Auxiliary Application for Mammography system calibration and testing

Prepared by: Alex Shkatov

Professional advice and images:

Andrey Broisman, Ariel University Center of Samaria

Introduction

- **Mammography** is the process of using low-energy-X-rays to examine the human breast.

- The goal of mammography is the early detection of breast cancer

- Over 300,000 mammography tests are performed every year in Israel.

Motivation

- Image quality is critical
- The system should be calibrated periodically
- Simple image quality checks are made manually
- Complex tests are not performed
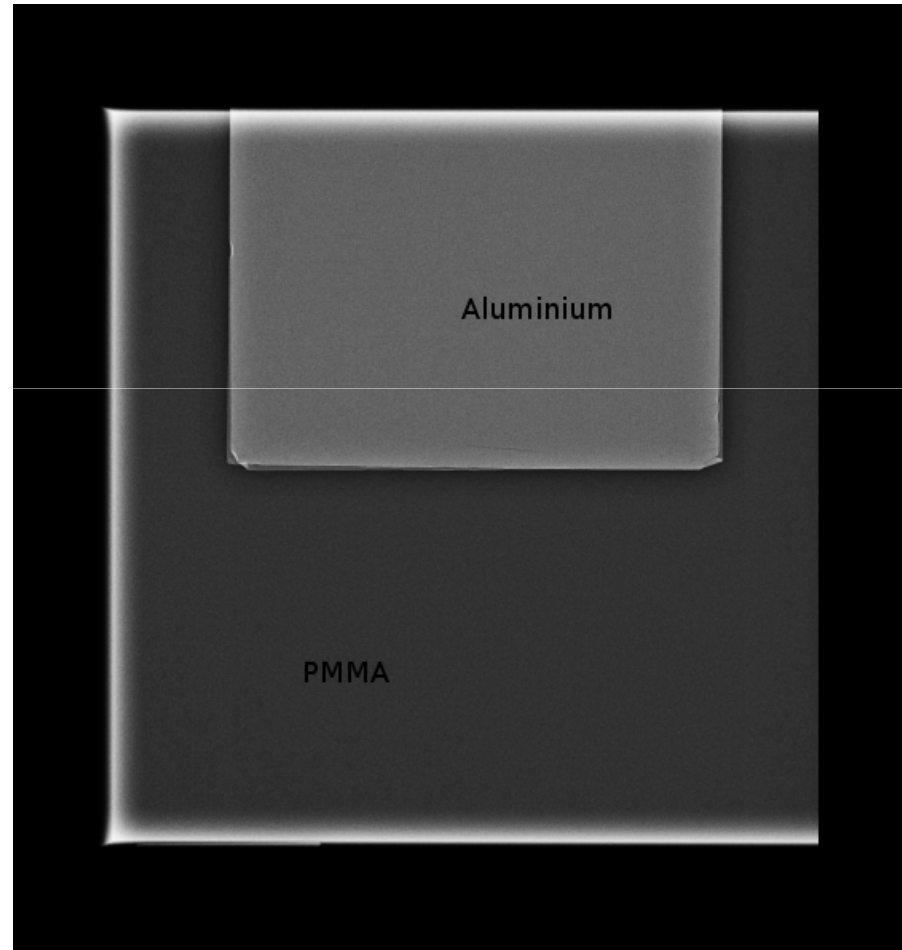- **Simple and free auxiliary tool is needed**

ImageJ

- Open source
- Portable – Java based
- Includes DICOM I/O libraries
- Includes Vision algorithms libraries
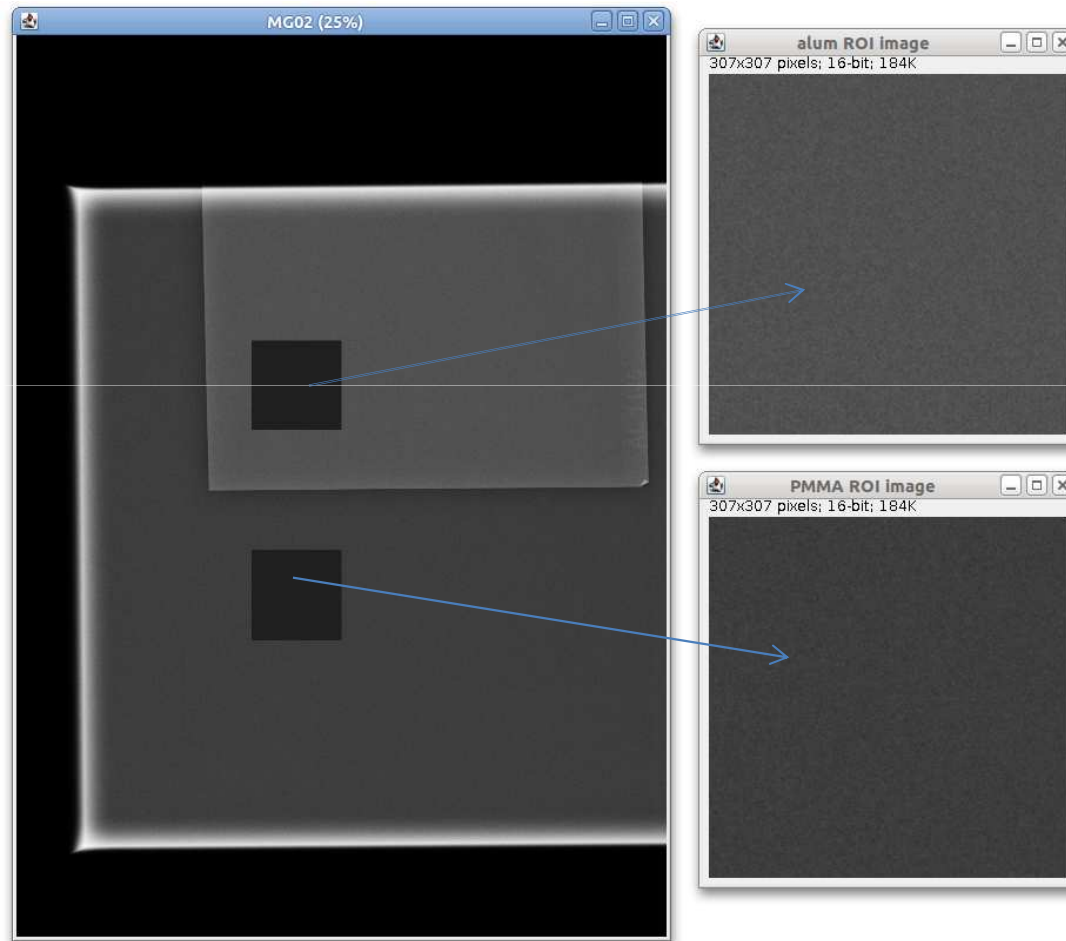- Simple code integration via Plug-ins

Supported image quality tests

1. Contrast to Noise Ratio (CNR)

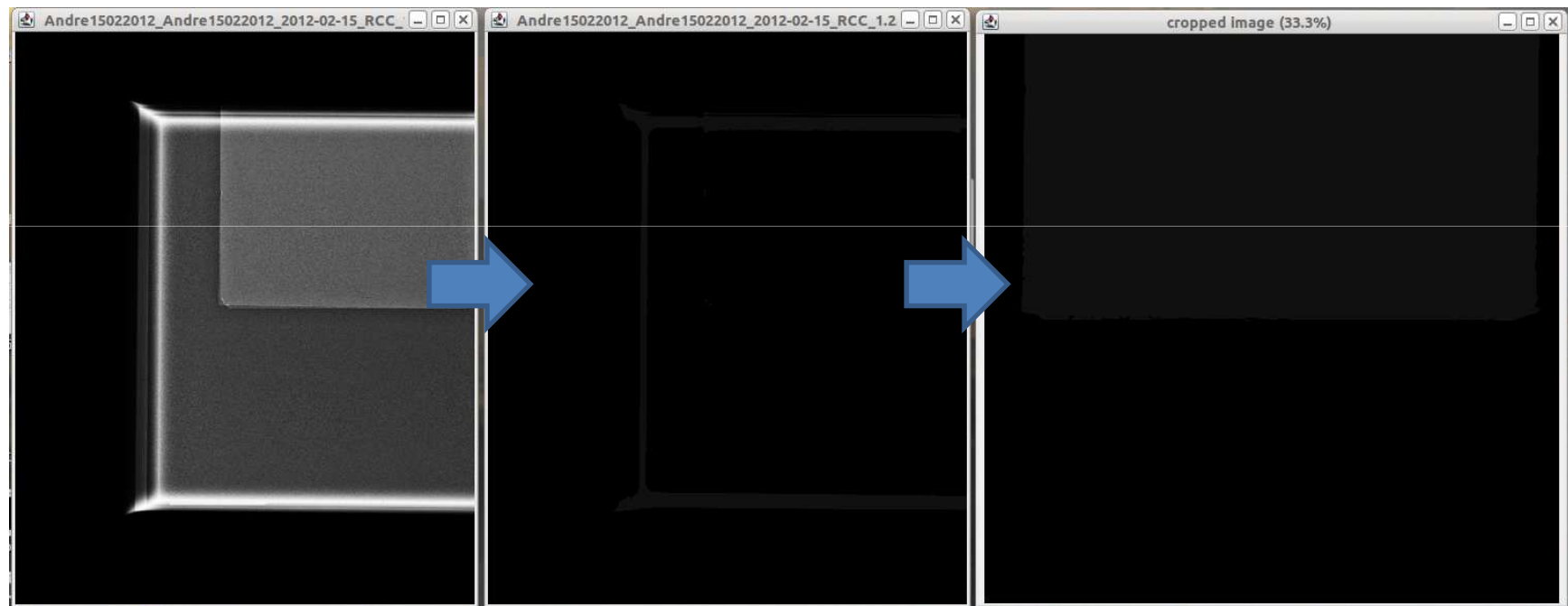2. Detector ghosting (SDNR)

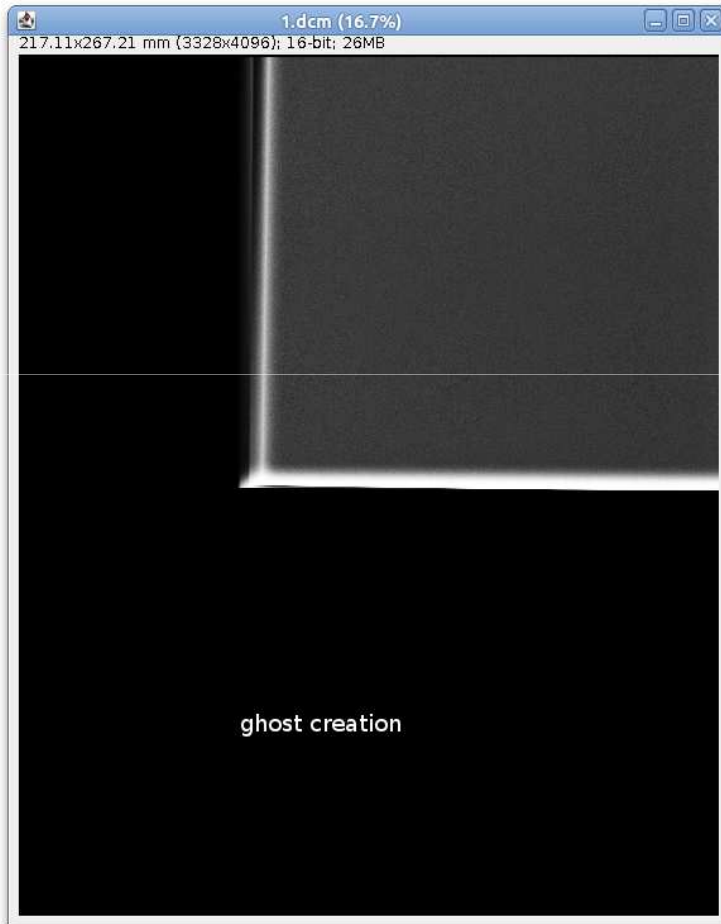3. Modulation transfer function(MTF)

Contrast to Noise Ratio (CNR)
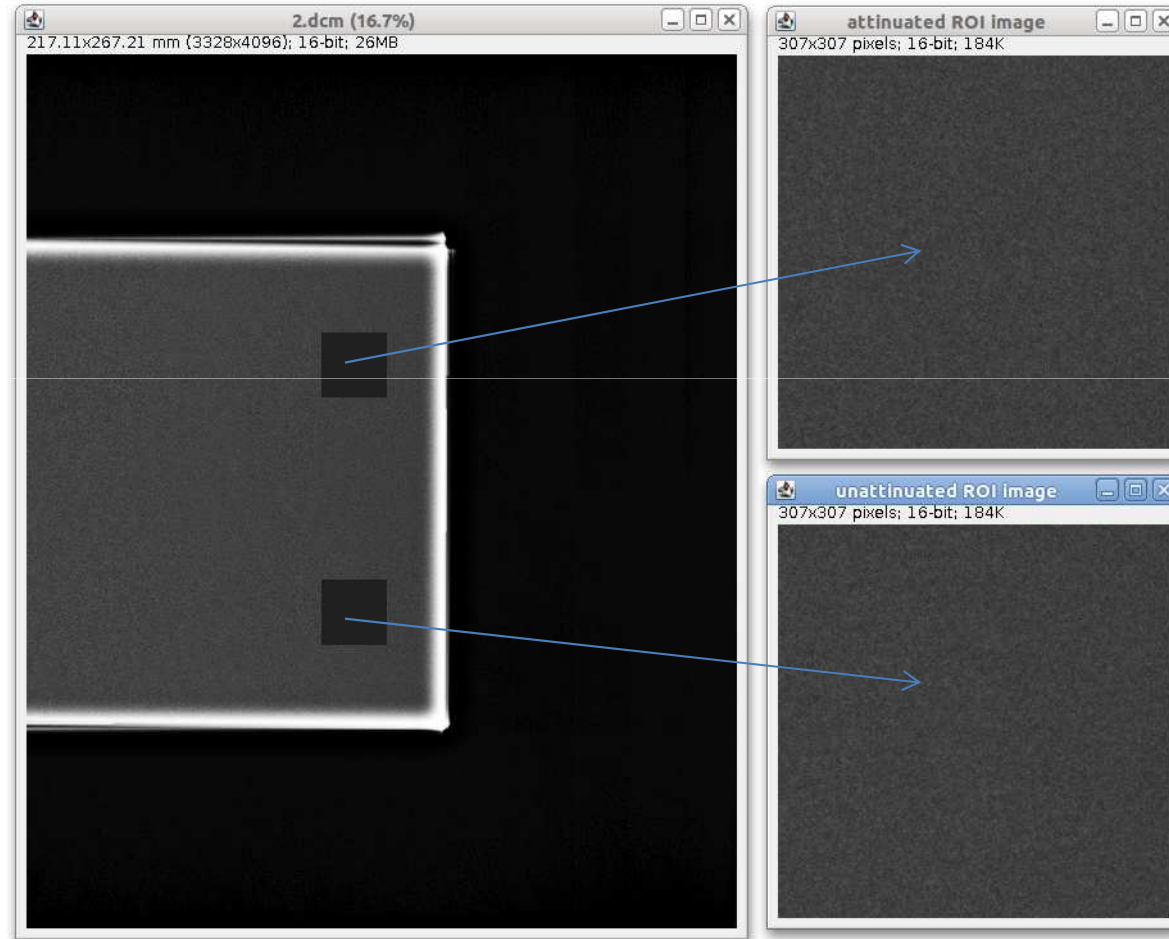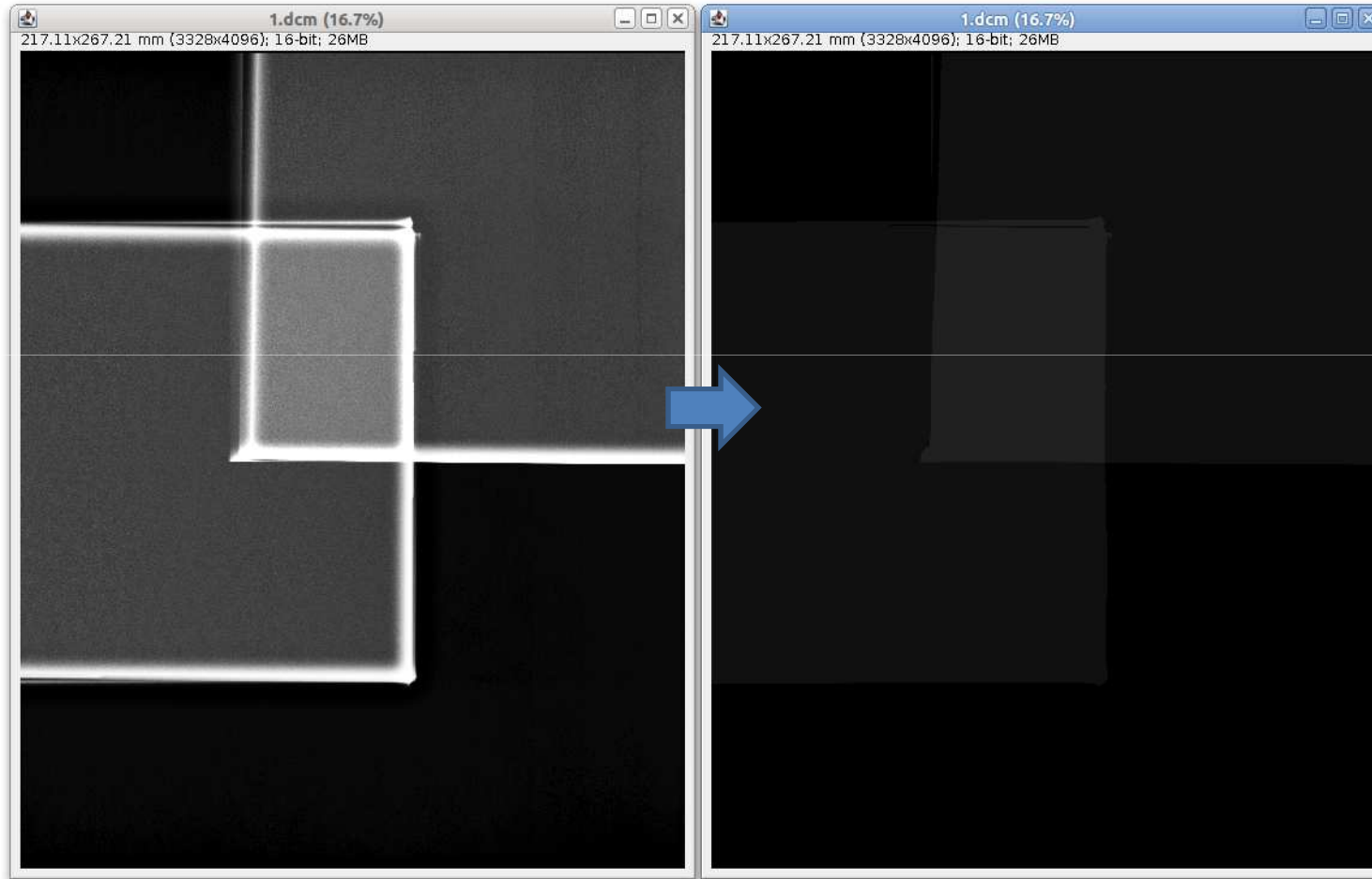
Contrast to Noise Ratio (CNR)

Contrast to Noise Ratio (CNR)

Detector ghosting (SDNR)

Detector ghosting (SDNR)

Detector ghosting (SDNR)

Modulation transfer function(MTF)

$$h(t) = L[\delta(t)]$$

$$x(t)$$

L

$$y(t) = x(t) * h(t)$$
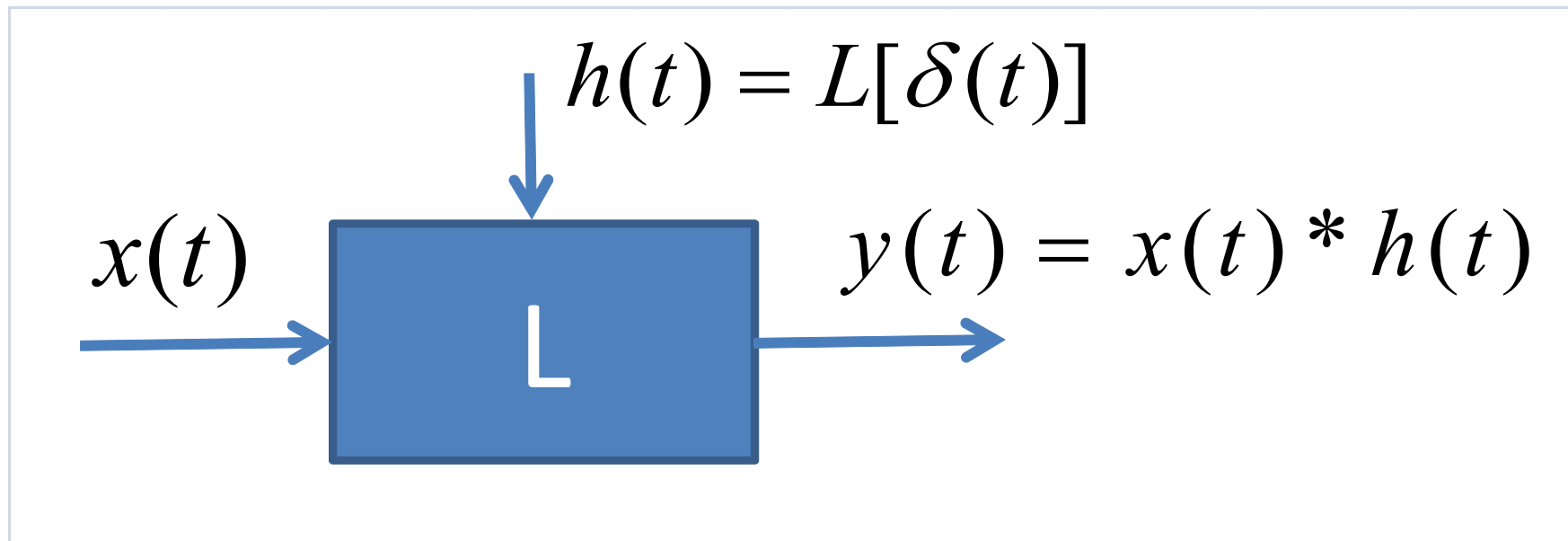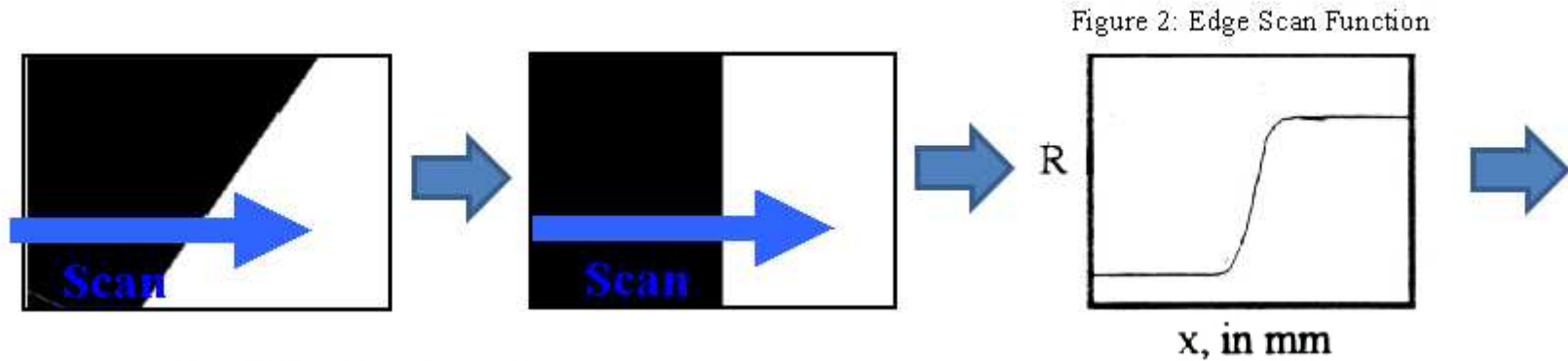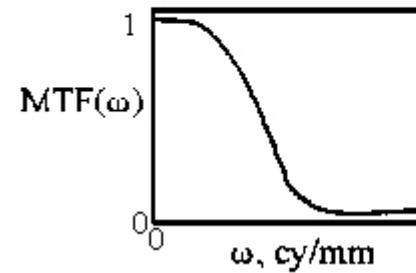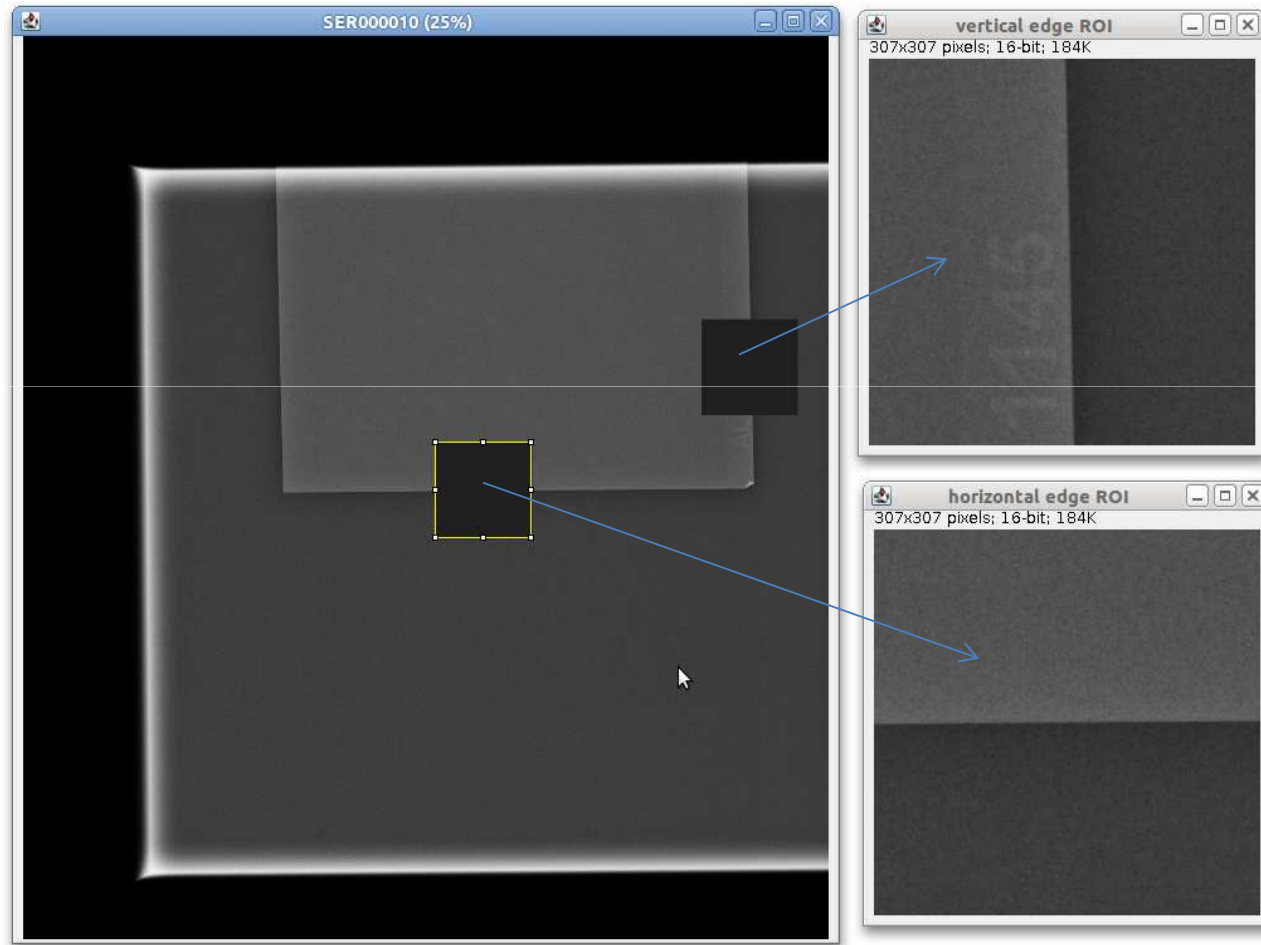
Modulation transfer function(MTF)

Figure 2: Edge Scan Function

Figure 3: Line Spread Function

Figure 4: Modulation Transfer Function

Modulation transfer function(MTF)

Results

CNR test results

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CNR absolute	Limiting values, %	CNR relative to 50mm, %	PMMA thickness, mm
5.751	115.000	126.000	20.000
5.112	110.000	112.000	30.000
4.537	105.000	99.000	40.000
4.540	100.000	100.000	50.000
4.518	95.000	99.000	60.000
3.990	90.000	87.000	70.000

detector ghosting test results

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SDNR	Limiting values
0.030	2.000

MTF image, horizontal edge test

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fall of MTF below 50%, frequency (lp/mm)	fall of MTF below 20%, frequency (lp/mm)
4.450	7.417

MTF image, vertical edge test

File   Edit   Font

fall of MTF below 50%, frequency (lp/mm)	fall of MTF below 20%, frequency (lp/mm)
3.956	6.923

Hologic Selenia	fall to 50%	fall to 20%
horizontal	4	9
vertical	4	9

Results - vertical edge
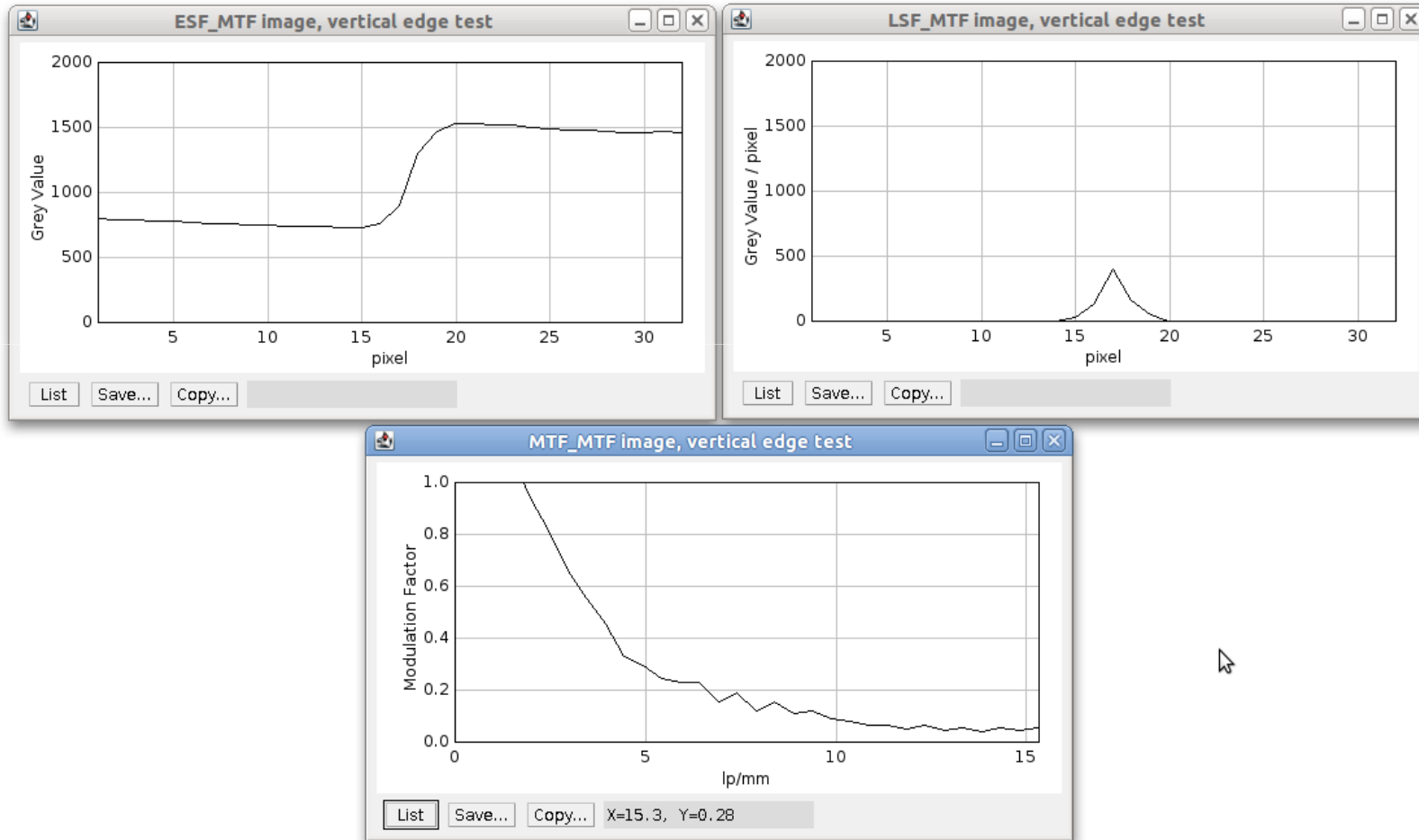
Results - horizontal edge
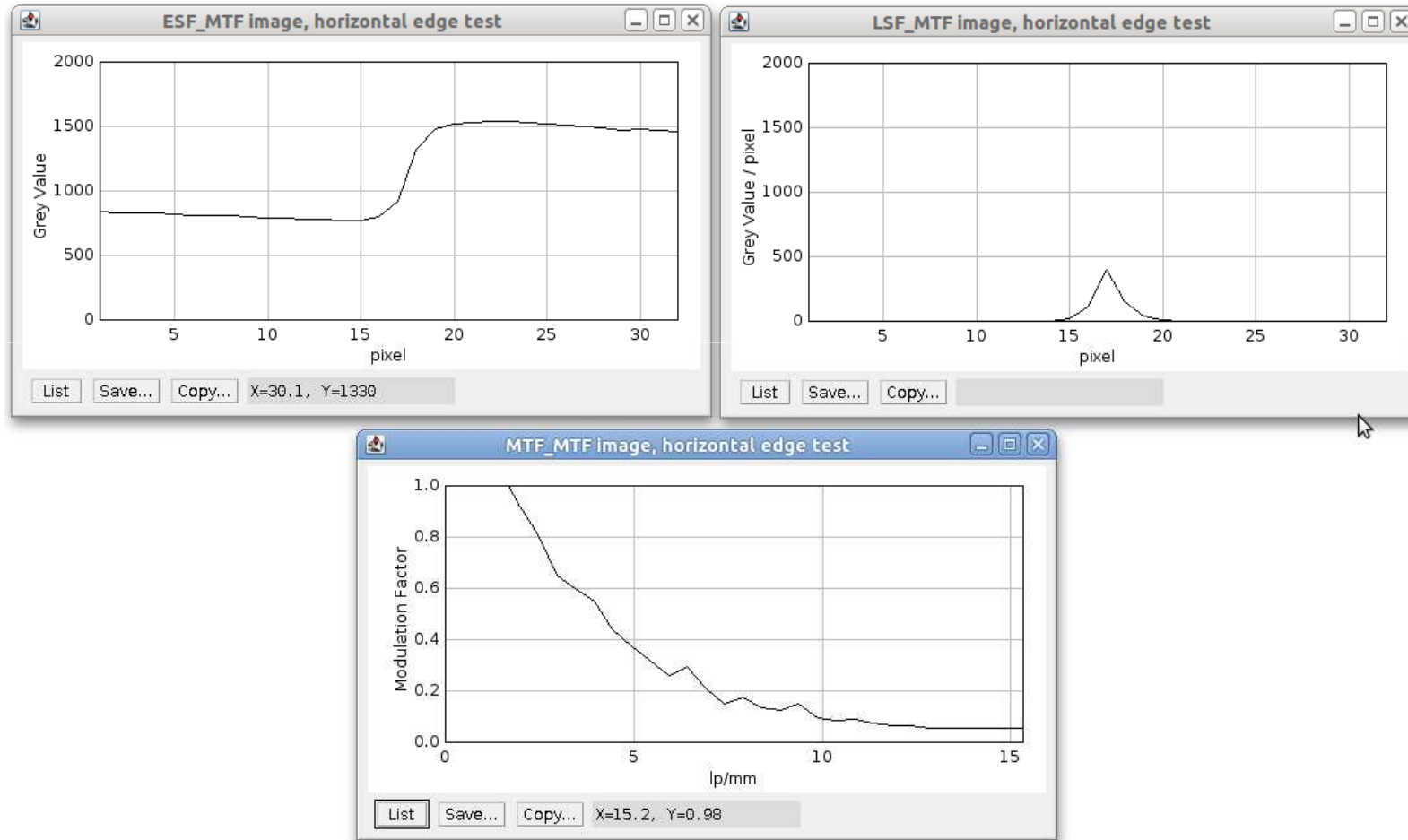
Conclusion

- The results produced by the application are close to standard.

- Additional images will be tested soon to verify the application.

- Practical tests will be performed on mammography system computer.

- Maybe someday the application will contribute to public health