

PerMoS: Automated data collection from PACS based on DICOM

**Andreas Jahnen¹, Johannes Hermen¹, Sarah Kohler¹, Lucian Krille²
Maria Blettner²**

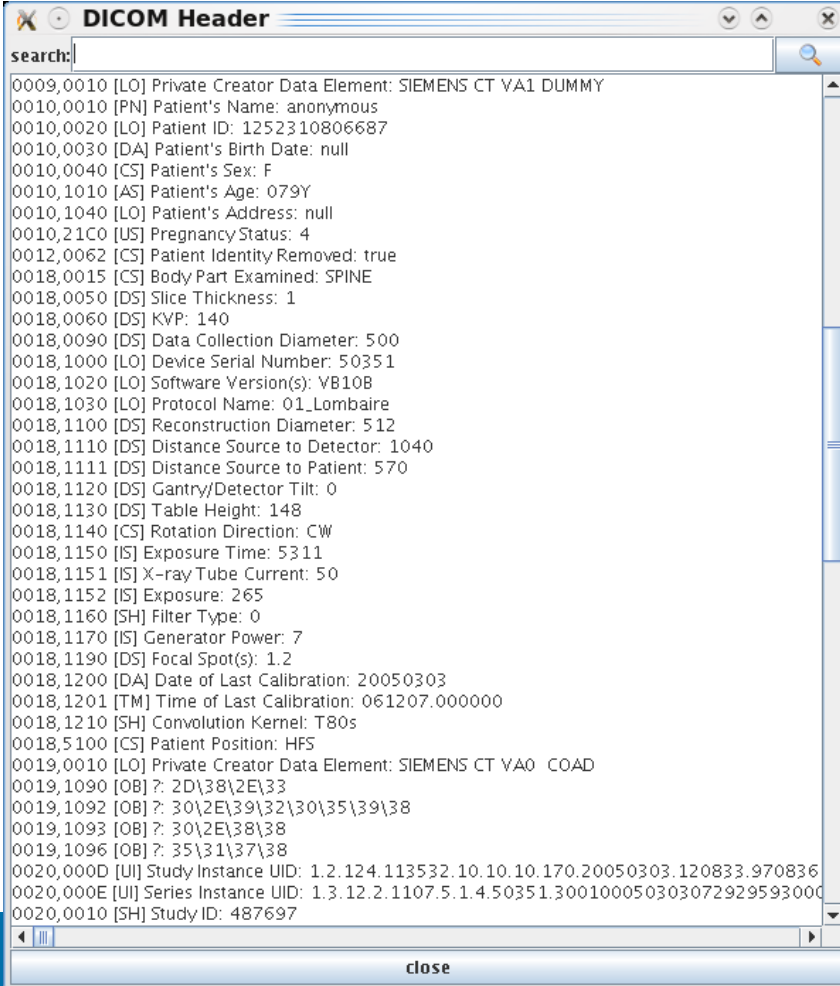
¹CRP Henri Tudor Luxembourg, ²IMBEI Mainz

Agenda

1. Introduction
2. Performance and Monitoring Server for Medical Data (PerMoS) - an Overview
3. PerMoS Data Collector
4. Security
5. PerMoS Data Manager
6. Dosimetry and other evaluations
7. PerMoS and EPICT: Initial Experiences

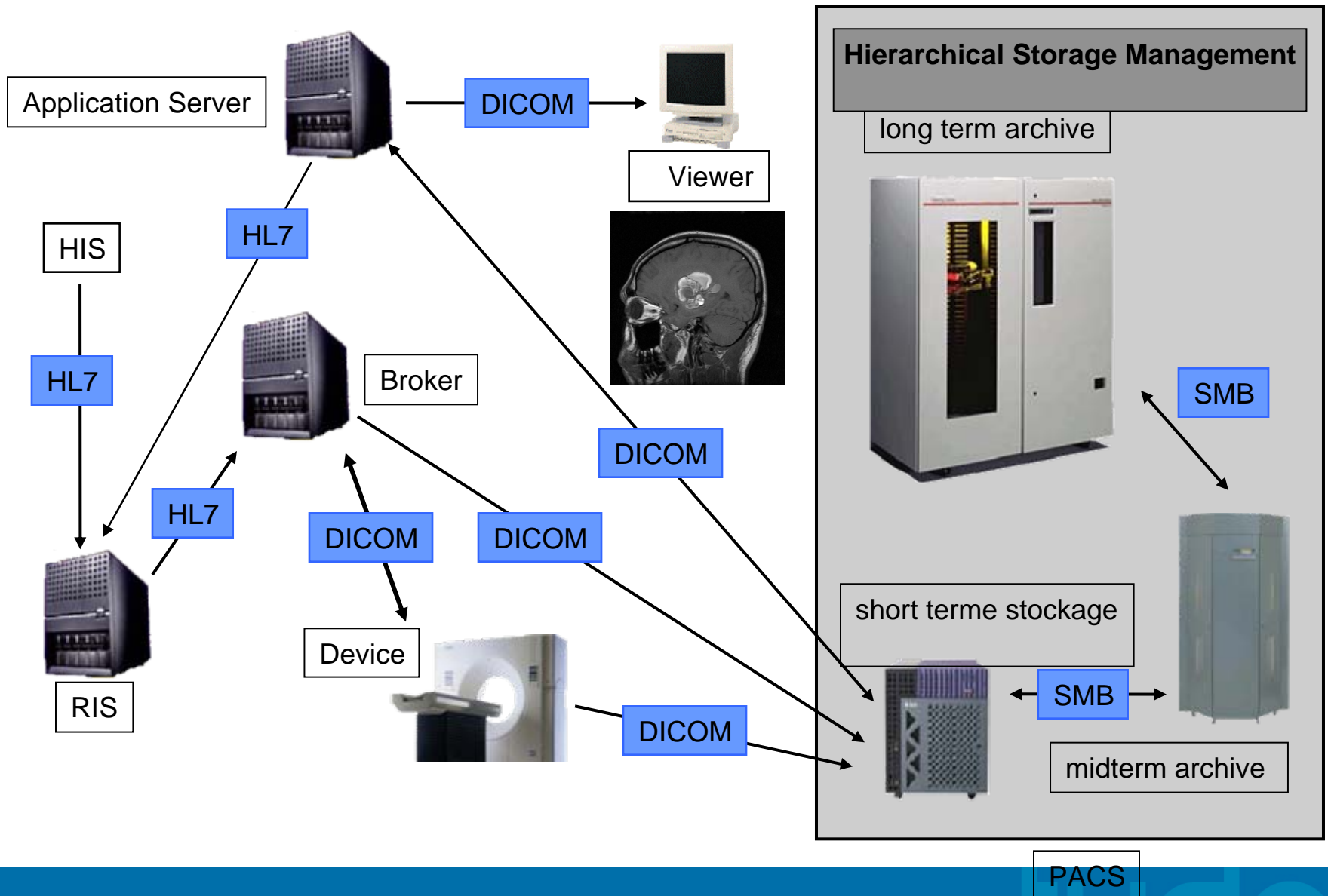
1. Introduction: What is DICOM?

- DICOM images consist of image- and meta-data (header).
- Header contains various information:
 - Examined Patient
 - Medical Treatment
 - Used Modality
- **Technical parameters of scanner used to calculate CT dose values.**
- Objective: Support of national dose studies

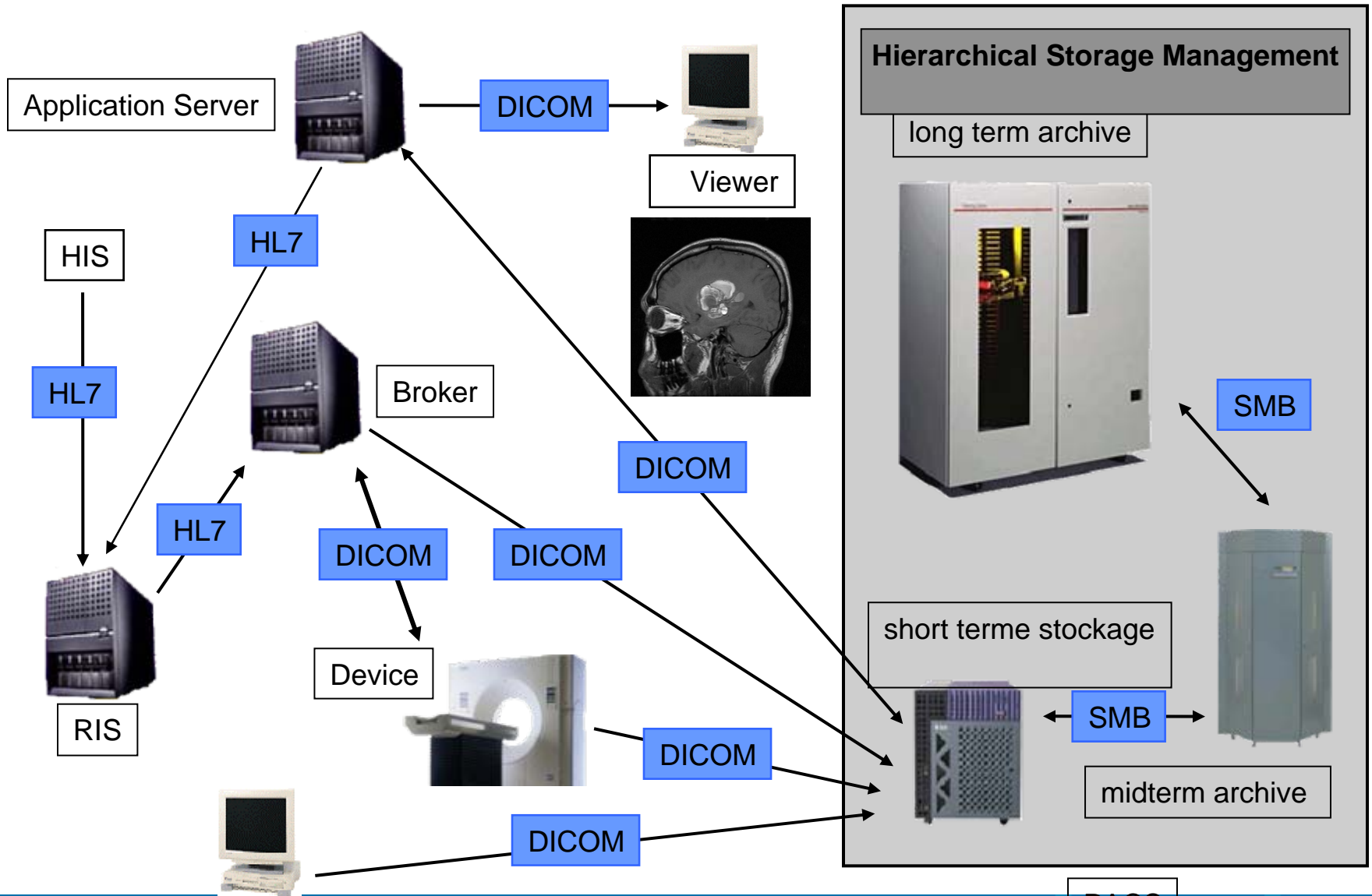


```
DICOM Header
search:
0009,0010 [LO] Private Creator Data Element: SIEMENS CT VA1 DUMMY
0010,0010 [PN] Patient's Name: anonymous
0010,0020 [LO] Patient ID: 1252310806687
0010,0030 [DA] Patient's Birth Date: null
0010,0040 [CS] Patient's Sex: F
0010,1010 [AS] Patient's Age: 079Y
0010,1040 [LO] Patient's Address: null
0010,21C0 [US] Pregnancy Status: 4
0012,0062 [CS] Patient Identity Removed: true
0018,0015 [CS] Body Part Examined: SPINE
0018,0050 [DS] Slice Thickness: 1
0018,0060 [DS] KVP: 140
0018,0090 [DS] Data Collection Diameter: 500
0018,1000 [LO] Device Serial Number: 50351
0018,1020 [LO] Software Version(s): VB10B
0018,1030 [LO] Protocol Name: 01_Lombaire
0018,1100 [DS] Reconstruction Diameter: 512
0018,1110 [DS] Distance Source to Detector: 1040
0018,1111 [DS] Distance Source to Patient: 570
0018,1120 [DS] Gantry/Detector Tilt: 0
0018,1130 [DS] Table Height: 148
0018,1140 [CS] Rotation Direction: CW
0018,1150 [IS] Exposure Time: 5311
0018,1151 [IS] X-ray Tube Current: 50
0018,1152 [IS] Exposure: 265
0018,1160 [SH] Filter Type: 0
0018,1170 [IS] Generator Power: 7
0018,1190 [DS] Focal Spot(s): 1.2
0018,1200 [DA] Date of Last Calibration: 20050303
0018,1201 [TM] Time of Last Calibration: 061207.000000
0018,1210 [SH] Convolution Kernel: T80s
0018,5100 [CS] Patient Position: HFS
0019,0010 [LO] Private Creator Data Element: SIEMENS CT VA0 COAD
0019,1090 [OB] ? 2D\38\2E\33
0019,1092 [OB] ? 30\2E\39\32\30\35\39\38
0019,1093 [OB] ? 30\2E\38\38
0019,1096 [OB] ? 35\31\37\38
0020,000D [UI] Study Instance UID: 1.2.124.113532.10.10.10.170.20050303.120833.970836
0020,000E [UI] Series Instance UID: 1.3.12.2.1107.5.1.4.50351.300100050303072929593000
0020,0010 [SH] Study ID: 487697
close
```

1. Introduction: RIS/PACS Communication



1. Introduction: RIS/PACS Communication

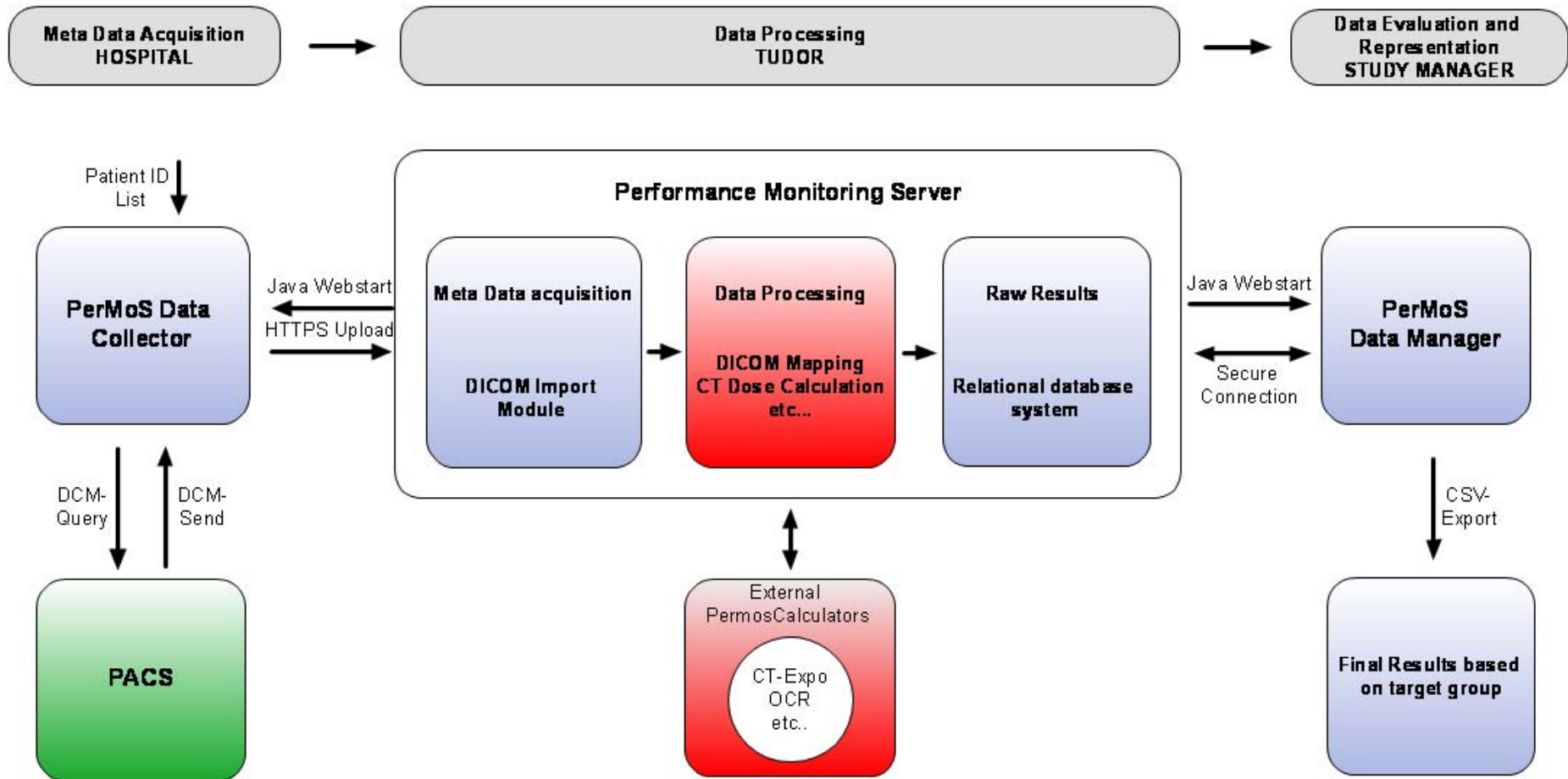


2. PerMoS Overview

- Software framework for acquisition and evaluation of DICOM meta-data.
- Generic way to access DICOM meta-data from hospital systems.
- Developed for in-house and multi-center studies.
- (Developed for live monitoring in the clinical environment)
- Supports multi-user and multi-studies.
- Pluggable applications for specific use cases.
- Access to result data via dedicated interface or data mining tools.

2. PerMoS: Technical Infrastructure

PerMoS - Performance and Monitoring Server for Medical Data



2. PerMoS: Data Processing

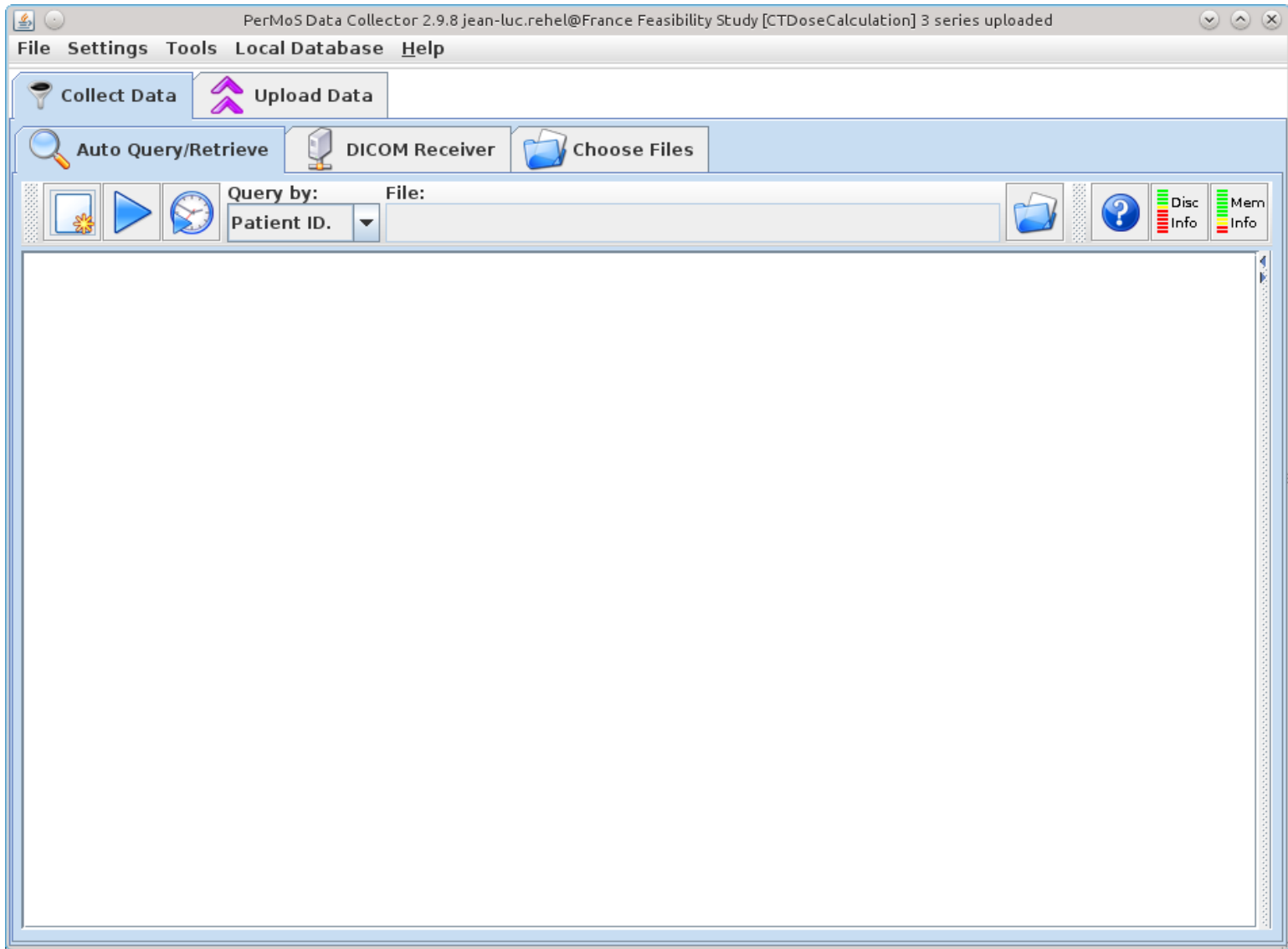
- Header-data is retrieved from the database, processed and written to application specific output tables.
- Vendor specific DICOM implementations are taken into account using a mapping and unit conversation table.
- Applications are implemented in Java / Java Script but may although run/control external software.
- PerMoS Data Manager:
 - to validate, control and complete the uploaded data.
 - To access and download data

3. PerMoS Data Collector: technical requirements

▪ PerMoS Data Collector

- Computer with Java 1.6 installed
- Internet access to download and Update the software (Java WebStart) .
- For data collection:
 - DICOM connectivity to the PACS
 - 5 Gbyte Hard disk space for 1000 patients
- For data upload to the database:
 - Internet connection (https); in the moment: no proxy support

3. PerMoS Data Collector: Query Retrieve



3. PerMoS Data Collector: Configuration

Configuration in collaboration with the hospital staff (RIS/PACS administrators)

Settings

General | **Datacollection** | **Upload**

LOGIN

Server:

User: Password:

OK

PROXY

Use Proxy Load System Proxy:

Proxyserver: Port:

CACHE

Caching directory

CacheDir OK

INFO

Information: andreas@Epi-CT Training [CTDoseCalculation] 0 series uploaded
Age Range: 0-150
Filter: 0008,0060=CT

Proxy for PACS: PACS ADDRESS:104 is NONE
Proxy for UPLOAD Server: https://158.64.4.161:443 is NONE

Config Dir: /home/jahnen/permos_settings

3. PerMoS Data Collector: Configuration

Configuration in collaboration with the hospital staff (RIS/PACS administrators)

DICOM STORE

Local Receiver: AE Title: PERMOS

Local Receiver: IP-Address: 127.0.1.1

Local Receiver: Network Port:

DICOM QUERY

PACS: AE Title: PACS AET

PACS: IP Address/Hostname: PACS ADDRESS

PACS: Network Port: 104

Query Interval (sec):

Patient ID File:

Autostart Query:

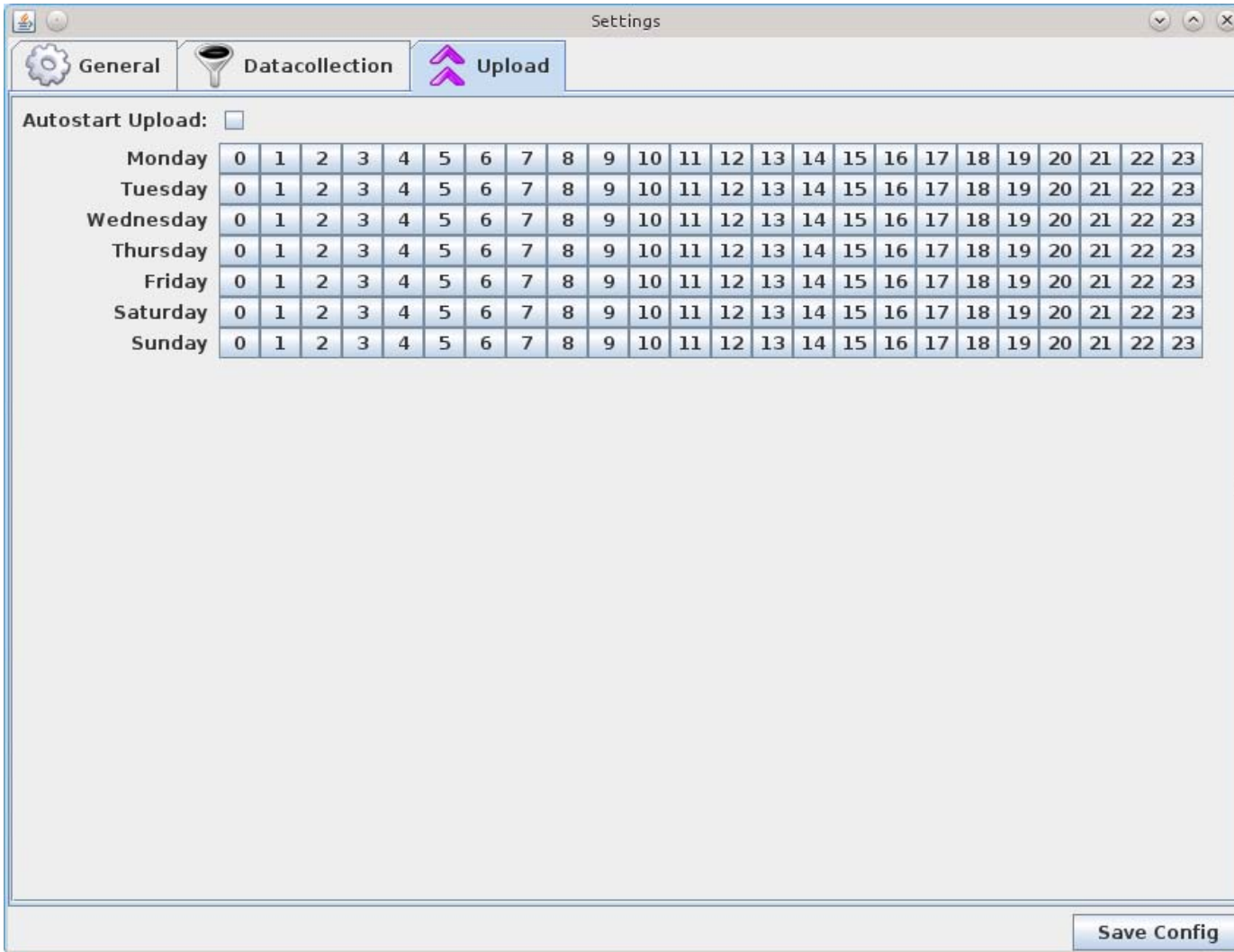
Monday	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Tuesday	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Wednesday	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Thursday	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Friday	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Saturday	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sunday	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Retry Patient on Error. In some cases the PACS system will send temporal or konstant error messages when trying to QUERY/RETRIEVE/MOVE some series. In case of these error messages the patient can be queried again to a later time or the automated query can be stopped. After the PACS connection has been setup and tested this option can be selected to run PerMoS unattended even in case of some query errors.

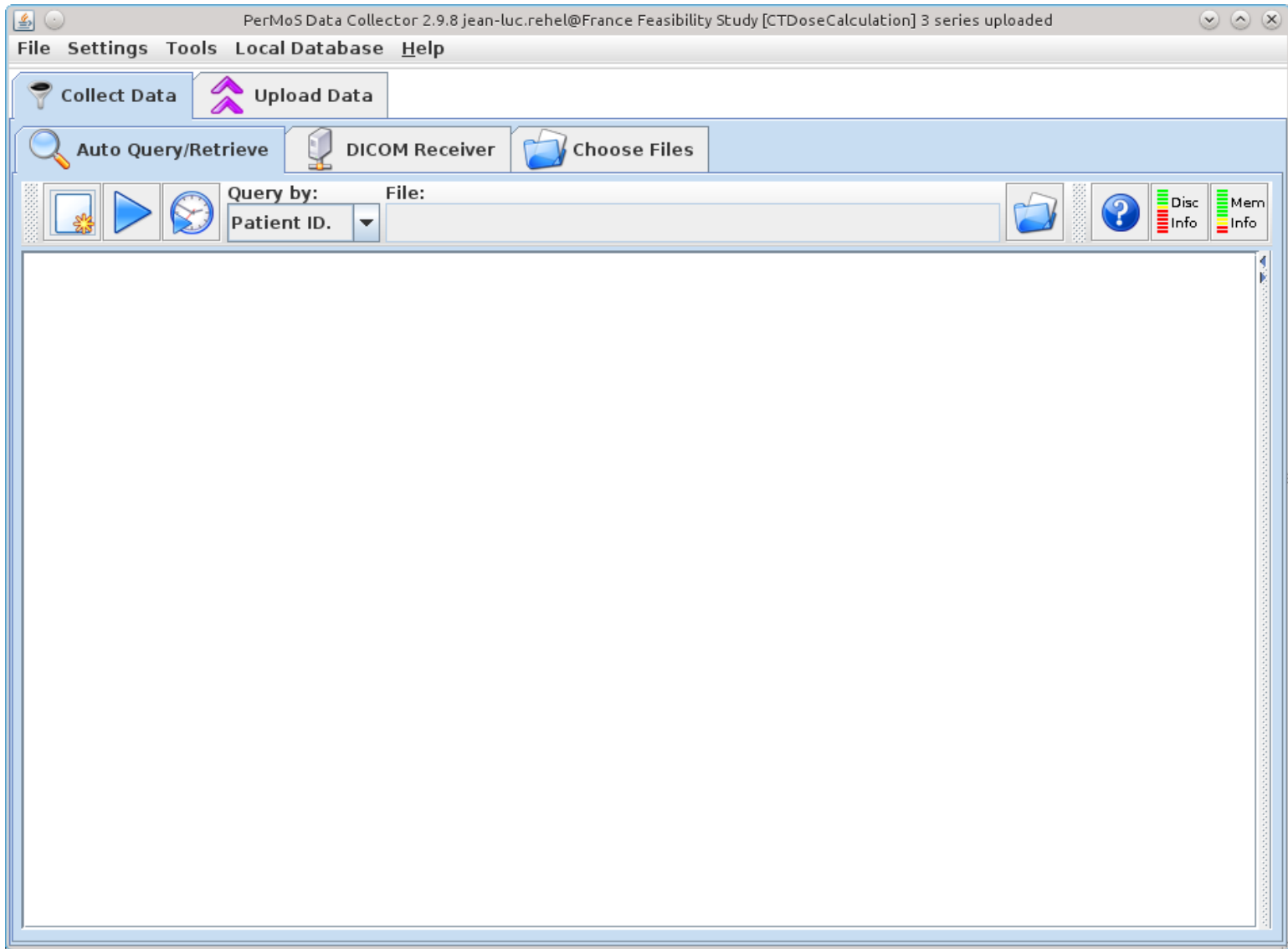
Save Config

3. PerMoS Data Collector: Configuration

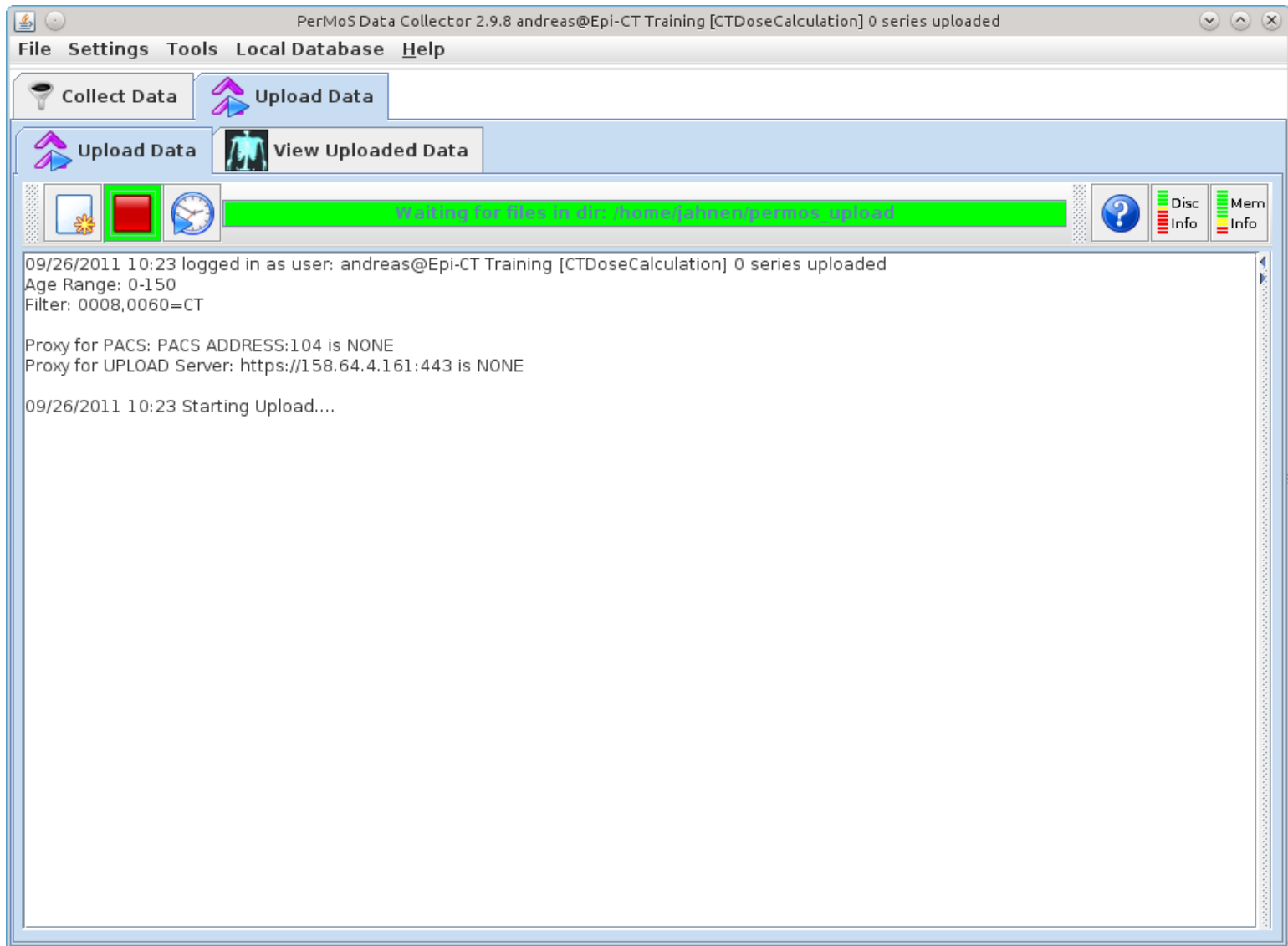
Configuration in collaboration with the hospital staff (RIS/PACS administrators)



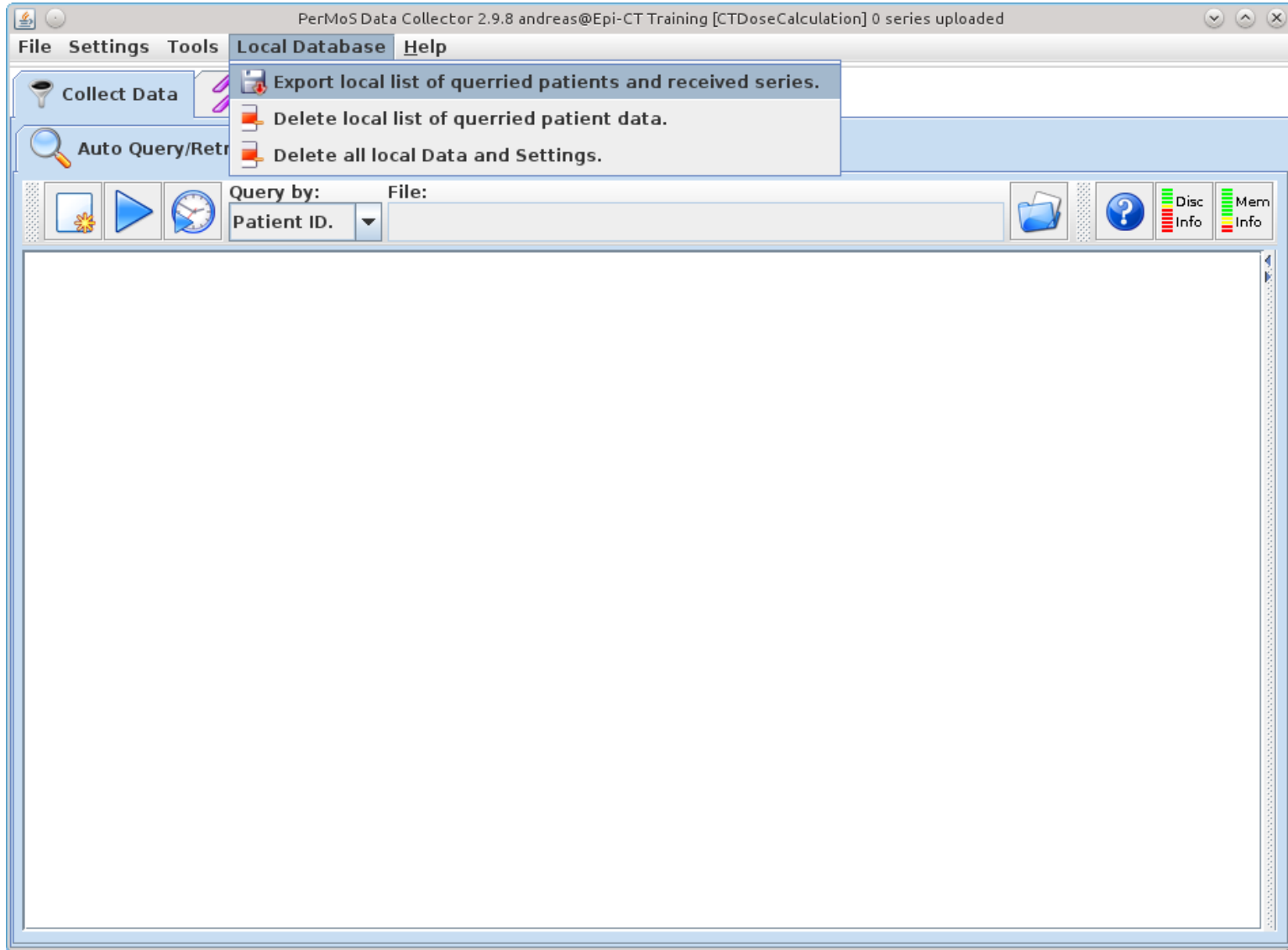
3. PerMoS Data Collector: Query Retrieve



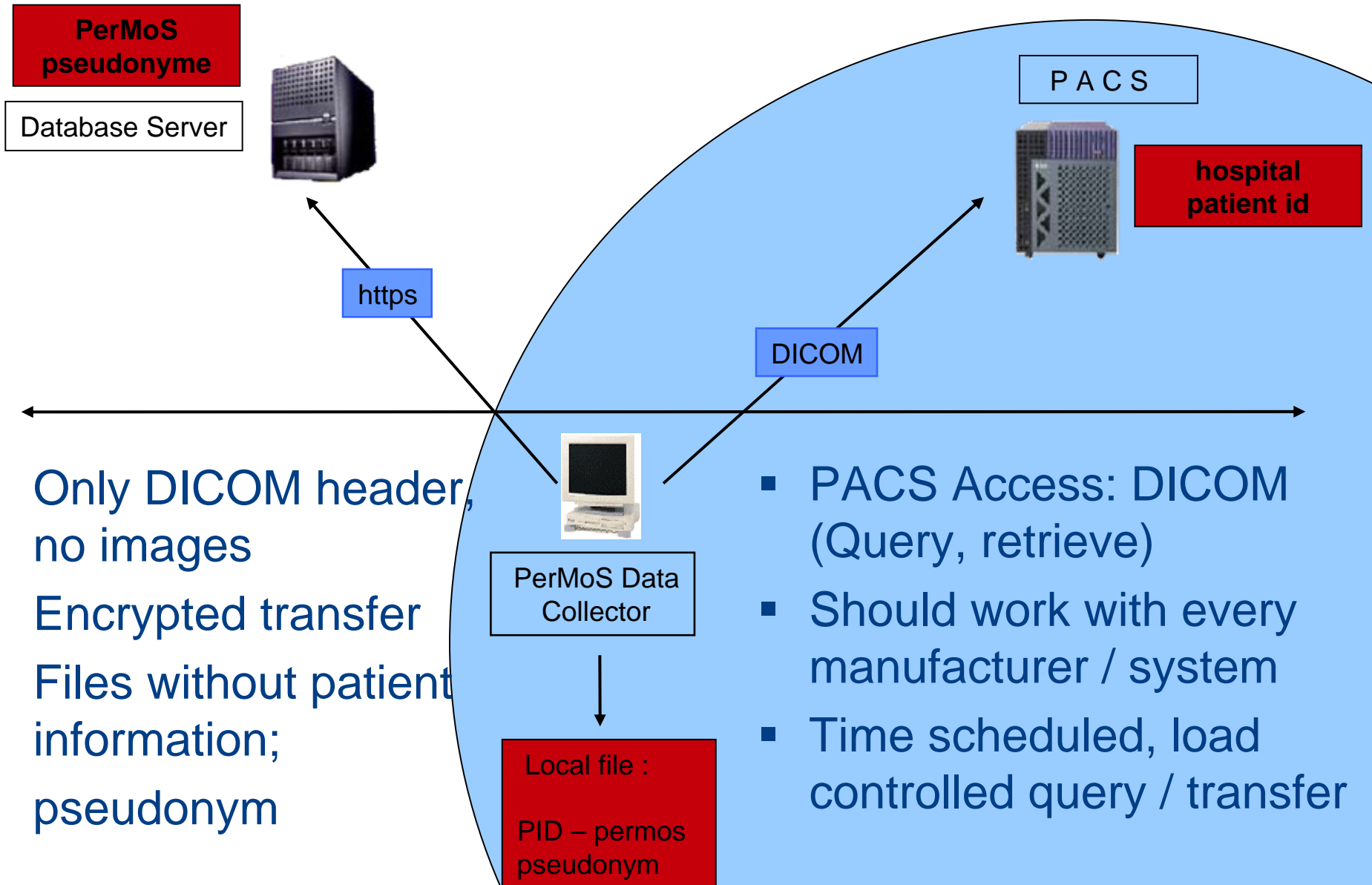
3. PerMoS Data Collector: Upload



3. PerMoS Data Collector: Export of patients



4. PerMoS: Security



- Only DICOM header, no images
- Encrypted transfer
- Files without patient information;
- pseudonym

- PACS Access: DICOM (Query, retrieve)
- Should work with every manufacturer / system
- Time scheduled, load controlled query / transfer

5. PerMoS Data Manager: technical requirements

▪ PerMoS Data Manager

- Computer with Java 1.6 installed
- Internet access to download, update the software (Java WebStart).
- Internet access to run the software:
 - 80 (http),
 - 443 (https) and
 - 3873 (jboss-ejb3).
- The PerMoS Data Manager does not support a proxy configuration currently. The proxy settings will be available in one of the next versions.

5. PerMoS Data Manager: Uploaded Data

PerMoS Data Manager ver. 2.9.8

File Help

Usermanagement DicomDB Series Overview Application Mapping Application Data

Application: CTDoseCalcu... Survey: Epi-CT Training User: ALL Stationname: ALL Page size: 50 State: ALL Type: ALL

15 Series [page 1/1]

id	uploadDate	seriesInstance	studyInstance	modality	sopclassuid	patientId	patientName	patientBirthd	patientAge	patientSe:
63167	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63168	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63169	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63170	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63171	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63172	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63173	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63174	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63175	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63176	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63177	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63178	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63179	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63180	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M
63181	2011-04-29	1.2.840.1136...	1.2.840.1136...	CT	1.2.840.1000...	8hQRgDaBsh...	johannes		108Y	M

5. PerMoS Data Manager: Study Overview

PerMoS Data Manager ver. 2.9.8

File Help

Usermanagement DicomDB Series Overview Application Mapping Application Data

Application: CTDoseCal... Survey: Epi-CT Trai... User: ALL Stationname: ALL Period: ALL State: ALL Type: ALL

Series Overview

Survey	User	Patient Count	Study Count	Series Count	Object Count
Epi-CT Training	johannes	1	1	15	577
Total	-	1	1	15	577

States/Type Overview

Survey	User	State	Type	Patient Count	Studies Count	Series Count	Object Count
Epi-CT Training	johannes	MAPPED	DOSEINFO	1	1	1	2
Epi-CT Training	johannes	INCOMPLETE		1	1	13	574
Epi-CT Training	johannes	UNUSED	RECONSTRUCTION	1	1	1	1
Total	-	-	-	3	3	15	577

Protocol Overview

Survey	User	StudyDesc	Patient Count	Series Count	Object Count	Avg. Obj./Ser.
Epi-CT Training	johannes	TEST SCANNER	1	15	577	38
Total	-	-	1	15	577	38

5. PerMoS Data Manager: Application Mapping

PerMoS Data Manager ver. 2.9.8

File Help

Usermanagement DicomDB Series Overview Application Mapping Application Data

Application CTDoseCalculation

Active	Man...	Name	Script	Mapping	Order
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	patientName	<input type="checkbox"/>	0010,0010 [Patient's Name]	10
<input checked="" type="checkbox"/>	<input type="checkbox"/>	modality	<input type="checkbox"/>	0008,0060 [Modality]	20
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	imageType	<input checked="" type="checkbox"/>	/* calculates the imageType */	25
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	examination	<input checked="" type="checkbox"/>	/* constructs the "examination" String from Body Part Examined/Study Description/Protocol Na...	30
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CTExpo_Examination	<input checked="" type="checkbox"/>	/* maps the "examination" to the CTExpo_Examination */	31
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	type_mapper	<input checked="" type="checkbox"/>	/* maps the "type" of image to RECONSTRUCTION/TOPOGRAM/DOSEINFO/SCAN */	32
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Institution	<input type="checkbox"/>	0008,0080 [Institution Name]	40
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	manufacturerModel	<input checked="" type="checkbox"/>	/* returns Manufacturer and Model Name from the header */	50
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CTExpo_Scanner	<input checked="" type="checkbox"/>	/* maps the "manufacturerModel" the "CTExpo_Scanner" */	52
<input checked="" type="checkbox"/>	<input type="checkbox"/>	stationName	<input type="checkbox"/>	0008,1010 [Station Name]	54
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Scanner Software	<input type="checkbox"/>	0018,1020 [Software Version(s)]	55
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	kvp	<input type="checkbox"/>	0018,0060 [KVP]	60
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	current	<input checked="" type="checkbox"/>	/* returns the mean "current" of the Series */	70
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	time	<input checked="" type="checkbox"/>	/* returns the rotation time */	80
<input checked="" type="checkbox"/>	<input type="checkbox"/>	seriesUID	<input type="checkbox"/>	0020,000E [Series Instance UID]	90
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	patientAge	<input type="checkbox"/>	0010,1010 [Patient's Age]	100
<input checked="" type="checkbox"/>	<input type="checkbox"/>	patientSex	<input type="checkbox"/>	0010,0040 [Patient's Sex]	105
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	spiralmode	<input checked="" type="checkbox"/>	/* returns "spiralmode" as true/false */	110
<input checked="" type="checkbox"/>	<input type="checkbox"/>	seriesNr	<input type="checkbox"/>	0020,0011 [Series Number]	120
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	objectCount	<input checked="" type="checkbox"/>	/* counts the images in the series */	130
<input checked="" type="checkbox"/>	<input type="checkbox"/>	sliceLocation	<input checked="" type="checkbox"/>	/* shows min and max slice location */	135
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	scanlength	<input checked="" type="checkbox"/>	/* calculates the scanlength from the min and max slice location */	136
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	tablefeed	<input checked="" type="checkbox"/>	/* returns the tablefeed */	140
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	sliceThickness	<input type="checkbox"/>	0018,0050 [Slice Thickness]	150
<input checked="" type="checkbox"/>	<input type="checkbox"/>	pitch	<input checked="" type="checkbox"/>	/* calculates the pitch */	180
<input checked="" type="checkbox"/>	<input type="checkbox"/>	exposureTime	<input type="checkbox"/>	0018,1150 [Exposure Time]	200
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	totalCollimation	<input checked="" type="checkbox"/>	/* calculates the totalCollimation */	200
<input checked="" type="checkbox"/>	<input type="checkbox"/>	instanceCreationDate	<input checked="" type="checkbox"/>	/* calculates the instanceCreationDate */	220
<input checked="" type="checkbox"/>	<input type="checkbox"/>	studyDescription	<input type="checkbox"/>	0008,1030 [Study Description]	250
<input checked="" type="checkbox"/>	<input type="checkbox"/>	seriesDescription	<input type="checkbox"/>	0008,103E [Series Description]	260
<input checked="" type="checkbox"/>	<input type="checkbox"/>	protocolName	<input type="checkbox"/>	0018,1030 [Protocol Name]	270
<input checked="" type="checkbox"/>	<input type="checkbox"/>	contrastAgent	<input type="checkbox"/>	0018,0010 [Contrast/Bolus Agent]	280
<input checked="" type="checkbox"/>	<input type="checkbox"/>	ppsID	<input type="checkbox"/>	0040,0253 [Performed Procedure Step ID]	290
<input checked="" type="checkbox"/>	<input type="checkbox"/>	ppsDescription	<input type="checkbox"/>	0040,0254 [Performed Procedure Step Description]	300
<input checked="" type="checkbox"/>	<input type="checkbox"/>	studyUID	<input type="checkbox"/>	0020,000D [Study Instance UID]	310
<input checked="" type="checkbox"/>	<input type="checkbox"/>	patientState	<input type="checkbox"/>	0038,0500 [Patient State]	320
<input checked="" type="checkbox"/>	<input type="checkbox"/>	...	<input type="checkbox"/>	/* calculates the ... */	...

5. PerMoS Data Manager: Data View

PerMoS Data Manager ver. 2.5

File Help

Usermanagement DicomDB Series Overview Application Mapping Application Data

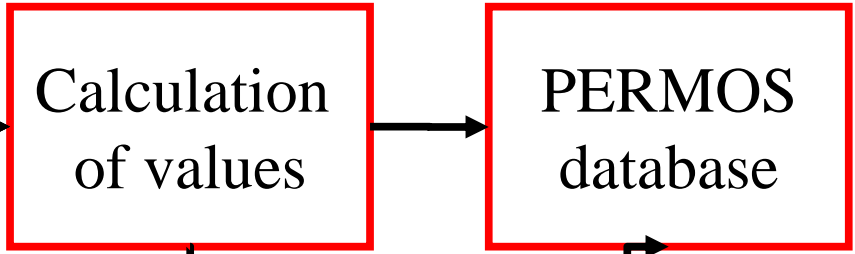
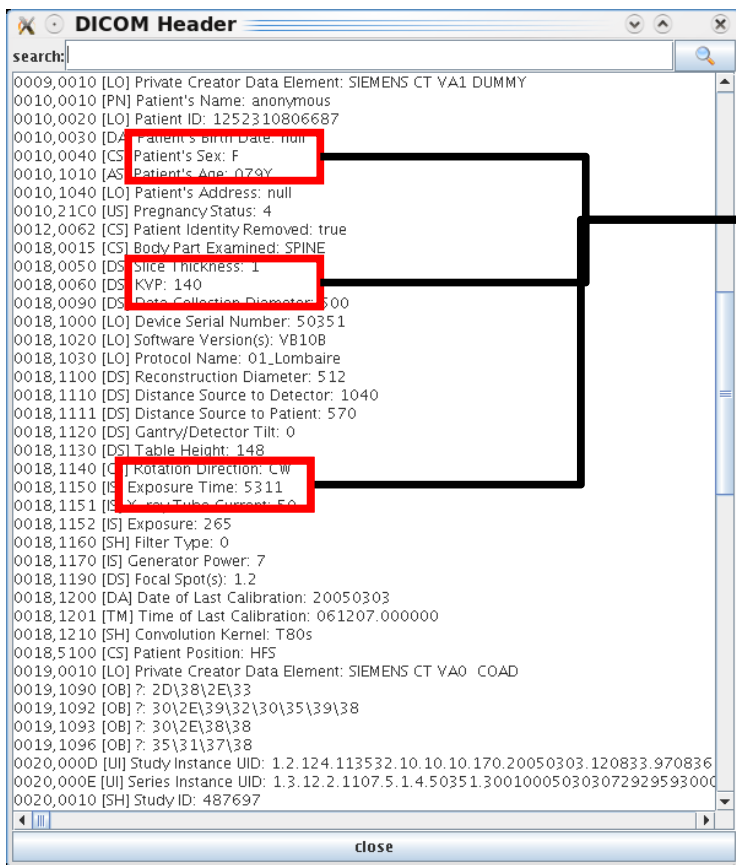
Application: CTDoseCalculation Survey: CTDoseEstimation 2010 Lux User: ALL Stationname: ALL page size: 50 state: ALL Type: ALL Mandatory:

Property: Value: Property: Value: Property: Value:

11052 Results [page 1/222]

state	type	series ID	patientName	examination	CTExpo Examination	type mapper	manufacturerModel	CTExpo Scann	kvp	current
MAPPED	DOSEINFO	17211	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
INCOMPLETE	TOPOGRAM	17212	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Topogram 1.0 T20s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE	SCAN	17213	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Sinus_WF 1.0 H50s	Facial Bones / Sinuses	SCAN	SIEMENS#Sensation 16	Siemens#Se...	120.0	35.0
UNUSED	RECONSTRUC...	17214	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#coro		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
UNUSED	RECONSTRUC...	17215	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#sag		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
MAPPED	DOSEINFO	17216	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
MAPPED	DOSEINFO	17217	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
MAPPED	DOSEINFO	17218	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
MAPPED	DOSEINFO	17219	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
INCOMPLETE	TOPOGRAM	17220	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Topogram 1.0 T20s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE	TOPOGRAM	17221	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Topogram 1.0 T20s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE	TOPOGRAM	17222	chem	HEAD#CT crâne sinus.058-1906-04#01 Crane_SC_OD#Topogram 1.0 T20s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE	SCAN	17223	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Sinus_WF 1.0 H50s	Facial Bones / Sinuses	SCAN	SIEMENS#Sensation 16	Siemens#Se...	120.0	35.0
INCOMPLETE	SCAN	17224	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Sinus_WF 1.0 H50s	Facial Bones / Sinuses	SCAN	SIEMENS#Sensation 16	Siemens#Se...	120.0	35.0
INCOMPLETE		17225	chem	HEAD#CT crâne sinus.058-1906-04#01 Crane_SC_OD#Crane_C-WF 2.0 H20s	Facial Bones / Sinuses	SCAN	SIEMENS#Sensation 16	Siemens#Se...	120.0	147.0
INCOMPLETE		17226	chem	HEAD#CT crâne sinus.058-1906-04#01 Crane_SC_OD#Sinus		SIEMENS#Sensation 16	Siemens#Se...	120.0	147.0	
UNUSED	RECONSTRUC...	17227	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#coro		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
UNUSED	RECONSTRUC...	17228	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#sag		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
UNUSED	RECONSTRUC...	17229	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#coro		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
UNUSED	RECONSTRUC...	17230	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#sag		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
UNUSED	RECONSTRUC...	17231	chem	HEAD#CT crâne sinus.058-1906-04#01 Crane_SC_OD#sag		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
UNUSED	RECONSTRUC...	17232	chem	HEAD#CT crâne sinus.058-1906-04#01 Crane_SC_OD#sag		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
UNUSED	RECONSTRUC...	17233	chem	HEAD#CT crâne sinus.058-1906-04#09 Rochers#coro sinus		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
UNUSED	RECONSTRUC...	17234	chem	HEAD#CT crâne sinus.058-1906-04#09 Rochers#sag sinus		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
INCOMPLETE	TOPOGRAM	17235	chem	HEAD#CT crâne sinus.058-1906-04#09 Rochers#Topogram 1.0 T80s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE		17236	chem	HEAD#CT crâne sinus.058-1906-04#09 Rochers#Sinus_WF 1.0 H50s		SIEMENS#Sensation 16	Siemens#Se...	120.0	35.0	
MAPPED	DOSEINFO	17237	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
INCOMPLETE	TOPOGRAM	17238	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Topogram 1.0 T20s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE	SCAN	17239	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Sinus_WF 1.0 H50s	Facial Bones / Sinuses	SCAN	SIEMENS#Sensation 16	Siemens#Se...	120.0	35.0
UNUSED	RECONSTRUC...	17240	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#coro		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
UNUSED	RECONSTRUC...	17241	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#sag		RECONSTRUC...	SIEMENS#Sensation 16	Siemens#Se...	120.0	NaN
MAPPED	DOSEINFO	17242	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
INCOMPLETE	TOPOGRAM	17243	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Topogram 1.0 T20s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE	SCAN	17244	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Sinus_WF 1.0 H50s	Facial Bones / Sinuses	SCAN	SIEMENS#Sensation 16	Siemens#Se...	120.0	35.0
MAPPED	DOSEINFO	17245	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
INCOMPLETE	TOPOGRAM	17246	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Topogram 1.0 T20s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE	SCAN	17247	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Sinus_WF 1.0 H50s	Facial Bones / Sinuses	SCAN	SIEMENS#Sensation 16	Siemens#Se...	120.0	35.0
MAPPED	DOSEINFO	17248	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
INCOMPLETE	TOPOGRAM	17249	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Topogram 1.0 T20s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE	SCAN	17250	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Sinus_WF 1.0 H50s	Facial Bones / Sinuses	SCAN	SIEMENS#Sensation 16	Siemens#Se...	120.0	35.0
MAPPED	DOSEINFO	17251	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
MAPPED	DOSEINFO	17252	chem	null#CT crâne sinus.058-1906-04#null#Patient Protocol		DOSEINFO	SIEMENS#Sensation 16	Siemens#Se...		NaN
INCOMPLETE	TOPOGRAM	17253	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Topogram 1.0 T20s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE	TOPOGRAM	17254	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Topogram 1.0 T20s		TOPOGRAM	SIEMENS#Sensation 16	Siemens#Se...	100.0	50.0
INCOMPLETE	SCAN	17255	chem	HEAD#CT crâne sinus.058-1906-04#07 Sinus_LowDose_OD#Sinus_WF 1.0 H50s	Facial Bones / Sinuses	SCAN	SIEMENS#Sensation 16	Siemens#Se...	120.0	35.0

6. Dosimetry and other evaluations: CT Expo Dose



Standard Examinations

Standard Examination: Routine Brain

Standard Scan Length L [cm]: 12

f_{mean} [mSv/mGy*cm]: 0.0022 (male), 0.0024 (female)

Scanner Model: Sensation

Scanner Data for Scan Region "Head / Neck":

$nCTDI_w$	U_{ref}	$F_{B,H}$	k_{CT}	dz_1	dz_2	$(N * h)_{ref}$	mOR	D_{OR}
0.184	120	0.76	0.9	3.0	3.0	24	1.0	1.0

Scan Parameters (for up to 3 series):

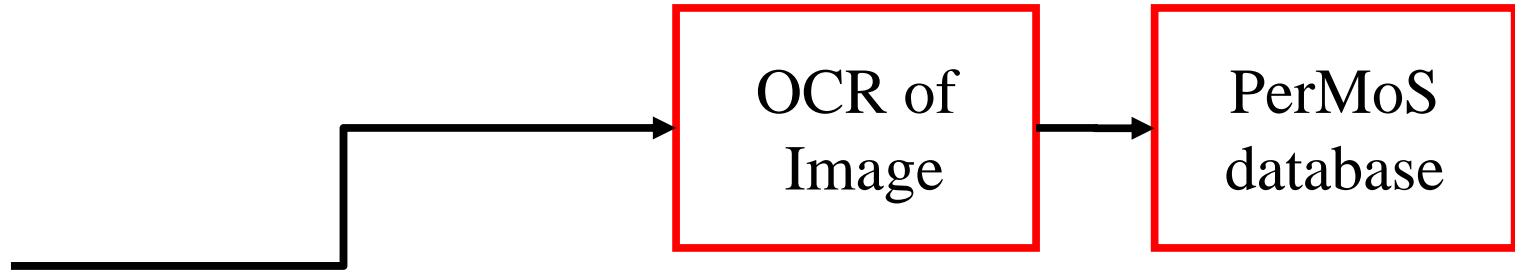
U	I	t	Q_{ref}	Q	$N * h_{col}$	TF	h_{rec}	p	L	k_{OB}	Spiral Mode	ΔL
[kV]	[mA]	[s]	[mAs]	[mAs]	[mm]	[mm]	[mm]		[cm]			[cm]
1st Series			0					1.0		1.00	<input type="checkbox"/>	0.0
2nd Series			0					1.0		1.00	<input type="checkbox"/>	0.0
3rd Series			0					1.0		1.00	<input type="checkbox"/>	0.0

Results:

	Dose values per scan or per series				Dose Values per Examination			
	$CTDI_w$	$CTDI_{ref}$	DLP_w	Effective Dose E*	DLP_w	Effective Dose E		
	[mGy]	[mGy]	[mGy*cm]	[mSv]	[mGy*cm]	[mSv]	[mSv]	[mSv]
1st Series	0,0	0,0	0	0	0,0	0,0	0,0	0,0
2nd Series	0,0	0,0	0	0	0,0	0,0	0,0	0,0
3rd Series	0,0	0,0	0	0	0,0	0,0	0,0	0,0

Depending on the protocol, up to 32 parameters from the DICOM Header are used.

6. Dosimetry and other evaluations: OCR Dose



NOT INTENDED FOR DIAGNOSIS

22-Jan-2009 10:22

Ward:
Physician:
Operator:

Total mAs 2604 Total DLP 241

	Scan	kV	mAs / ref.	CTDIvol	DLP	Tl	cSL
Patient Position H-SP							
Topogram	1	120				5.3	0.6
Abdomen	2	120	82 / 110	6.85	241	0.5	0.6

1.0x Width: 50

Siemens works, GE and Philips are in development

7. PerMoS and EPICT: Initial Experiences

- Thanks to Peter Scholz and Lucian Krille from Mainz for their feedback.
- Based on experiences of the use of PerMoS during data collection in the University hospital Mainz
- **Setting:**
 - **Approx. 4,500 patients with 8,300 examinations**
 - **200 Patients per night requested, roundabout 70,000 files a day uploaded**
 - **31800 series uploaded**

7. PerMoS and EPICT: Initial Experiences

Radiology

- Manage the main patient database of the hospital
- Protect the data against access from out of the network
- Protect private information of patients against misuse
- Guarantee an all-time fast access to medical data

Study-Team

- **Manage a multi-centre study on cancer**
- **Need access to the database for data-mining and upload data by Internet**
- **Try to get as much information on any patient as possible**
- **Need to move a huge amount of data in short time**

[Scholz2011]

7. PerMoS and EPICT: Initial Experiences

- **Main Concerns of the Radiology Admin:**
 - One Laptop having both: connection to PACS and to the Internet at the same time
 - Possible uncontrolled upload of data to a external server
 - High traffic on PACS interfering clinical routine
 - Lots of traffic for little information
 - Loss of privacy protection
 - No guarantee for the completeness of the data
- **Solutions:**
 - Different access to PACS and Internet via scheduler
 - Starting the upload manually after checking the data
 - Scheduling the Queries to time slots with low traffic (night, weekend) and pausing between two queries
 - Precise filtering for relevant cases
 - Anonymisation as early as possible

[Scholz2011]

7. PerMoS and EPICT: Initial Experiences

- **Settings used:**
 - **Laptop:**
 - Installed in a server-room
 - Maintenance via remote-desktop-connection
 - **Receiver:**
 - Schedule 7:00 pm to 6:00 am next day, 7 days a week
 - Delay between two requests: 120 seconds
 - 180-200 ID in one night
 - Between 30s and 20min for one request
 - **Uploader:**
 - Schedule 8:00 am to 6:00 pm, 7 days a week
 - ~ 70,000 files/day
 - 4-5 hours uploading every day
 - Average 80kb/s

[Scholz2011]

7. PerMoS and EPICT: Initial Experiences

▪ Checklist:

- Contact the admin in charge as early as possible!
- Get information on the security directives of the department for your laptop
- Discuss the data structure with your admin
 - Which ID first
 - Since when are images stored
 - Age of data to be transferred to archive server
- Find appropriate time slots for request and upload
- Give the admin access to PerMoS
- Discuss the query results with the radiology for optimizing the query strategy

[Scholz2011]

Optimage and Tudor DICOM Tools: Software tools for automated dose reporting and quality assurance in radiology based on DICOM

**Andreas Jahnen¹, Christian Moll¹, Johannes Hermen¹, Alex Meyer²,
Martine Grelot², Octavian Dragusin², Christina Bokou², Olga
Kaphammel², Alexandra Schreiner³, Carlo Back³**

**¹CRP Henri Tudor Luxembourg, ²EHL Luxembourg,
³Ministry of Health, Luxembourg**

1. Introduction and Motivation

A quality assurance solution for the radiological department:

- Facilitation and documentation of the quality control
- Creation of a central tool, ready to be deployed
- Automated processing of the acquired constancy tests

All tests based on existing phantoms and standards

Required functionality

- Flexible and customisable mode of operation
- DICOM integration
- Automatic processing of images (as much as possible)
- Documentation and reporting
- Statistical evaluation of the calculated results
- Support for the most important modalities

2. Design of the system

Development of the Optimage Framework:

- Support for dynamic modules (plugins) that implement a new test or support a new phantom type
- Image processing functionality based on ImageJ [Wayne Rasband, National Institute of Health]
- Integrated or external relational database
- Statistical functionality including plotting of measurements and export of the data
- Reporting functionality for documentation reasons
- Integrated help system, to support the users in doing the tests
- Multilingual user interface

Due to this framework, new modules automatically benefit from this functions!

3. Profiles

Profiles are the reference for every measurement done

Contain information about the phantom used

- Manufacturer, Model, Methods of calculation

Contain the most important measurement parameters

- We can only “compare” measurements taken with the same machine settings

Contain reference and tolerance values

- Individual settings of the tolerance are possible

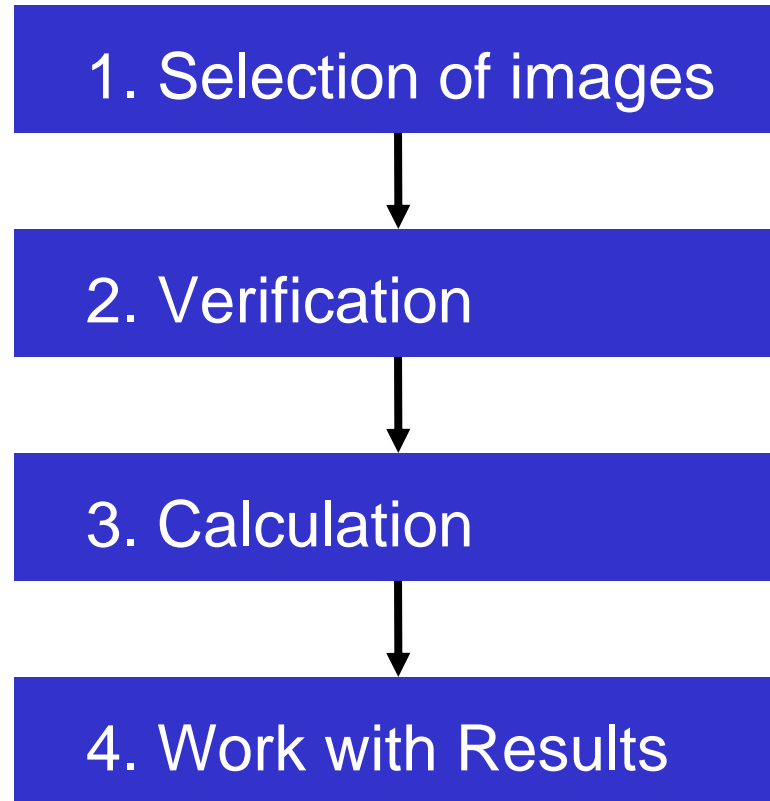
Why profiles?

(1) As a reference point in the database

(2) As the entry point for statistics, export function and reporting

(3) To not compare data, that is not comparable due to the selected parameters

4. Workflow of measurements



Save / Load into the database
Statistics: Visualisations and export
Reports: per profile; over time; ...

6. Statistics

We need to find out, if the measurement is within the acceptable range.

Strategy A: Read the particular guidelines and use the specified limits

Strategy B: Use Statistics (mean \pm 2 sigma)

Plot the measurements over time to discover a change in performance.

**Statistical Process Control: Discover trends as soon as possible
($n > 30$)**

UCL: Upper control line

LCL: Lower control line

UAL: Upper alarm line

LAL: Lower alarm line

7. Reporting

We want to document the measurements:

Print one or more individual measurements

Create an overview for machine XX for the year YYYY

Print over time the SNR for machine XX

Which tests have been done for machine XX

...

Every report starts at the profile

Report generation based on templates, which are “easy” to customize with a graphical editor

Reports can be created in several different formats:

Direct printing

Export to PDF, HTML, RTF, ...

The software in action: Selection

The screenshot shows the Optimage software interface with a selection dialog box open. The dialog box has a title bar and a menu bar (File, Edit, Help). It contains several sections:

- Status:** DICOM STORE is Running
- Patients Table:**

Patient Name	Patient ID
TEST^CATPHAN	26072004
CONTROLE^QU...	1209982
	cq2
- Studies Table:**

Study Desc.	Date	Time
Test Quali...	15.11.05	11:55
- Series Table:**

Modality	Series Desc.	dicom....
CT	30 COUPES F...	2
- Images Table:**

Nr.	Filename
1	1.2.840.113619.2.30.1.1...
2	1.2.840.113619.2.30.1.1...
22	1.2.840.113619.2.30.1.1...
- Preview:** A circular CT scan slice image.
- Informations:**
 - Modality: CT
 - Station Name: [blurred]
 - Image Number: 2
 - Slice Thickness: 5.000000
 - kVp: 120
 - Series Date: 15.11.2005
 - Series Time: 15:11:35
 - File Size: 526
- Buttons:** show Image preview (slower), send to PACS, delete, open, cancel, Show DICOM Header.

The background interface shows a sidebar with icons for Filesystem, DICOM STORE, DICOM QUERY, and DICOMDIR CD. The main window has a menu bar (File, Edit, Help) and a toolbar with various icons. The status bar at the bottom contains buttons for Load Results, View/Export, Plot Time Series, Report over Time, Evaluate, Verify, and Calculate.

The software in action: Verification

The screenshot displays the Optimage software interface. At the top, the title bar reads "Optimage" and the menu bar includes "File", "Edit", and "Help". Below the menu bar is a toolbar with various icons for file operations and a "select User" dropdown menu set to "jahnen". The main window title is "XRAY DIN6868-13 digital Mammography PAS 1054".

The central area is titled "Optimage digital Mammography PAS 1054". It features a "Phantom image folder:" field containing the path "C:\Documents and Settings\jahnen\My Documents\My Pictures\19883141" and a "select Image" button. Below this is a "Profile: PAS 1054 Demo Profile" field with a "select Profile" button.

The main display area is divided into two sections. On the left is a grayscale image of a phantom with green annotations: "Resolution", "Boundary 1", "SFR", "CMT area", "Boundary 2", "Greyarea", "High Contrast Fields", and "Offset". At the bottom of the image, it shows "Center: 3932", "0.4x", and "Width: 7777". On the right is a "Details" section with a table of "checked Parameters".

checked Parameters	Profile	Image
Manufacturer		
Model		
Station		
Device Serial Number		
Anode		
Filter		
Exposure Control Mode		
Detector ID		

To the right of the table is an "Image infos" section with a table of metadata:

Image infos	
Date	
time	
kV	
mAs	
Pixel Size	
Temperature	
Image	
rows	
columns	

At the bottom, a status bar shows "State: Verification of image successful!" with a progress indicator at "100%". Below the status bar are two groups of buttons: "Results" (Load Results, View/Export, Plot Time Series, Report over Time) and "Evaluate" (Verify, Calculate).

The software in action: Results

Optimage

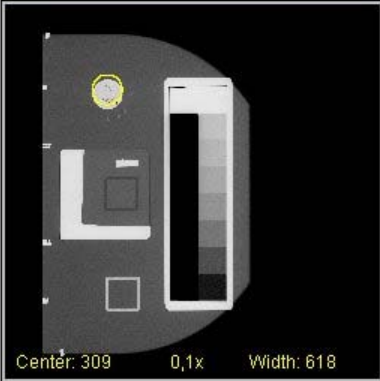
File Edit Help

select User
jahren

XRAY DIN6868-13 digital Mammography PAS 1054

Control Tab Test Results Fri May 05 16:46:44 CEST 2006

PAS 1054 Demo Profile [] Fri May 05 16:46:44 CEST 2006



Center: 309 0,1x Width: 618

Details

Double-Click the preview image to get a larger view with extended features.

Please select the different rows in the result table to explore the measurement details.

Use the [All Results] Button to see additional Results.

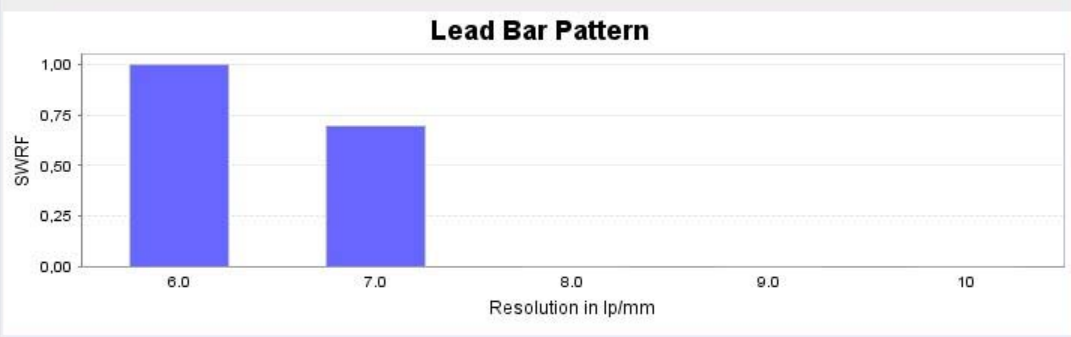
[All Results]

Results

Parameter	Value	Reference	Tolerance	State
SNR	32,21 dB	36,00 dB	±5,00 dB	✓
CNR	49,40 dB	36,00 dB	±5,00 dB	✗
SFR				
Nyquistfrequency	7,14 lp/mm	-	-	✓
vertical SFR Index	0,88	-	-	✓
horizontal SFR Index	0,85	-	-	✓
Correlation of vertical/horizontal SFR Index	1,04	-	-	✓
Resolution				
Visible Resolution Lead Bar:	7,00 lp/mm	7,00 lp/mm	±4,00 lp/mm	✓

Info

Lead Bar Pattern

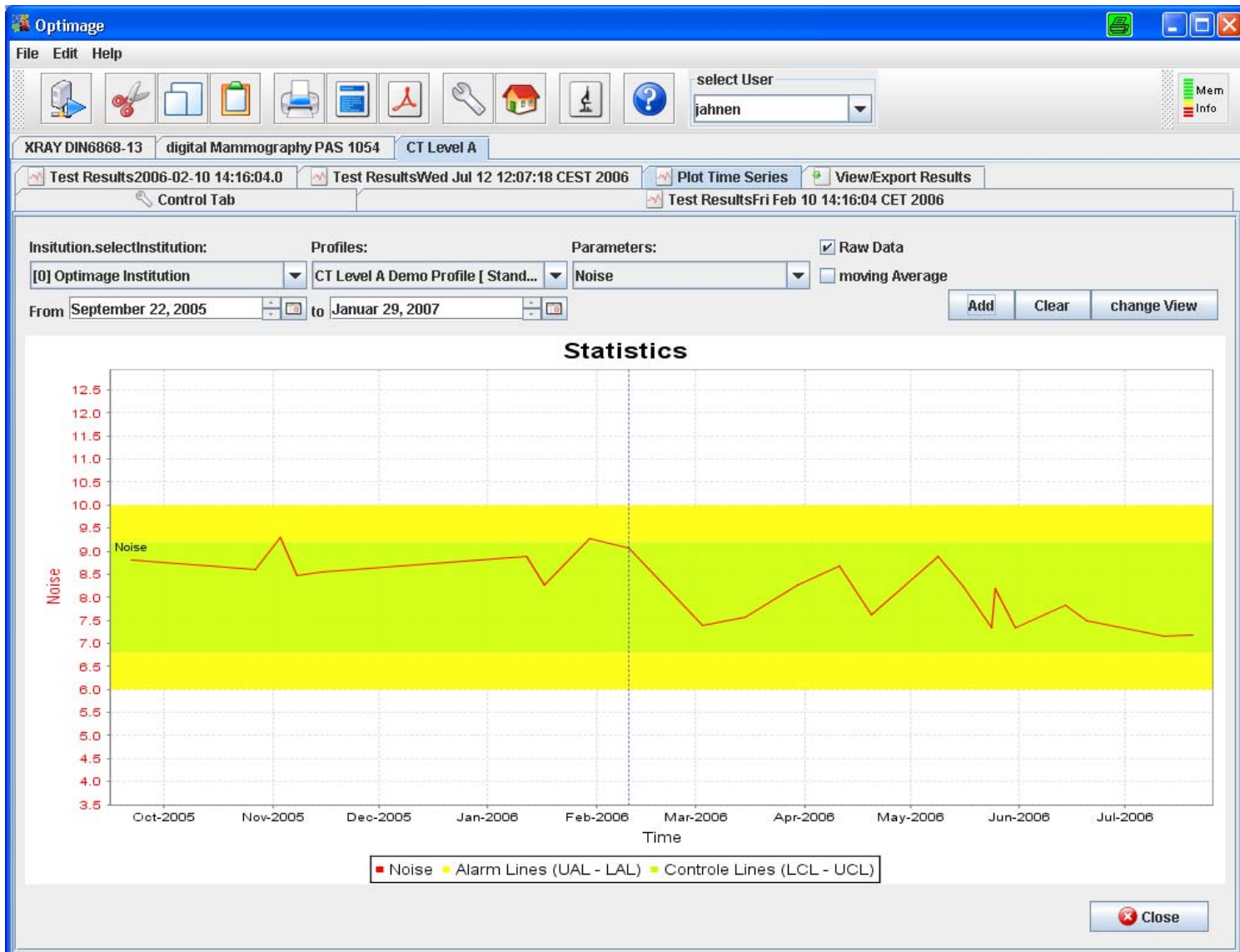


SWRF

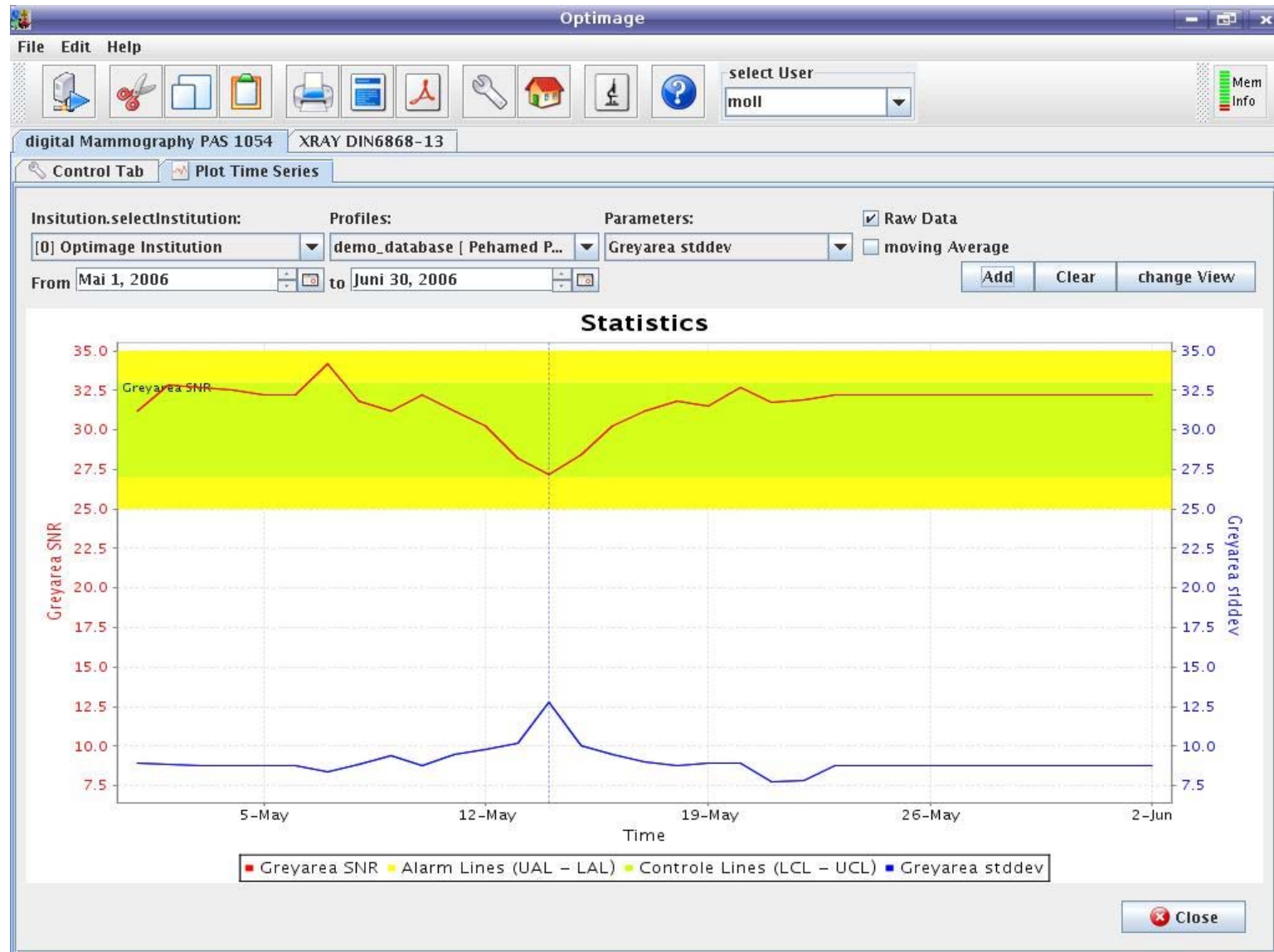
Resolution in lp/mm

save Close

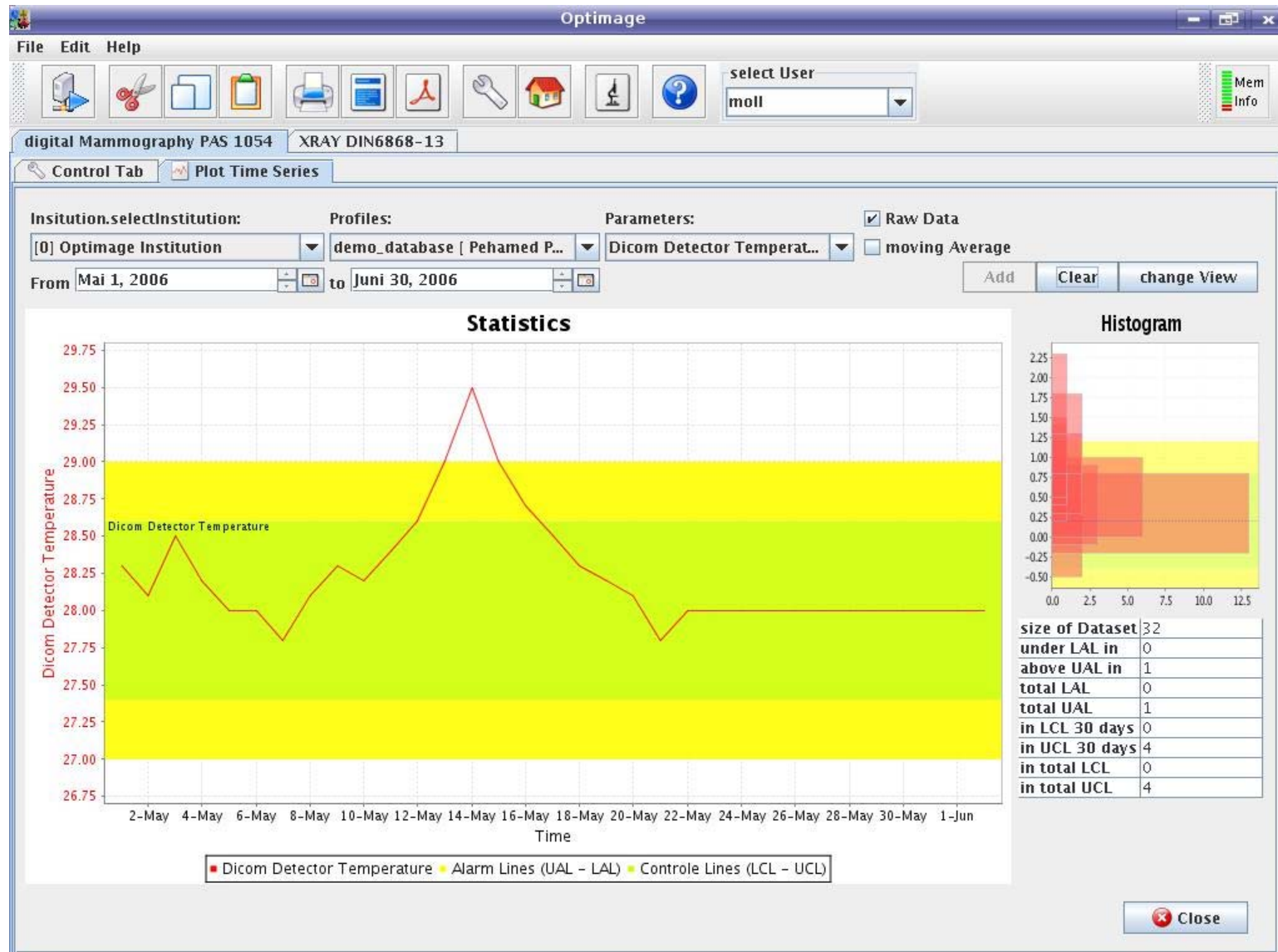
The software in action: Statistics



The software in action: Statistics



The software in action: Statistics



The software in action: Statistics

Optimage

File Edit Help

select User
jahnen

XRAY DIN6868-13 digital Mammography PAS 1054 CT Level A

Control Tab View/Export Results

[0] Optimage Institution CT Level A Demo Profile [] From September 22, 2005 to January 29, 2007 Select

measurements table

Date	CT Numbers Air	CT Numbers Water	Comment	Noise	Relative Values Nois...	Relative Values Unif...	Uniformity Maximal D...
Sep 22, 2005	-1,000.810	1.660	0.000	8.814	-0.531	0.078	-1.293
Oct 27, 2005	-1,001.400	-1.720	0.000	8.600	0.499	-0.096	-1.645
Nov 3, 2005	-1,003.070	0.100	0.000	9.289	-9.261	1.385	-1.389
Nov 8, 2005	-1,001.260	1.950	0.000	8.477	-0.434	0.083	-1.617
Nov 15, 2005	-1,001.680	3.490	0.000	8.558	-0.245	0.048	-1.681
Jan 12, 2006	-1,000.980	2.300	0.000	8.892	-0.386	0.055	-1.276
Jan 17, 2006	-999.890	2.910	0.000	8.269	-0.284	0.057	-1.662
Jan 30, 2006	-1,002.590	2.680	0.000	9.276	-0.345	0.056	-1.504
Feb 10, 2006	-998.100	0.070	0.000	9.057	-12.963	2.150	-1.502
Mar 3, 2006	-997.200	-5.050	0.000	7.395	0.147	-0.004	-0.223
Mar 15, 2006	-999.740	-0.550	0.000	9.304	1.692	-0.278	-1.527
Mar 15, 2006	-998.980	-1.790	0.000	7.557	0.423	-0.035	-0.629
Mar 30, 2006	-1,002.240	1.030	0.000	8.259	-0.800	0.136	-1.407
Apr 11, 2006	-1,000.190	1.230	0.000	8.668	-0.705	0.096	-1.187
Apr 20, 2006	-1,003.110	-1.030	0.000	8.407	0.814	-0.125	-1.293
Apr 20, 2006	-998.180	-3.840	0.000	7.610	0.199	-0.011	-0.422
May 9, 2006	-997.880	-5.110	0.000	7.871	0.154	-0.013	-0.638
May 9, 2006	-1,003.470	1.040	0.000	8.886	-0.852	0.135	-1.414
May 16, 2006	-999.010	-3.330	0.000	7.395	0.222	-0.003	-0.116
May 16, 2006	-1,002.590	0.720	0.000	8.250	-1.143	0.134	-0.971
May 24, 2006	-997.470	-2.530	0.000	7.349	0.291	0.010	0.255
May 25, 2006	-1,002.210	2.190	0.000	8.189	-0.373	0.088	-1.483
May 31, 2006	-998.520	-4.740	0.000	7.333	0.155	-0.015	-0.703
Jun 14, 2006	-998.580	-1.510	0.000	7.817	0.518	0.045	0.674
Jun 20, 2006	-1,002.230	1.340	0.000	9.065	-0.675	0.108	-1.451

Result Table

View/Export Results	CT Numbers Air	CT Numbers Water	Comment	Noise	Relative Values Nois...	Relative Values Unifo...	Uniformity Maximal D...
mean	-1,000.451	-0.477	0.000	8.272	-0.671	0.120	-0.860
2 sigma	3.795	4.951	0.000	1.411	6.010	0.966	1.745

Export to File Close

The software in action.

Reporting

Optimage

File Edit Help

Select User
jahren

Mem
Info

XRAY DING6868-13 digital Mammography PAS 1054 CT Level A

Control Tab Report over Time

[0] Optimage Institution CT Level A Demo Profile [XXXXXXXXXXXXXXXXXXXX] From September 22, 2005 to January 29, 2007 Select Report

39.46%

Time-report Calculations from 2005-09-22 00:00:00 to 2007-01-29 23:59:59

Identification: institution: Optimage Institution address: 29, Avenue John F. Kennedy L-1855 Luxembourg - Kierstberg phone: 00352 42 59 94 250 fax: 00352 42 59 94 250 addition: This is a default institution for calibration, please adjust it to your wishes.	Measurement report: CT Level A Demo Profile device: not checked manufacturer: not checked model: not checked recording conditions: Current: 0.0 Peak kV: not checked kV: not checked Slice Thickness: 0.0 Station Names: not checked Voltage: 0.0 used printers:
--	--

Module Name: CT_Level_A
Profile Name: CT Level A Demo Profile

TABLE OF CONTENTS

1	CT Numbers Air
2	CT Numbers Water
3	Noise Noise
4	Uniformity Center Region
5	Uniformity East Region
6	Uniformity Maximal Difference
7	Uniformity North Region
8	Uniformity South Region
9	Uniformity West Region

Page 1 of 19

Print Export Close

7. Modules / Methods available

Module	Test procedure	Phantom type	Measured parameter
CT level A	Basic measurements	Manufacturer phantoms	Noise, SNR, homogeneity, CT numbers (water, air)
CT level B	CATPHAN Manual ⁽³⁾	CATPHAN 500	Noise, SNR, homogeneity, CT numbers (air, LDPE, acryl, teflon), low contrast, resolution, pixel size, slice thickness, table incrementation
MRI level A	IPEM recommendations ⁽⁴⁾	Standard bottle phantom	Noise, SNR, homogeneity
X-ray level A	DIN 6868-13 ⁽⁵⁾	DIN 6868-13 phantoms	Noise, homogeneity, low contrast, resolution, dynamic range, collimation
CDRAD Mammography level A	CDRAD Manual ⁽⁶⁾ European Guideline ⁽⁷⁾ and PAS 1054 ⁽⁸⁾	CDRAD phantom PAS 1054 phantom and PMMA block	Number and position of detected points Noise, SNR, CNR, grey-area reference, homogeneity, resolution, dynamic range, boundary
Mammography level B	European Guideline ⁽⁷⁾ and PAS 1054 ⁽⁸⁾	PAS 1054 phantom with LCD24 insert	Noise, SNR, CNR, grey-area reference, resolution, dynamic range, boundary, low contrast detail
Nuclear Medicine level A	DIN EN 60789 ⁽⁹⁾	No phantom needed	Intrinsic non-uniformity

Jahnen, A., Schilz, C., Shannoun, F., Schreiner, A., Hermen, J., & Moll, C. (2008). **Optimage central organised image quality control including statistics and reporting**. Radiation protection dosimetry, 129(1-3), 253-7. doi:10.1093/rpd/ncn015

The software is available as Open Source (LGPL) at the project homepage:

<http://santec.tudor.lu/projects/optimage/>

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- Dr Ferid Shannoun, Ministry of Health, Luxembourg
- Phillip Sprenger, CRP Henri Tudor, Luxembourg

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Tudor DICOM Tools:

Software tools for automated dose reporting and quality assurance in radiology based on DICOM

Johannes Hermen¹, Andreas Jahnen¹, Christian Moll¹

¹CRP Henri Tudor Luxembourg,

Agenda

1. Introduction
2. Tudor DICOM Viewer, simple DICOM Viewer
3. Tudor DICOM Viewer, special functions for quality assurance
4. DICOM Tools for ImageJ
5. Case 1: Control of dose values in fluoroscopy
6. Case 2: Automatic modifications of DICOM files

2. Tudor DICOM Viewer, simple DICOM Viewer

- **Viewing images:** The Toolkit offers components to view DICOM images with features like windowing, zooming, shifting, measuring etc. The Tudor DICOM Viewer, a simple but yet powerful DICOM viewer application is able to display multiple images in several splitscreen or multi-monitor configurations. Multiple series can be loaded and managed in the viewer from different available image sources.
- **Opening and writing** The toolkit offers functionality to read DICOM files in various image compressions and formats from a disc or DICOMDIR fileset (DICOM CD). Images from any kind can be saved as uncompressed DICOM files. It is easy to create a lightweight, but standard conform STORAGE-SCP that is able to receive DICOM objects via network and store them into a DICOMDIR file-set or directory

2. Tudor DICOM Viewer, simple DICOM Viewer

Sending and receiving DICOM objects can be queried from a PACS by their patient name, study, series and image UID using the integrated QUERY/RETRIEVE-SCU. A DICOM sender (STORAGE-SCU) can be used to send images to any configured DICOM node in the network.

DICOM header handling It is possible to change the DICOM metadata for example to anonymise images or fix meta data related problems. Header data can be used in conditions to take decisions depending on the provided data. Headers can be viewed as text or hexadecimal values for debugging purposes. A comparison of headers from different files is possible too. Software framework for acquisition and evaluation of DICOM meta-data.

2. Tudor DICOM Viewer, simple DICOM Viewer

0020,0013 [IS] Instance Number: 0020,0013 UNDEF FOR DIAGNOSIS
0010,0010 [PN] Patient's Name: BRAINIX□
0010,0030 [DA] Patient's Birth Date: 19490301
0010,0040 [CS] Patient's Sex: 0000

Center: 405 1.9x Width: 707

0020,0013 [IS] Instance Number: 0020,0013 UNDEF FOR DIAGNOSIS
0010,0010 [PN] Patient's Name: BRAINIX□
0010,0030 [DA] Patient's Birth Date: 19490301
0010,0040 [CS] Patient's Sex: 0000

Center: 686 1x Width: 1195

0020,0013 [IS] Instance Number: 0020,0013 UNDEF FOR DIAGNOSIS
0010,0010 [PN] Patient's Name: BRAINIX□
0010,0030 [DA] Patient's Birth Date: 19490301
0010,0040 [CS] Patient's Sex: 0000

Center: 379 1.7x Width: 661

0020,0013 [IS] Instance Number: 0020,0013 UNDEF FOR DIAGNOSIS
0010,0010 [PN] Patient's Name: BRAINIX□
0010,0030 [DA] Patient's Birth Date: 19490301
0010,0040 [CS] Patient's Sex: 0000

Center: 123 1.9x Width: 215

prev next

Slice: 1/22 size: 11.07mb
Name: BRAINIX□
Birthdate: 01.03.1949
Sex: 0000 Modality: MR
Series Date: 01.12.2006
Body Part:

Slice: 1/100 size: 13.63mb
Name: BRAINIX□
Birthdate: 01.03.1949
Sex: 0000 Modality: MR
Series Date: 01.12.2006
Body Part:

Slice: 1/22 size: 11.76mb
Name: BRAINIX□
Birthdate: 01.03.1949
Sex: 0000 Modality: MR
Series Date: 01.12.2006
Body Part:

Slice: 1/22 size: 3.56mb
Name: BRAINIX□
Birthdate: 01.03.1949
Sex: 0000 Modality: MR
Series Date: 01.12.2006
Body Part:

Slice: 1/22 size: 11.07mb
Name: BRAINIX□
Birthdate: 01.03.1949
Sex: 0000 Modality: MR
Series Date: 01.12.2006
Body Part:

Slice: 1/22 size: 2.82mb
Name: BRAINIX□
Birthdate: 01.03.1949
Sex: 0000 Modality: MR
Series Date: 01.12.2006
Body Part:

Mem Info

2. Tudor DICOM Viewer, simple DICOM Viewer

Status: DICOM STORE is Running SANTEC@10.14.1.111:5104

show Image preview (slower)

Filesystem

DICOM STORE

DICOM QUERY

DICOM CD

DICOMDIR

Image Select...

Patients

Patient Name	Patient ID
QC Mammo	12269105034...
QC NM	12269105949...
QC XRAY	12269109513...
QC MRI	12269109823...
QC CT	12269104827...
Anonymous, Ma...	172.16.0.208:...
QUALITE, CONT...	18700101000
QUALITE, CONT...	20030507000
Anonymous, Fe...	172.16.0.208:...
CEREBRIX	Xsxuld
PHENIX	Vafk,T,6
Anonymized	0123456789

Studies

Study Desc.	Date	Time
PET^PET...	03.08.07	16:42
Neuro^C...	20.07.07	08:13

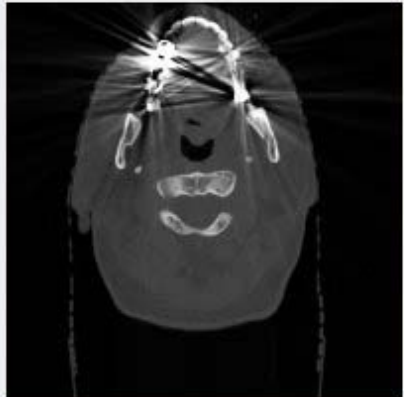
Series

Modality	Series Desc.	
CT		3
PT		5
PT		6
PT		7

Images

Nr.	Type
1	IMAGE
2	IMAGE
3	IMAGE
4	IMAGE
5	IMAGE
6	IMAGE

Preview:



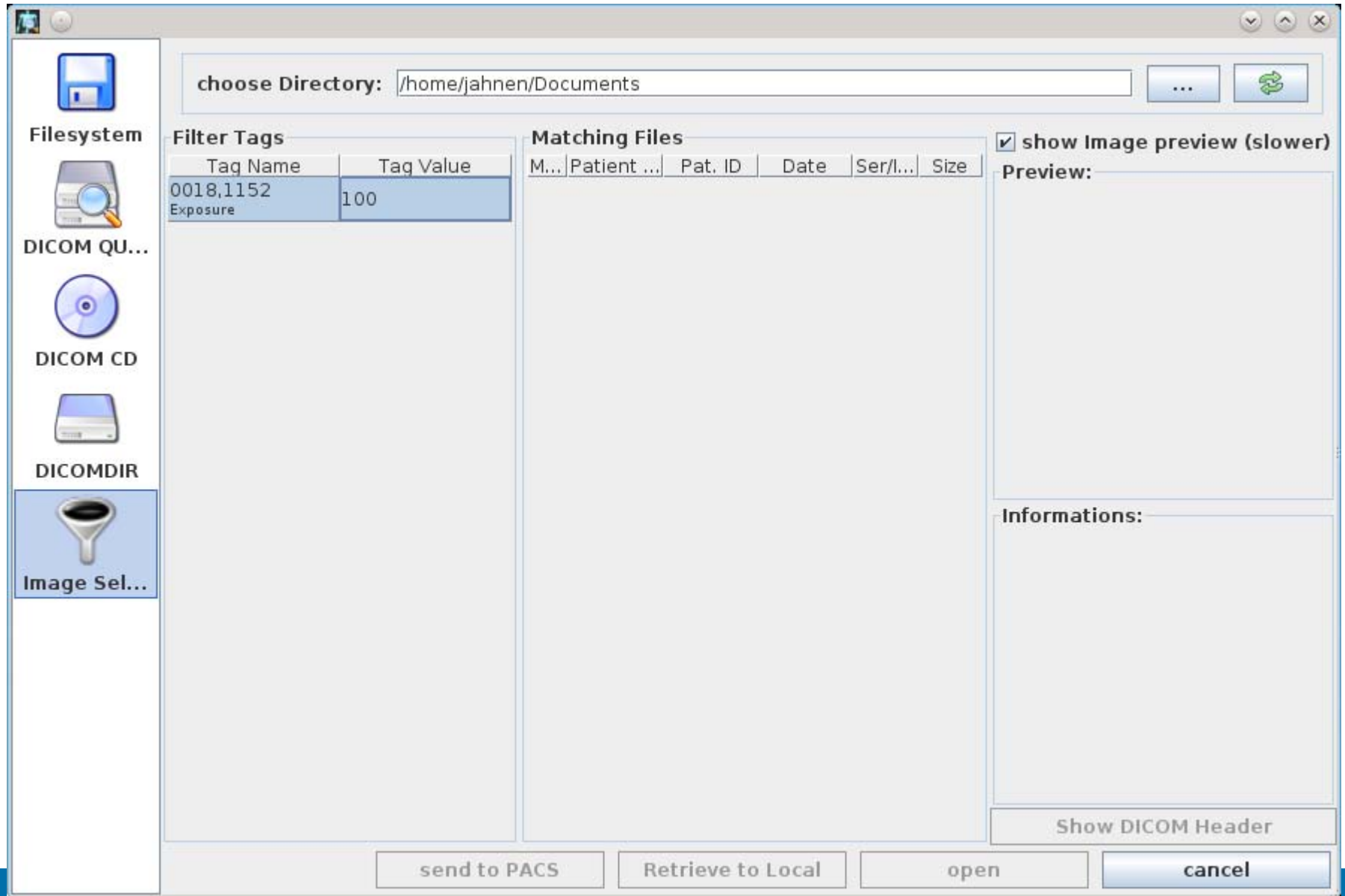
Informations:

Image Type: ORIGINAL
Modality: CT
Manufacturer: SIEMENS
Station Name: CT48545
Instance Number: 1
Slice Thickness: 2
KVP: 120
File Size: 514

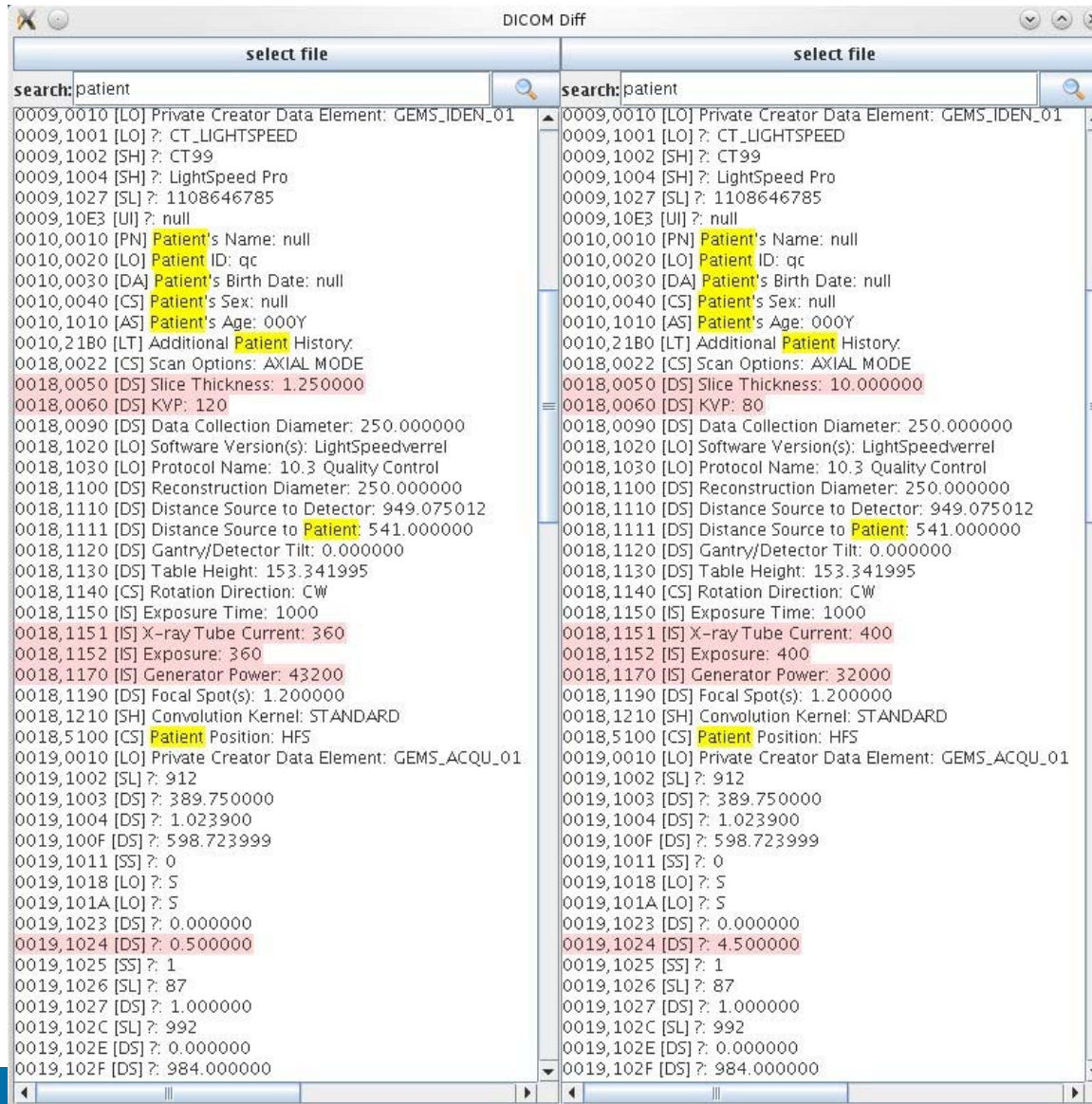
Show DICOM Header

delete **send to PACS** **Open file** **open Series** **cancel**

2. Tudor DICOM Viewer, special functions



2. Tudor DICOM Viewer, special functions



2. Tudor DICOM Viewer, special functions

DicomAnonymizerGui

/home/hermenj/ct_head

remove Patient Information

NEW Patient ID

NEW Patient Name

remove Patient Additional Information

remove Institution Information

NEW Institution Name

remove Physician Information

remove Manufacturer Information

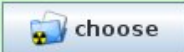
remove Image (This will leave only the DICOM-Header!)

rename Files to _anon.dcm/_header.dcm

processing file: /home/hermenj/ct_head/IM-0001-0217.dcm
processing file: /home/hermenj/ct_head/IM-0001-0350.dcm
processing file: /home/hermenj/ct_head/IM-0001-0256.dcm
processing file: /home/hermenj/ct_head/IM-0001-0309.dcm
processing file: /home/hermenj/ct_head/IM-0001-0162.dcm
processing file: /home/hermenj/ct_head/IM-0001-0310.dcm
processing file: /home/hermenj/ct_head/IM-0001-0277.dcm
processing file: /home/hermenj/ct_head/IM-0001-0159.dcm
processing file: /home/hermenj/ct_head/IM-0001-0201.dcm
processing file: /home/hermenj/ct_head/IM-0001-0351.dcm
processing file: /home/hermenj/ct_head/IM-0001-0158.dcm

2. Tudor DICOM Viewer, special functions

DICOM Headerdata evaluator


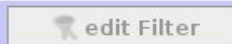
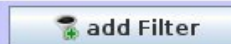
Selected Files: /media/daten/DICOM/DICOM_Images/CHEM_Siemens_Fluoroscopy_header 





Selected Tags:

VR	Nr.	Name
DA	0008,0022	Acquisition Date
TM	0008,0032	Acquisition Time
CS	0008,0060	Modality
DS	0008,1010	KVP
LO	0018,1030	Protocol Name
IS	0018,1150	Exposure Time
IS	0018,1152	Exposure
IS	0018,1153	Exposure in μ As
DS	0018,115E	Image and Fluoroscopy Area Dose Prod...
DS	0018,8150	Exposure Time in μ S
SH	0020,0010	Study ID

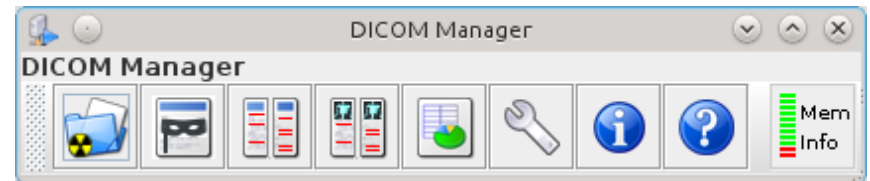
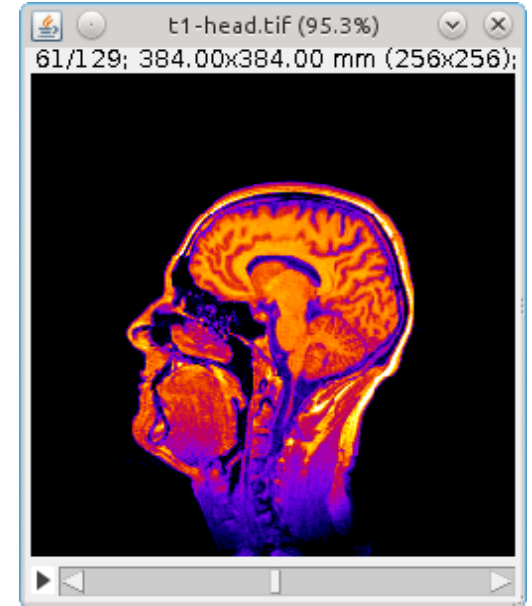
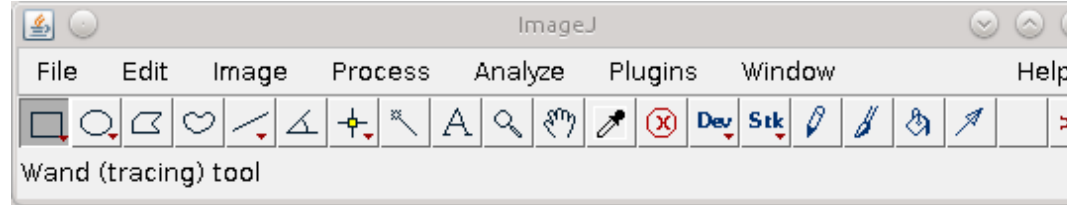
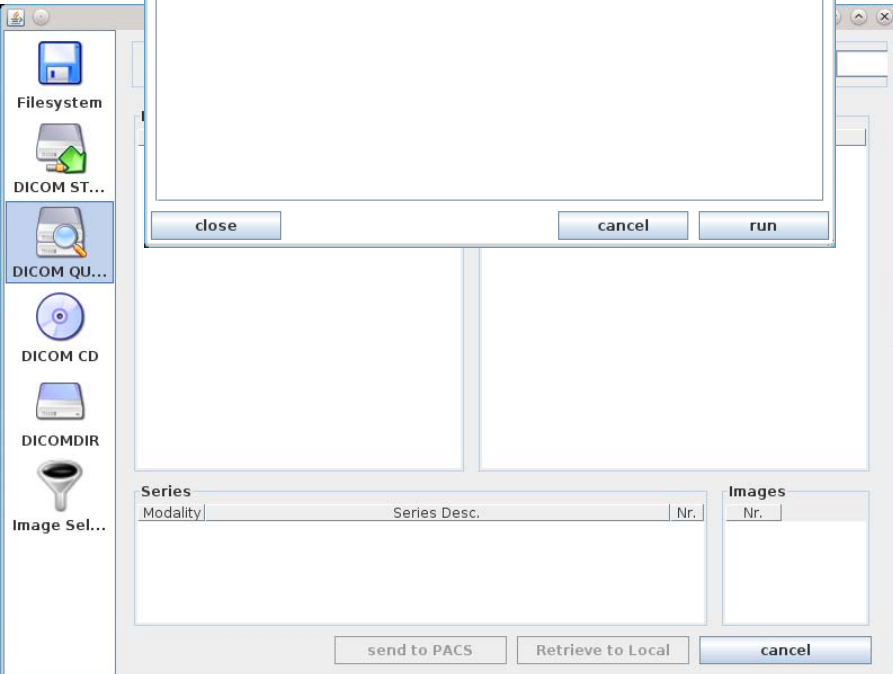
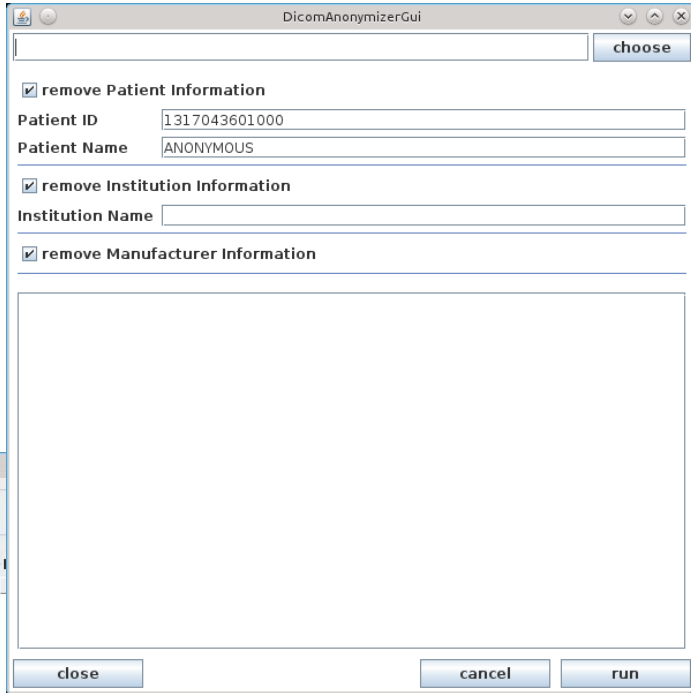
Used DICOM Filters:

VR	Nr.	Name	Value
CS	0008,0060	Modality	CR DR


   


2. Tudor DICOM tools for ImageJ



5. Case 1: Control of dose values in fluoroscopy

DICOM Headerdata evaluator

Selected Files: /media/daten/DICOM/DICOM_Images/CHEM_Siemens_Fluoroscopy_header 




Selected Tags: 





VR	Nr.	Name
UL	0002,0000	File Meta Information Group Length
OB	0002,0001	File Meta Information Version
UI	0002,0002	Media Storage SOP Class UID
UI	0002,0003	Media Storage SOP Instance UID
UI	0002,0010	Transfer Syntax UID
UI	0002,0012	Implementation Class UID
SH	0002,0013	Implementation Version Name
AE	0002,0016	Source Application Entity Title
UI	0002,0100	Private Information Creator UID
OB	0002,0102	Private Information
CS	0004,1130	File-set ID
CS	0004,1141	File-set Descriptor File ID
CS	0004,1142	Specific Character Set of File-set Descriptor File
UL	0004,1200	Offset of the First Directory Record of the Root Dir...
UL	0004,1202	Offset of the Last Directory Record of the Root Dir...
US	0004,1212	File-set Consistency Flag
SQ	0004,1220	Directory Record Sequence
UL	0004,1400	Offset of the Next Directory Record
US	0004,1410	Record In-use Flag
UL	0004,1420	Offset of Referenced Lower-Level Directory Entity
CS	0004,1430	Directory Record Type
UI	0004,1432	Private Record UID
CS	0004,1500	Referenced File ID
UL	0004,1504	MRDR Directory Record Offset
UI	0004,1510	Referenced SOP Class UID in File
UI	0004,1511	Referenced SOP Instance UID in File
UI	0004,1512	Referenced Transfer Syntax UID in File
UI	0004,151A	Referenced Related General SOP Class UID in File
UL	0004,1600	Number of References
UL	0008,0001	Length to End

VR	Nr.	Name
DA	0008,0022	Acquisition Date
TM	0008,0032	Acquisition Time
CS	0008,0060	Modality
DS	0008,1010	KVP
LO	0018,1030	Protocol Name
IS	0018,1150	Exposure Time
IS	0018,1152	Exposure
IS	0018,1153	Exposure in μ As
DS	0018,115E	Image and Fluoroscopy Area Dose Prod...
DS	0018,8150	Exposure Time in μ S
SH	0020,0010	Study ID

Used DICOM Filters:

VR	Nr.	Name	Value
CS	0008,0060	Modality	CR DR

5. Case 1: Control of dose values in fluoroscopy

DICOM Headerdata evaluator

Selected Files: /media/daten/DICOM/DICOM_Images/CHEM_Siemens_Fluoroscopy_header choose

Selected Tags:

VR	Nr.	Name
UL	0002,0000	File Meta Information Group Length
OB	0002,0001	File Meta Information Version
UI	0002,0002	Media Storage SOP Class UID
UI	0002,0003	Media Storage SOP Instance UID
UI	0002,0010	Transfer Syntax UID
UI	0002,0012	Implementation Class UID
SH	0002,0013	Implementation Version Name
AE	0002,0016	Source Application Entity Title
UI	0002,0100	Private Information Creator UID
OB	0002,0102	Private Information
CS	0004,1130	File-set ID
CS	0004,1141	File-set Descriptor File ID
CS	0004,1142	Specific Character Set of File-set Descriptor File
UL	0004,1200	Offset of the First Directory Record of the Root Dir...
UL	0004,1202	Offset of the Last Directory Record of the Root Dir...
US	0004,1212	File-set Consistency Flag
SQ	0004,1220	Directory Record Sequence
UL	0004,1400	Offset of the Next Directory Record
US	0004,1410	Record In-use Flag
UL	0004,1420	Offset of Referenced Lower-Level Directory Entity
CS	0004,1430	Directory Record Type
UL	0004,1432	Private Record UID

VR	Nr.	Name
DA	0008,0022	Acquisition Date
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IS	0018,1152	Exposure
IS	0018,1153	Exposure in μ As
DS	0018,115E	Image and Fluoroscopy Area Dose Prod...
DS	0018,8150	Exposure Time in μ S
SH	0020,0010	Study ID

Used DICOM Filters:

VR	Nr.	Name	Value
CS	0008,0060	Modality	CR DR

DICOM Data-Table: 13 Results

Acquisition Date	Acquisition Time	Modality	KVP	Protocol Name	Exposure Time	Exposure	Exposure in μ As	Image and Fluoroscopy Area Dose Product	Exposure Time in μ S
20110817	073655.0375	CR	CHEST	RAD THORAX FACE PA	1	0	600	0.322	1800
20110817	073750.0171	CR	CHEST	RAD THORAX PROFIL	4	1	1800	0.866	4000
20110817	100554.0468	CR	HIP	RAD HANCHE D FACE	31	24	24900	1.488	31200
20110817	100617.0390	CR	HIP	RAD HANCHE D AXIALE	28	22	22800	1.554	28300
20110817	100918.0750	CR	CHEST	RAD GRIL COSTAL G BAS AP	24	10	10100	1.212	24100
20110817	100943.0187	CR	CHEST	RAD GRIL COSTAL G BAS AP	29	12	12600	1.654	29900
20110817	101011.0343	CR	CHEST	RAD GRIL COSTAL G BAS AP	14	5	5900	0.697	14200
20110817	100856.0734	CR	TSPINE	RAD COL DORS FACE	29	23	23200	1.330	29100
20110817	101053.0812	CR	TSPINE	RAD COL DORS PROFIL	39	31	31400	2.113	39200
20110817	101521.0843	CR	FOOT	W Pied G Face 3/4	5	2	2000	0.289	5100
20110817	101600.0562	CR	FOOT	W Pied G Prof	8	3	3200	0.606	8100
20110817	101416.0437	CR	FOOT	W Cheville G Face	9	4	4000	0.913	9300
20110817	101444.0218	CR	FOOT	W Cheville G Profil	9	4	4000	1.028	9400

export to .csv

close

1. Case 2: Automatic modifications of DICOM files

```
// from TransCodeNode.java
public void fireDicomEvent(DicomEvent event) {

    logger.info("event: " + event);

    File inFile = event.getFile();
    File outFile = new File(inFile.getAbsolutePath() + ".converted.dcm");

    // read orig file
    DicomInputStream in;
    in = new DicomInputStream(file);
    DicomObject dcmobj = in.readDicomObject();
    in.close();

    // modify header
    dcmobj.putDouble(Tag.DoseValue, dcmobj.vrOf(Tag.DoseValue), 08.15)

    // write file
    FileOutputStream fos = new FileOutputStream(outFile);
    BufferedOutputStream bos = new BufferedOutputStream(fos);
    DicomOutputStream dos = new DicomOutputStream(bos);
    dos.writeDicomFile(dcmobj);
    dos.close();

    // send converted file
    this.dicomSender.send(outFile);
}
```

Online resources

EPI-CT and PerMoS

- EPI-CT Homepage: <http://epi-ct.iarc.fr/>
- Tudor Resources: <http://santec.tudor.lu/project/epict/>

Optimage

- Homepage: <http://santec.tudor.lu/project/optimage>

Tudor DICOM Tools

- Homepage: <http://www.santec.lu/project/dicom/>
- ImageJ Homepage: <http://rsbweb.nih.gov/ij/>