Comparison of two digital mammography systems using quantitative methods

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Introduction

Optimal assessment of imaging systems and patient dose is an important task in digital mammography. Digital detector technology makes it possible to use objective, computational methods to compare digital mammography systems.

Materials and Methods

In our work we compared two digital systems housed at MSCNRIO in Warsaw:

- Siemens Mammomat Inspiration unit with direct conversion, amorphous selenium detector (pixel size 85 µm), W/Rh anode/filter combination used clinically and,
- GE Senographe Pristina unit with indirect conversion, CsI scintillator and a-Si detector (pixel size 100 µm), Mo/Mo and Rh/Ag anode/filter combinations.

We compared different performance aspects of mentioned systems using:

- effective Modulation Transfer Function (eMTF) which describes system's capability to transfer object contrast to an image and a decrease of the signal amplitude;
- effective Normalized Noise Power Spectrum (eNNPS) which represents the noise content in the obtained images;
- effective Detective Quantum Efficiency (eDQE) which describes the performance of an imaging system (Eq. 1).

All those methods were considered in a spatial frequency domain.

$$eDQE(u') = \frac{eMTF(u')^2(1-SF)^2}{eNNPS(u') \cdot TF \cdot E_0 \cdot q}$$

Eq. 1 eDQE equation used in this work

Results

Measurements were performed for using polymethyl methacrylate (PMMA) of three thicknesses (20, 40 and 70 mm) as breast substitute material with an anti-scatter grid. Anode/filter combinations and exposure levels (mAs) were set by automatic exposure control (AEC) system. For the GE unit, additional measurements were made using a Mo/Mo combination for 40 mm PMMA.

AGD was calculated based on the 4th edition of the *European guidelines for quality assurance in breast cancer screening and diagnosis.*

Thickness of PMMA phantoms	Siemens Mammomat Inspiration		GE Pristina Senographe	
	anode/filter	AGD [mGy]	anode/filter	AGD [mGy]
20mm PMMA	W/Rh	0.51	Mo/Mo	0.42
40mm PMMA		0.99	Mo/Mo	0.81
			Rh/Ag	0.98
70mm PMMA		2.44	Rh/Ag	2.13

Tab. 1 Average glandular doses calculated for PMMA phantoms

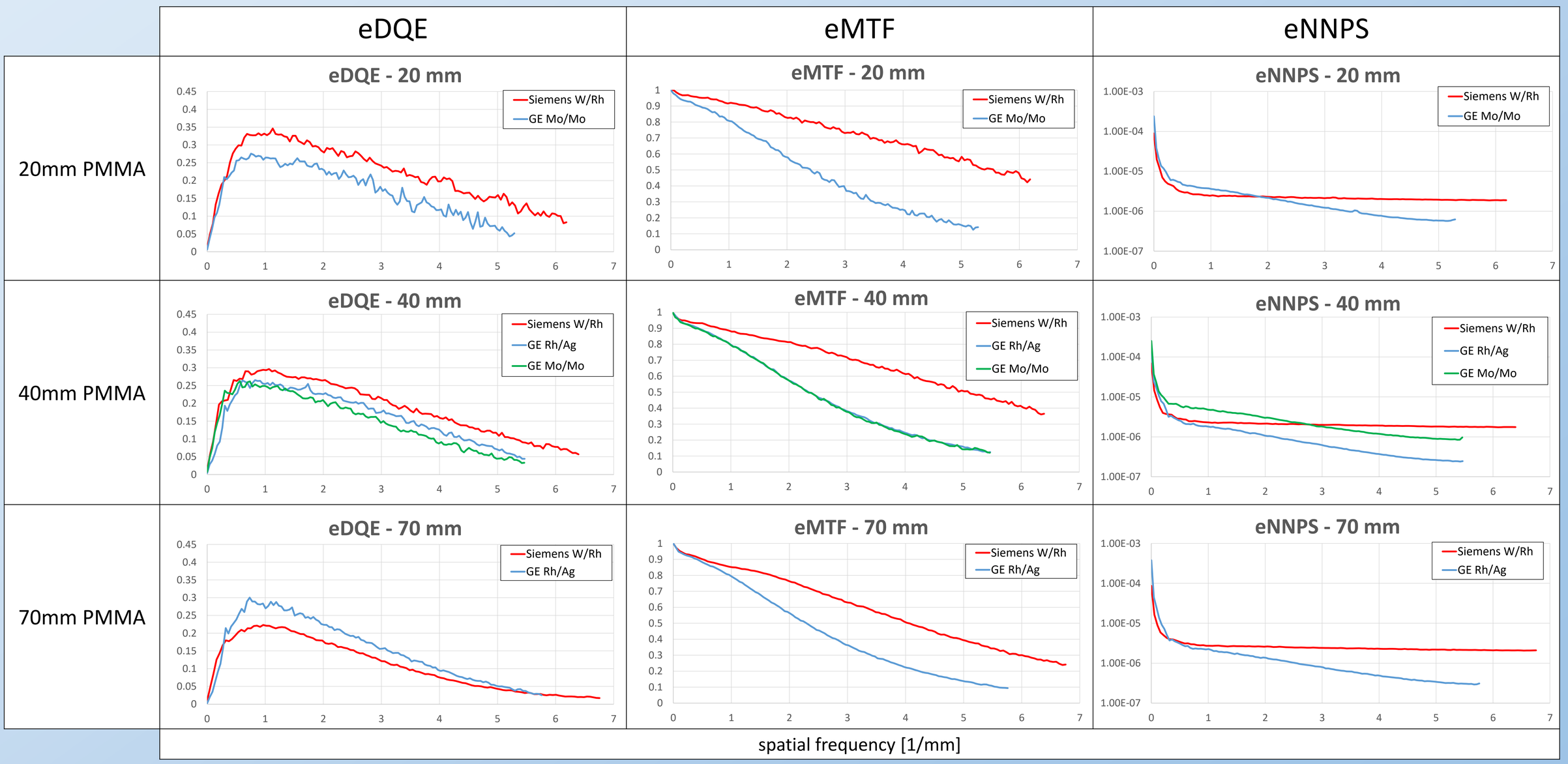

Fig. 1 Radial mean of eDQE in function of spatial frequency for two mammography systems

Summary

Analysis of computational parameters in different types of mammography systems can provide valuable information on the performance of these units under semi-clinical conditions. This information may potentially be useful for optimization of imaging, especially regarding which unit to choose for specific breast thicknesses.