

Optimage – central organised images quality control including statistics and reporting

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Introduction and Motivation

- A 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 (Reporting)
 - Statistical evaluation of the calculated results
 - Support for the most important modalities

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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!

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Approach for a new module

1. Definition of the test parameters
2. Definition of test method and used test equipment (standards, phantoms,...)
3. A software module for Optimage, that is able to calculate the test
4. A user guide, which describes how to perform the test correctly

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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?
 - As a reference point in the database
 - As the entry point for statistics, export function and reporting
 - To not compare data, that is not comparable due to the selected parameters

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Workflow of measurements

1. Selection of images



2. Verification



3. Calculation



4. Work with Results

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

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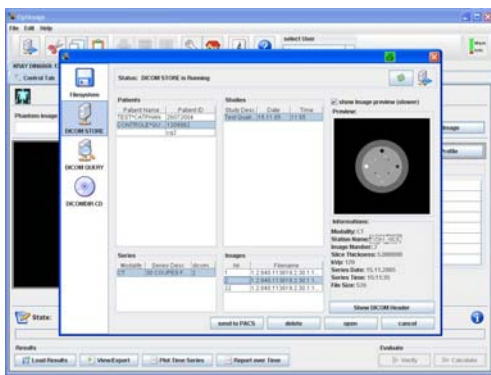
Statistics

- 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

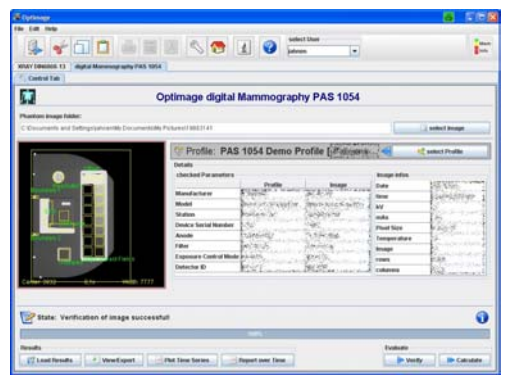
Reporting

- 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, ...

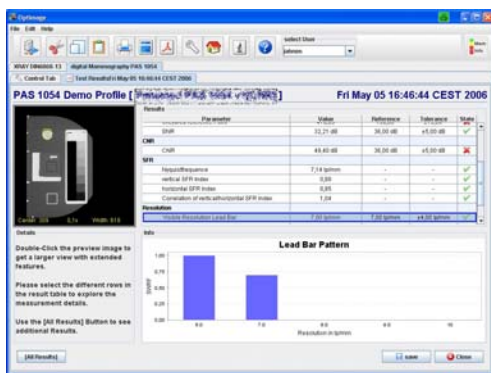
The software in action: Selection



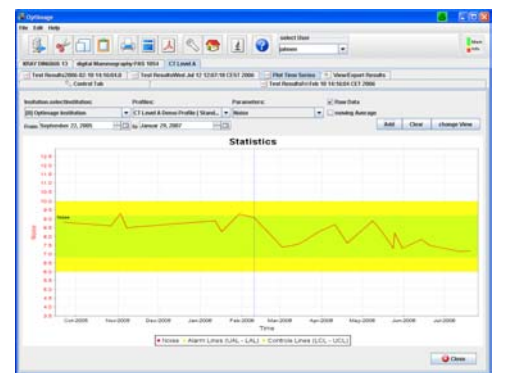
The software in action: Verification



The software in action: Results



The software in action: Statistics



... as Free Software; "Open Source"

- The software has a "copyright" (not public domain)
- Optimage: LGPL - Lesser General Public License
 - Permits the use of the code in commercial applications
 - Changes to the original code have to be open again
- Why?
 - We want to emphasize the non-manufacturer depend nature
 - A suitable way to establish collaborations
 - We want to benefit from know-how of "the community"
 - We want to benefit from other groups development
- Commercial versions and support possible, even more flexible (independent)

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Conclusions

- The software solution shows great acceptance in the clinical field The central approach is flexible enough to be customized for different IT infrastructures
- The development of new modules is now easy and fast due to the developed framework
- The evaluation of the tests are less time consuming than the that by human observers
- The included statistical functions are easy to use (and useful)
- Next Steps
 - Evaluation of the developed methods
 - How to set up suitable reference and tolerance values?
 - Development of additional "Modules"

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Thank you for your attention

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

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

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