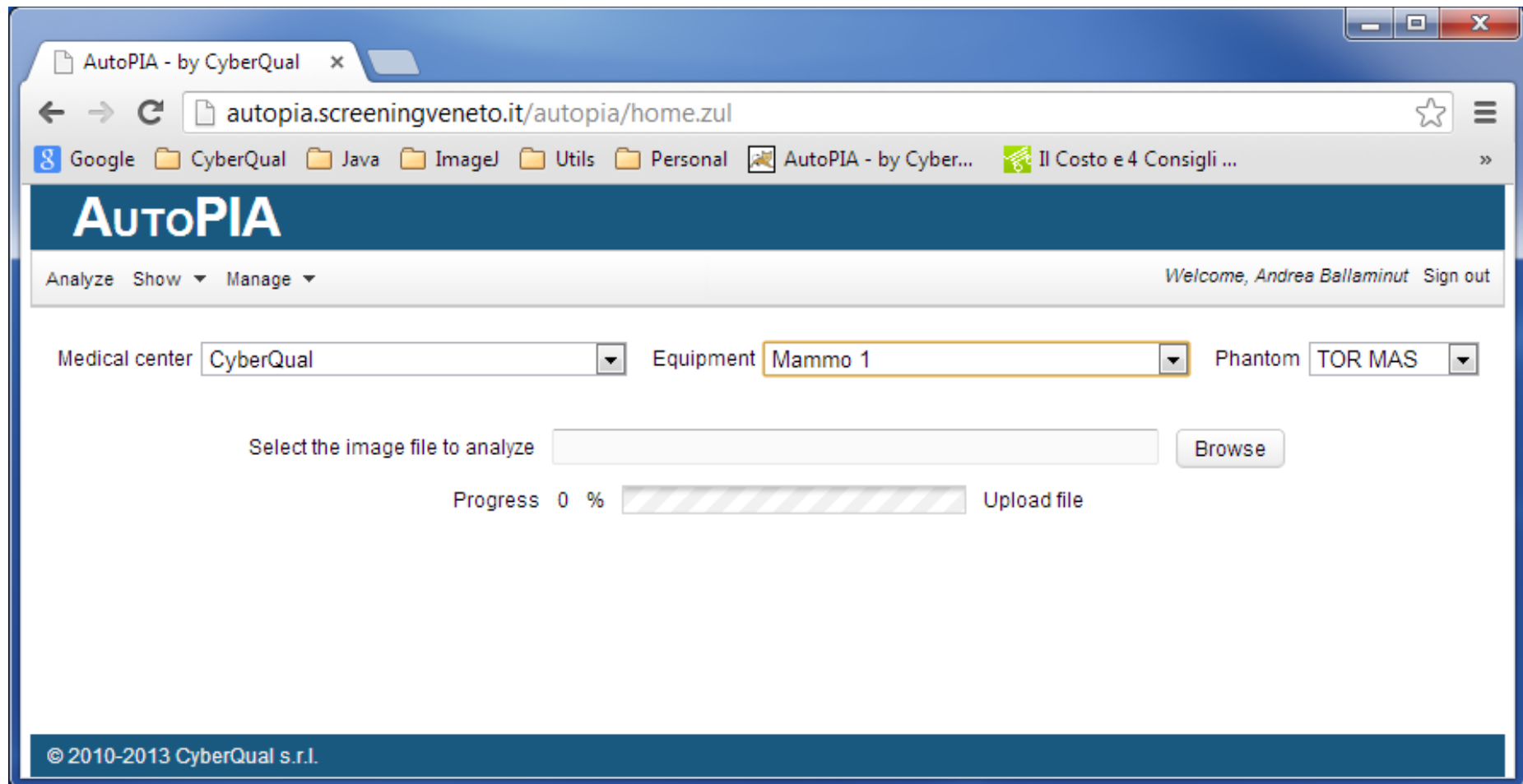
The screenshot shows a web browser window with the title "AutoPIA - by CyberQual". The address bar displays the URL "autopia.screeningveneto.it/autopia/index.zul". The browser's toolbar includes navigation buttons (back, forward, refresh) and a search icon. Below the address bar, there are several bookmarks: "Google", "CyberQual", "Java", "ImageJ", "Utils", "Personal", "AutoPIA - by Cyber...", and "Il Costo e 4 Consigli ...". The main content area of the browser is a light gray color. In the center of the page, there is a login form titled "AutoPIA - Sign in". The form contains two input fields: "Username" with the text "andrea" and "Password" with a masked password "*****". Below the password field is a button labeled "Entra".

AutoPIA - Sign in

Username

Password

Customers Upload Images



The screenshot shows a web browser window with the title "AutoPIA - by CyberQual". The address bar displays "autopia.screeningveneto.it/autopia/home.zul". The browser's toolbar includes links to Google, CyberQual, Java, ImageJ, Utils, Personal, and the current page. The page header features the "AutoPIA" logo and navigation links: "Analyze", "Show", and "Manage". A user greeting "Welcome, Andrea Ballaminut" and a "Sign out" link are visible in the top right. The main form contains three dropdown menus: "Medical center" (set to "CyberQual"), "Equipment" (set to "Mammo 1"), and "Phantom" (set to "TOR MAS"). Below these is a text input field labeled "Select the image file to analyze" with a "Browse" button to its right. A progress bar shows "Progress 0 %" and an "Upload file" button.

AutoPIA - by CyberQual

autopia.screeningveneto.it/autopia/home.zul

Google CyberQual Java ImageJ Utils Personal AutoPIA - by Cyber... Il Costo e 4 Consigli ...

AutoPIA

Analyze Show Manage

Welcome, Andrea Ballaminut Sign out

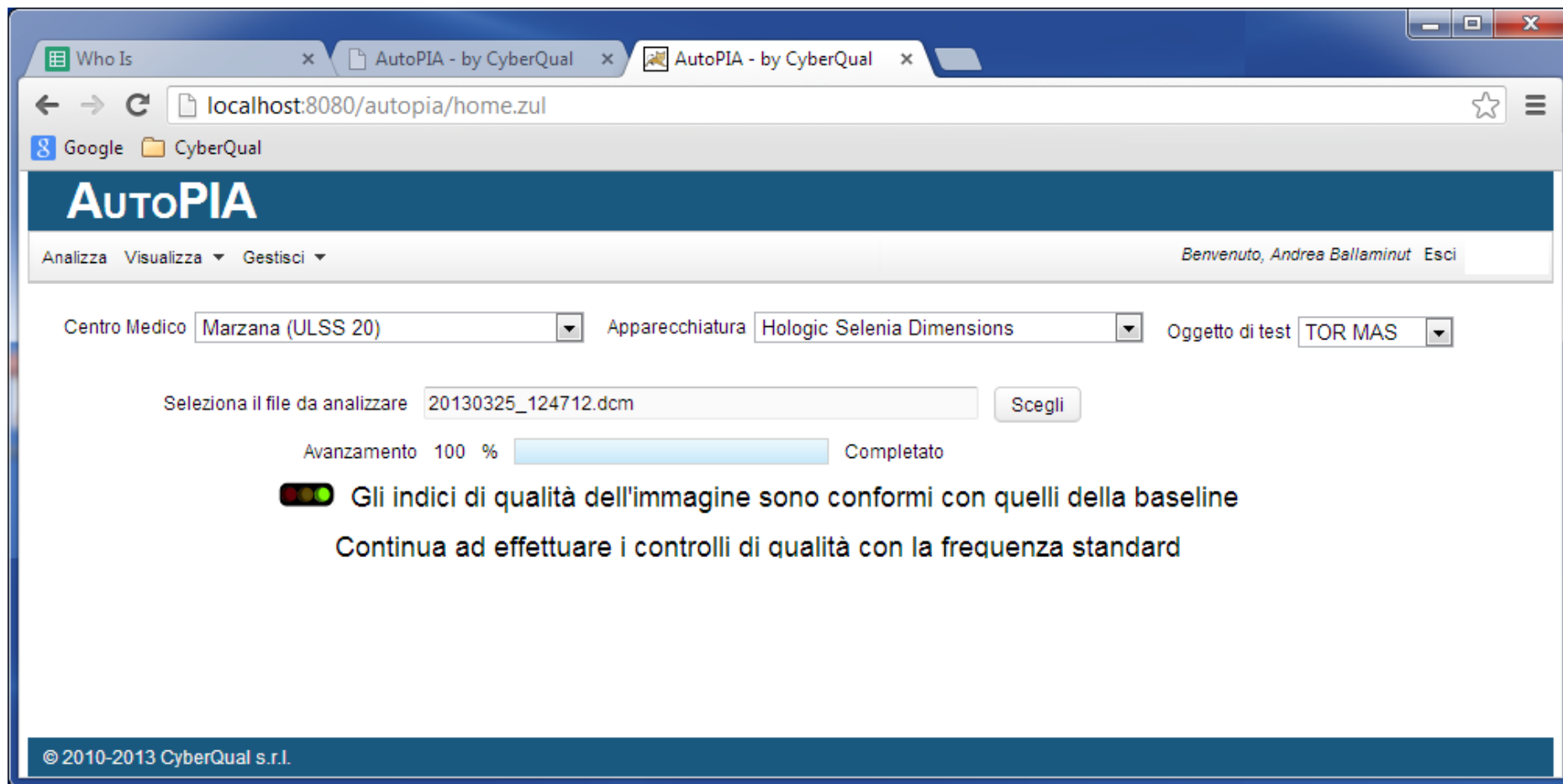
Medical center CyberQual Equipment Mammo 1 Phantom TOR MAS

Select the image file to analyze Browse

Progress 0 % Upload file

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Customers Get Feedback



Overview Of All Equipments

AutoPIA - by CyberQual

← → ↺ autopia.screeningveneto.it/autopia/home.zul

Google CyberQual Java ImageJ Utils Personal AutoPIA - by Cyber... Il Costo e 4 Consigli ... DOWNLOADS - Ove...

AutoPIA

Analyze Show Manage

Welcome, Andrea Ballaminut Sign out

SUMMARY

Medical center	Equipment	Phantom	Status	Last
Adria (ULSS 19)	Hologic Selenia	TOR MAS		Thu - 27 Jun 2013 - 08:13:03
Belluno (ULSS 1)	IMS Giotto Image	TOR MAS		Mon - 01 Jul 2013 - 08:33:44
Bussolengo U.M. (ULSS 22)	GE Senographe DS	TOR MAS		Mon - 10 Jun 2013 - 08:02:52
Castelfranco Veneto (ULSS 8)	Hologic Selenia Dimensions	TOR MAS		Sat - 29 Jun 2013 - 12:56:50
Cittadella (ULSS 15)	Siemens Inspiration	TOR MAS		Mon - 24 Jun 2013 - 12:15:32
Conegliano (ULSS 7)	Sectra Microdose	TOR MAS		Wed - 26 Jun 2013 - 13:13:57
Dolo U.M. (ULSS 13)	Konica Instrumentarium CR	TOR MAS		Mon - 20 May 2013 - 08:23:53
Este (ULSS 17)	IMS Giotto Image	TOR MAS		Mon - 01 Jul 2013 - 08:29:06
Feltre (ULSS 2)	Hologic Selenia	TOR MAS		Thu - 27 Jun 2013 - 13:15:13
Marostica (ULSS 3)	Hologic Selenia Dimensions	TOR MAS		Fri - 28 Jun 2013 - 08:01:46
Marzana (ULSS 20)	GE Senographe DS	TOR MAS		Mon - 01 Jul 2013 - 13:38:54
Marzana (ULSS 20)	Hologic Selenia Dimensions	TOR MAS		Mon - 01 Jul 2013 - 13:34:39

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Details of a Single Equipment

The screenshot shows the AutoPIA web application interface. The browser address bar displays `autopia.screeningveneto.it/autopia/home.zul`. The page header includes the "AutoPIA" logo and navigation links: "Analyze", "Show", and "Manage". A user greeting "Welcome, Andrea Ballaminut" and a "Sign out" link are visible on the right.

Below the header, there are three dropdown menus for filtering data: "Medical center" set to "Treviso (ULSS 9)", "Equipment" set to "IMS Giotto Image", and "Phantom" set to "TOR MAS".

The main content area is divided into two sections. On the left is a table listing studies, and on the right is a detailed view of the selected equipment.

Type	Date	Status	Delete
Study	27 Jun 2013 12:43:13		
Study	26 Jun 2013 12:28:51		
Study	20 Jun 2013 15:12:04		
Study	19 Jun 2013 12:46:40		
Study	12 Jun 2013 12:53:38		
Study	05 Jun 2013 18:10:58		
Study	29 May 2013 15:41:53		
Study	22 May 2013 13:30:54		
Study	15 May 2013 14:46:59		
Study	08 May 2013 12:02:13		

At the bottom of the study list, there are navigation controls: a left arrow, a right arrow, a text input "1", a slash, a text input "5", another right arrow, and a bracketed range "[1 - 10 / 43]".

The right section displays details for the selected equipment:

- Created on:** Wed - 26 Jun 2013 - 12:28:51
- Phantom:** TOR MAS
- Status:** Under surveillance Increase quality controls to once a day

Below the status, there are two tabs: "Baseline checks" (selected) and "Image checks". The "Baseline checks" tab contains a table with the following data:

	Message	Subject	Value	Constraint
	Image quality index different than baseline	CNR of 5.6mm #1	3.949	More than 4/5 outside $[3.971 \pm 4.250]$ ($[\mu - 1.0\sigma \pm \mu + 1.0\sigma]$)

The footer of the application shows the copyright notice: "© 2010-2013 CyberQual s.r.l."

Image Quality Indices

The screenshot shows the AutoPIA web application interface. The browser address bar displays `autopia.screeningveneto.it/autopia/home.zul`. The application header includes the "AutoPIA" logo and navigation links: "Analyze", "Show", and "Manage". A user greeting "Welcome, Andrea Ballaminut" and a "Sign out" link are visible on the right.

Below the header, there are three dropdown menus for filtering data: "Medical center" (set to "Treviso (ULSS 9)"), "Equipment" (set to "IMS Giotto Image"), and "Phantom" (set to "TOR MAS").

The main content area is divided into two sections. On the left, a table lists studies with columns for "Type", "Date", "Status", and "Delete". The "Status" column uses traffic light icons to indicate the status of each study. On the right, a detailed view of a specific study is shown, including fields for "Created on", "Phantom", "Operator", and "File". Below these fields is a table of quality indices.

Type	Date	Status	Delete
Study	27 Jun 2013 12:43:13		
Study	26 Jun 2013 12:28:51		
Analysis			
Study	20 Jun 2013 15:12:04		
Study	19 Jun 2013 12:46:40		
Study	12 Jun 2013 12:53:38		
Study	05 Jun 2013 18:10:58		
Study	29 May 2013 15:41:53		
Study	22 May 2013 13:30:54		
Study	15 May 2013 14:46:59		

Navigation controls at the bottom of the study list show "1 / 5" and "[1 - 10 / 44]".

The detailed view on the right includes the following fields:

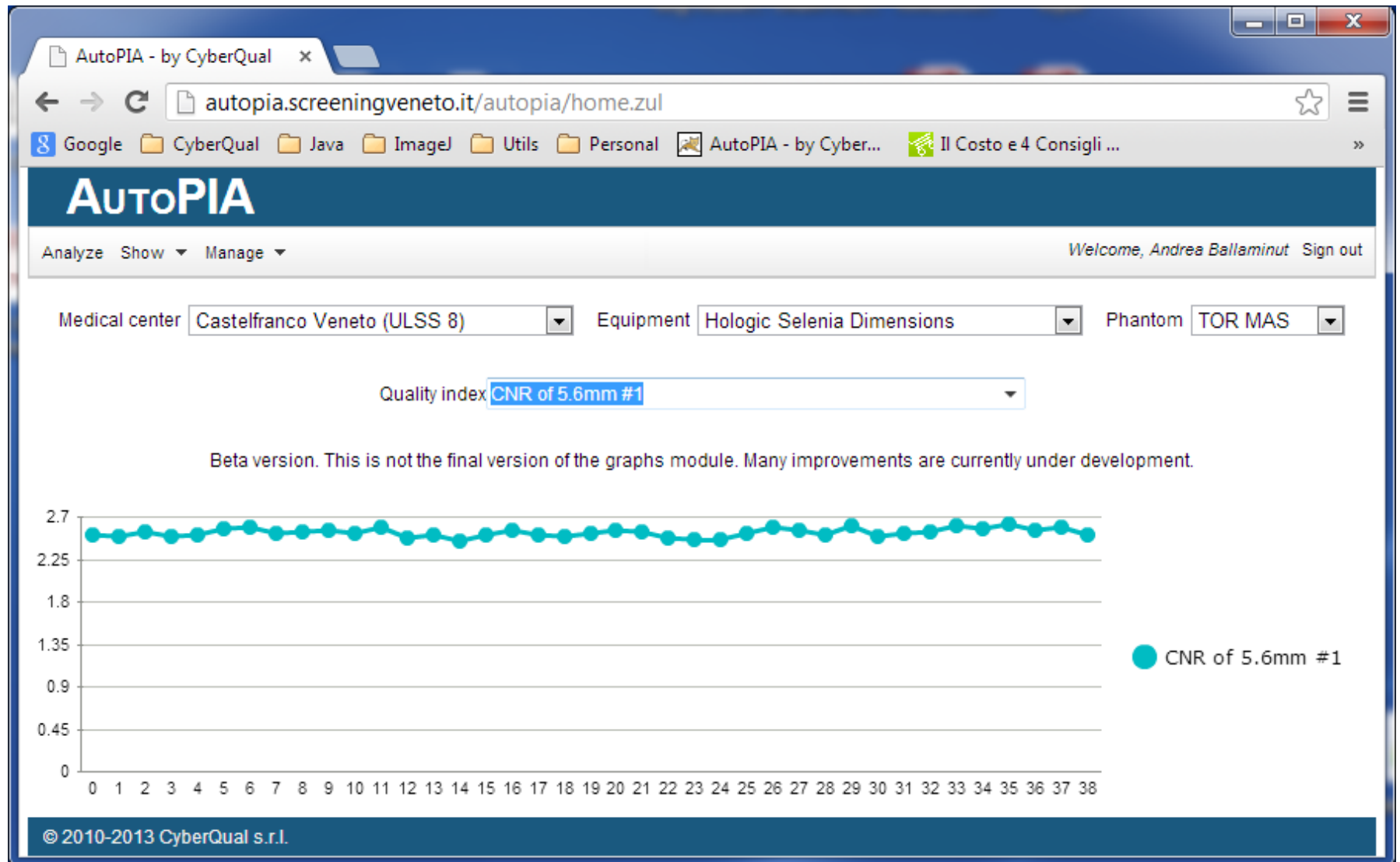
- Created on: Wed - 26 Jun 2013 - 12:28:51
- Phantom: TOR MAS
- Operator: [Empty field]
- File: RAW_TORMAS 26-06-2013_TORMAS 26-06-2013 [Download] [QI CSV]

Below these fields is a table of quality indices:

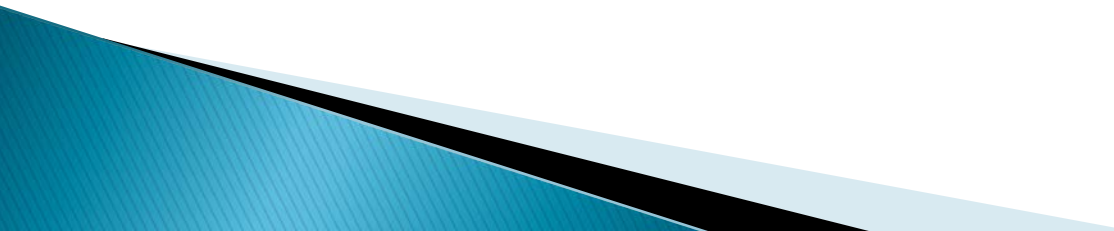
Quality index	Detail	Value	UoM
MTF Area	Perpendicular HCR	424.52	% lp/mm
CNR	5.6mm #1	3.95	#
DCC	0.5mm #1	15.71	#
DCC	0.25mm #1	11.13	#
Rel contrast	Step 3	0.593	#
Rel contrast	Step 8	0.229	#
Ratio	S2-3	1.995	#
Ratio	M2-3	3.713	#

The footer of the application displays "© 2010-2013 CyberQual s.r.l."

Control Charts



Successful Stories

- ▶ CyberQual
 - 35 equipments
 - ▶ Oncological Institute of Veneto
 - 27 equipments (over 24 locations)
 - ▶ Company in Belgium
 - 35 equipments
- 

Thank You

email

andrea.ballaminut@cyberqual.it

Web sites

<http://www.cyberqual.it>

<http://autopia.cyberqual.it>

