Performance Comparison of Different DR Detectors Using Simplified eDQE Approach

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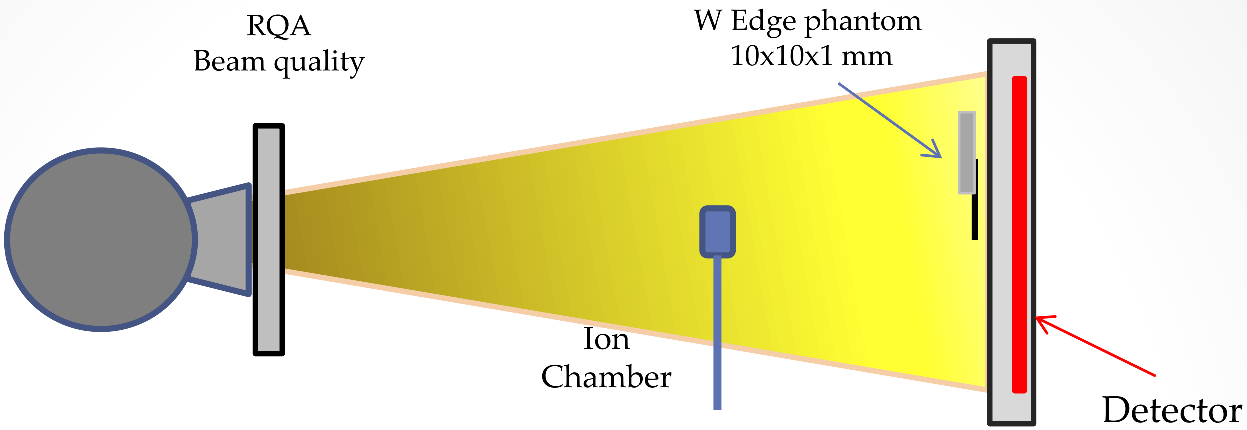
OBJECTİVE

Simplification of eDQE formalism by excluding the beam stop measurements

Comparison of different system performance in terms of eDQE

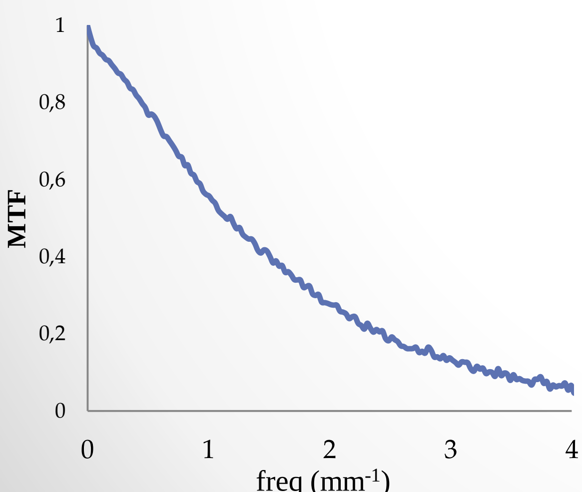
Use of eDQE for the optimization of clinical image qualities

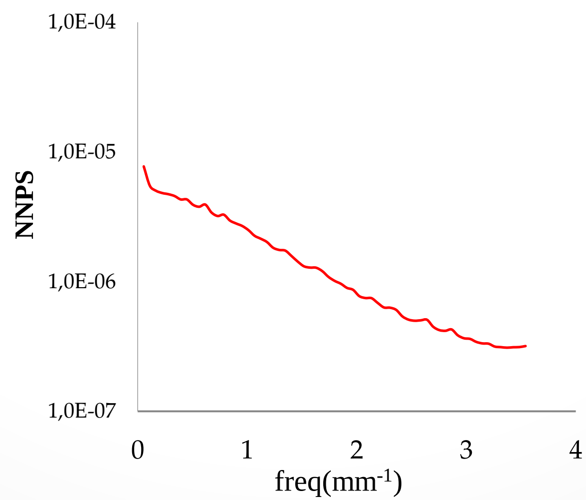
DETECTIVE QUANTUM EFFICIENCY-DQE

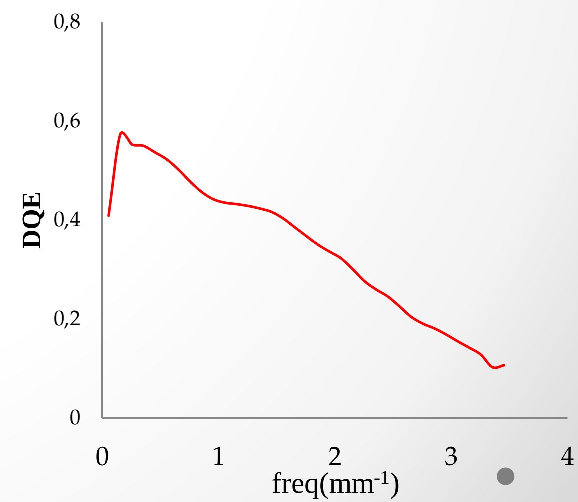


$$DQE\ (f) = \frac{MTF(f)^2}{NNPS\ (f)\ .\ K.q}$$

Physical performance of the detector

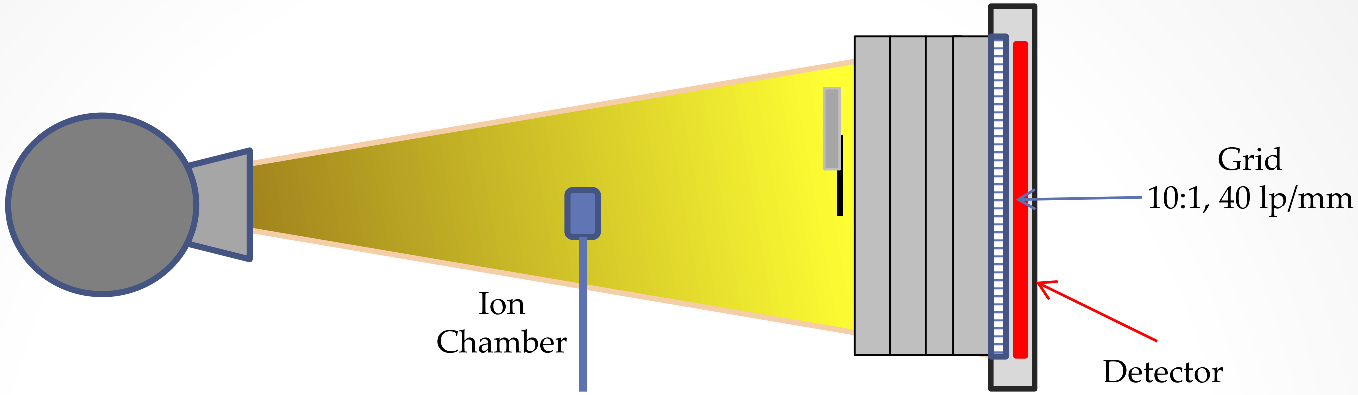






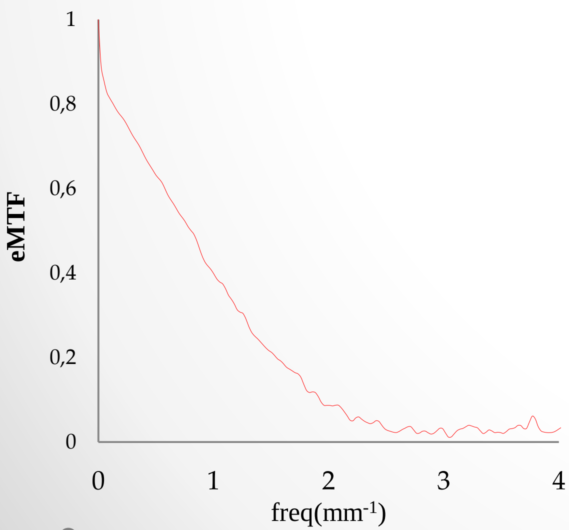
*IEC-62220-1

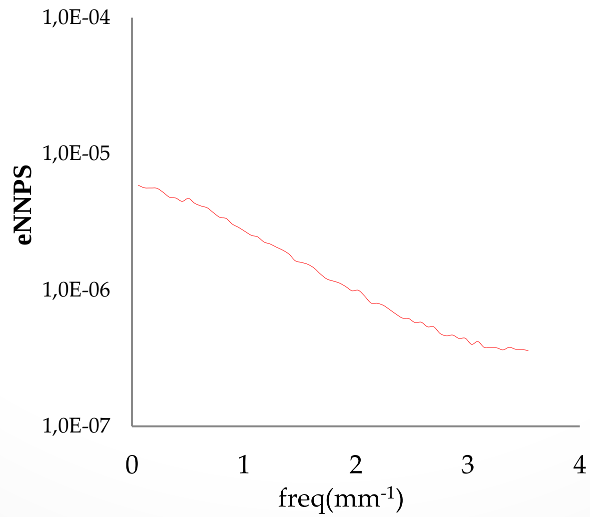
EFFECTIVE DETECTIVE QUANTUM EFFICIENCY- EDQE-

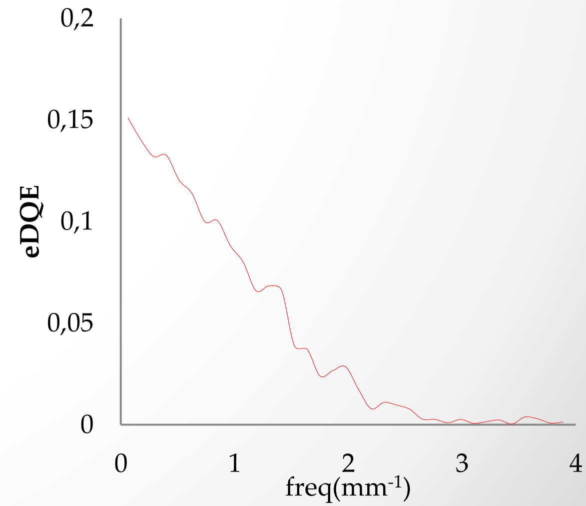


$$\text{eDQE (f)} = \frac{\text{MTF(f)}^2\,(1 - \text{SF})^2}{\text{NNPS (f) . TF. K.q}}$$

Performance of the system as a whole



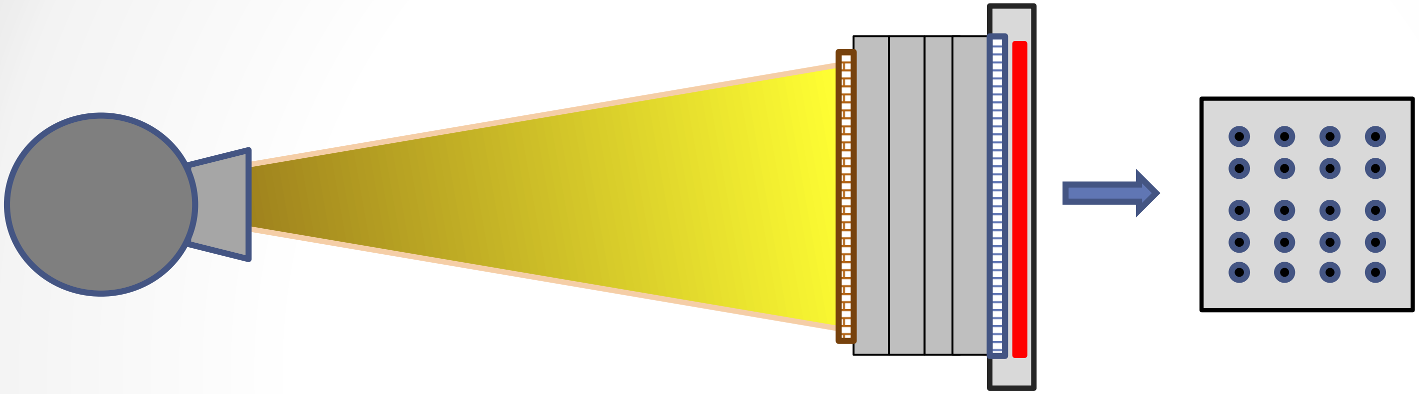




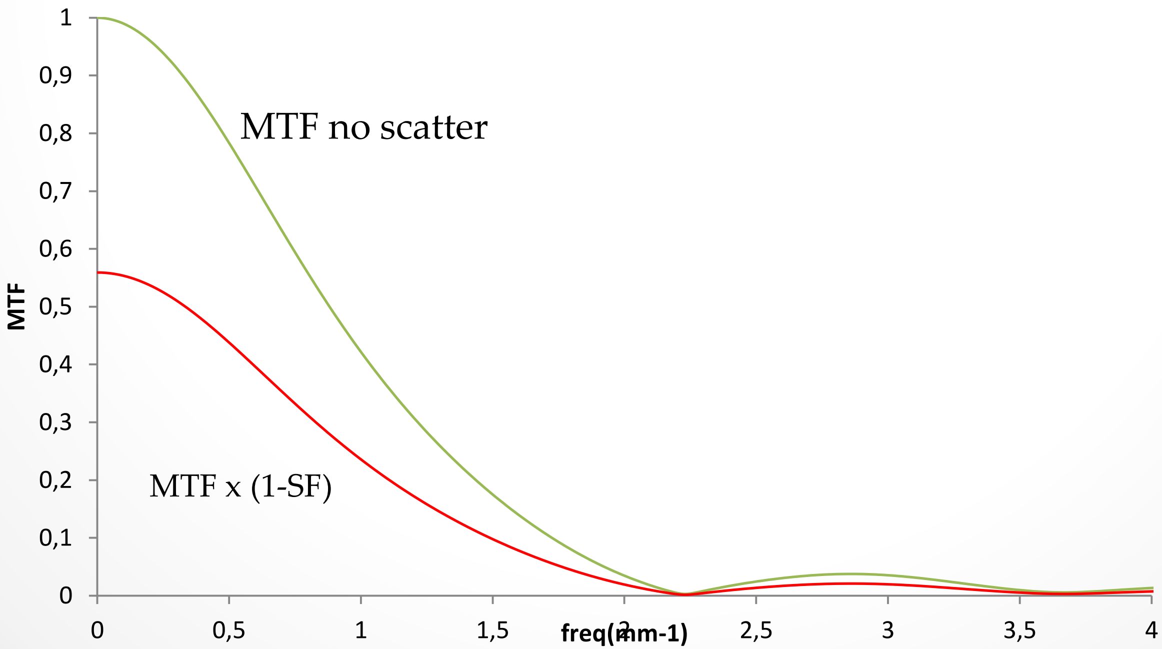
*Samei et al Med. Phys. 2009

INCLUSION OF SCATTER DATA TO THE MTF

Use of Beam Stop Technique

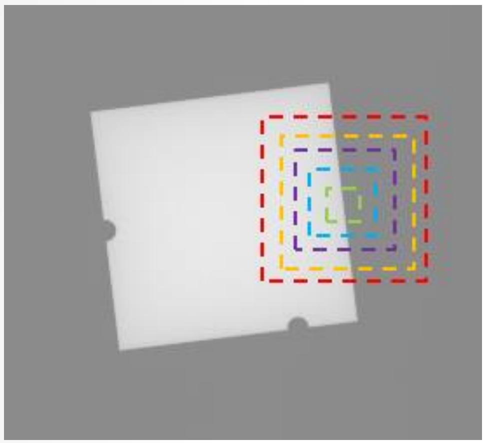


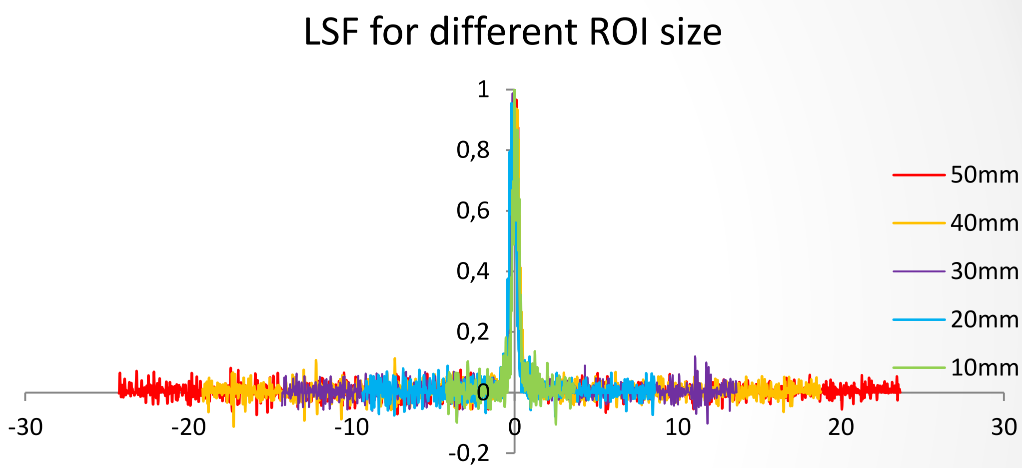
$$SF = \frac{PV_{Atten.}}{PV_{Backg.}}$$

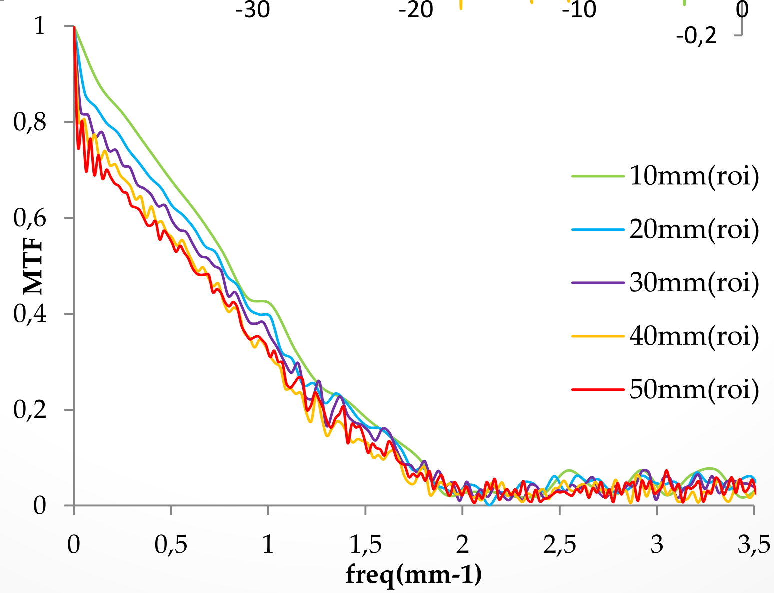


INCLUSION OF SCATTER DATA TO THE MTF

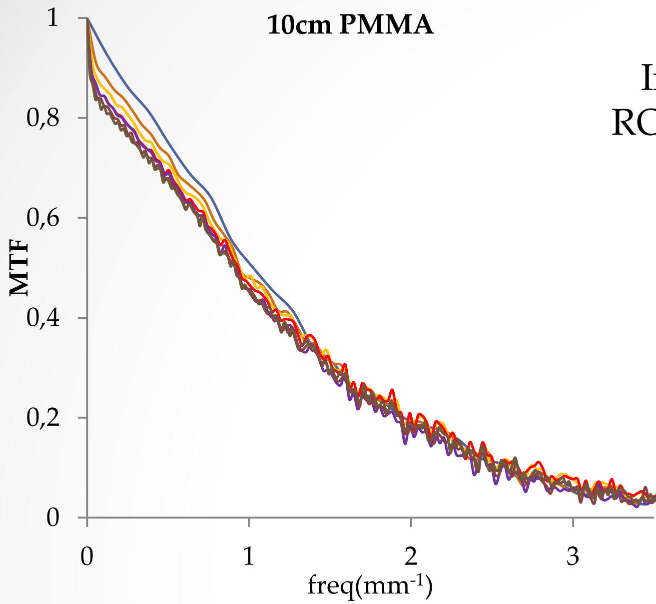
- No truncation and windowing of LSF
- Include all the tail of LSF with a large ROI
- No normalization of the zero frequenc to unity for MTF





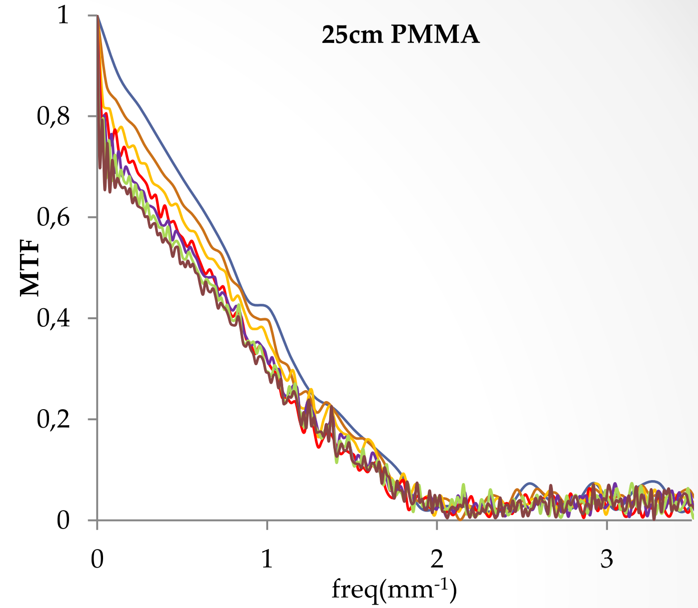


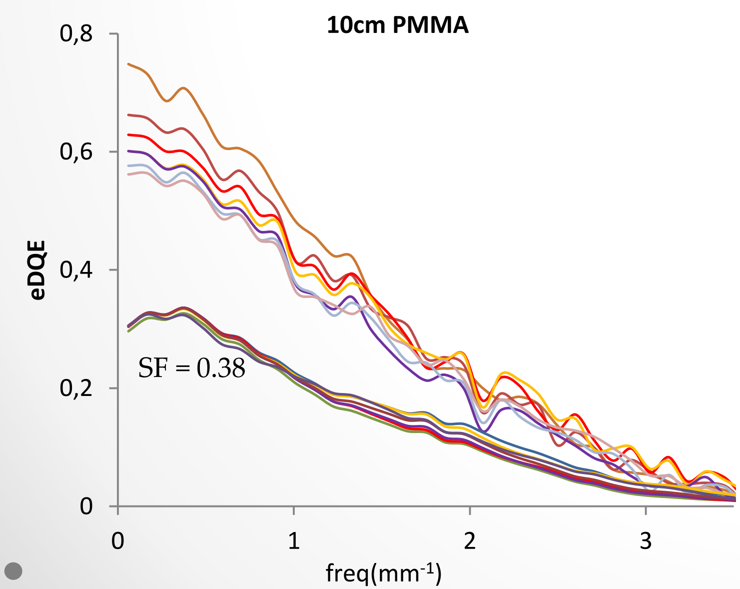
COMPARISON OF TWO TECHNIQUE

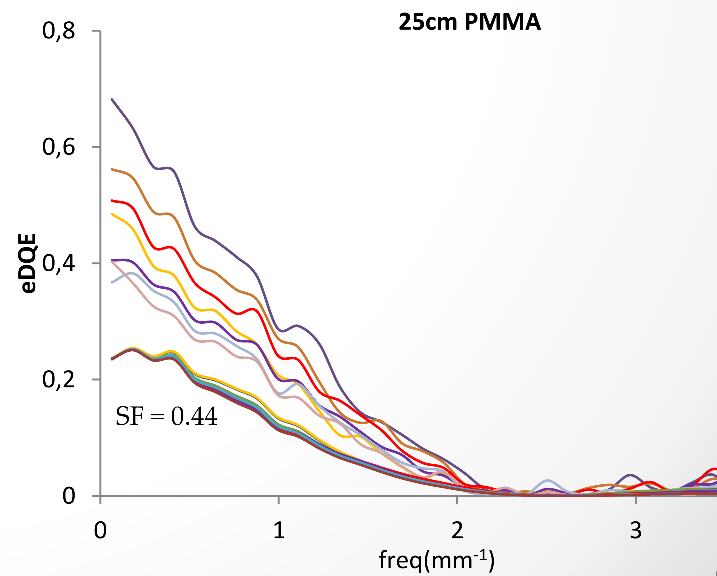


Increasing ROI size (mm)

10
20
.
.
70



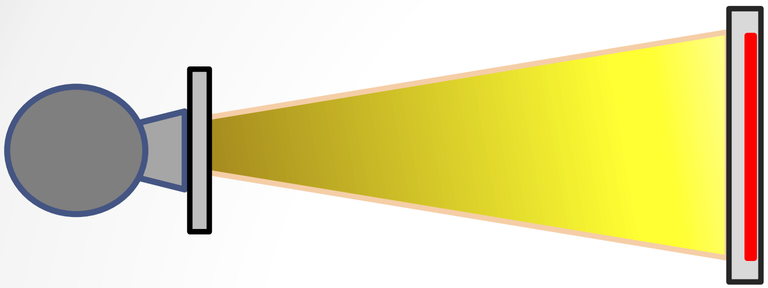




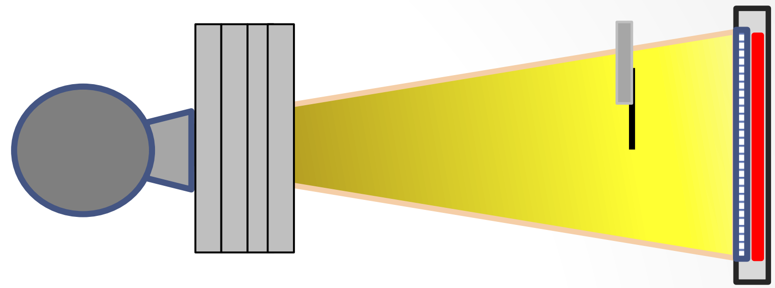
TECHNICAL CHARACTERISTICS OF THE FOUR SYSTEM EVALUATED

Systems	Kodak DRX-1	Kodak DRX-1C	Toshiba FDX4343R	Philips l Pixium 4600
Conversion phosphor	$Gd_2O_2S:Tb$	CsI	CsI	CsI
Pixel area	35x43cm		43x43cm	43x43cm
Pixel matrix	2544x3056	3072x2560	3008x3072	3001x3001
Pixel pitch	139µm		143µm	143µm
Grid type	Stationary		Stationary	Moving
Grid ratio	10:1		12:1	12:1
Focal spot size(mm)	2.0	1.2	1.2	1.2

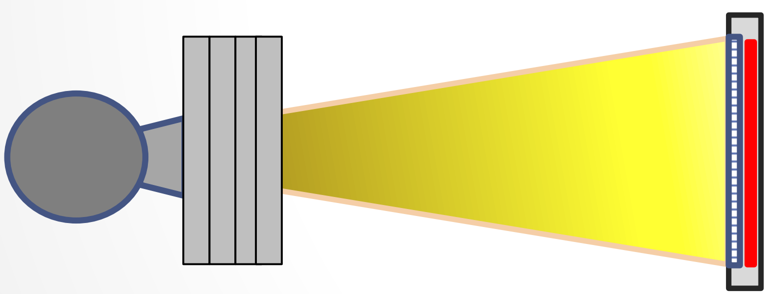
ACQUISITION GEOMETRIES



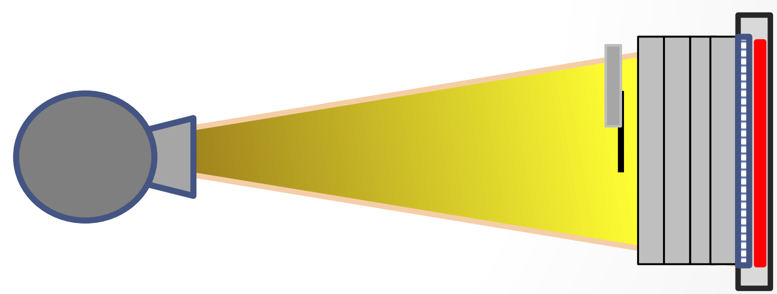
IEC Methodology



Low scatter, focus unsharpness (G2)



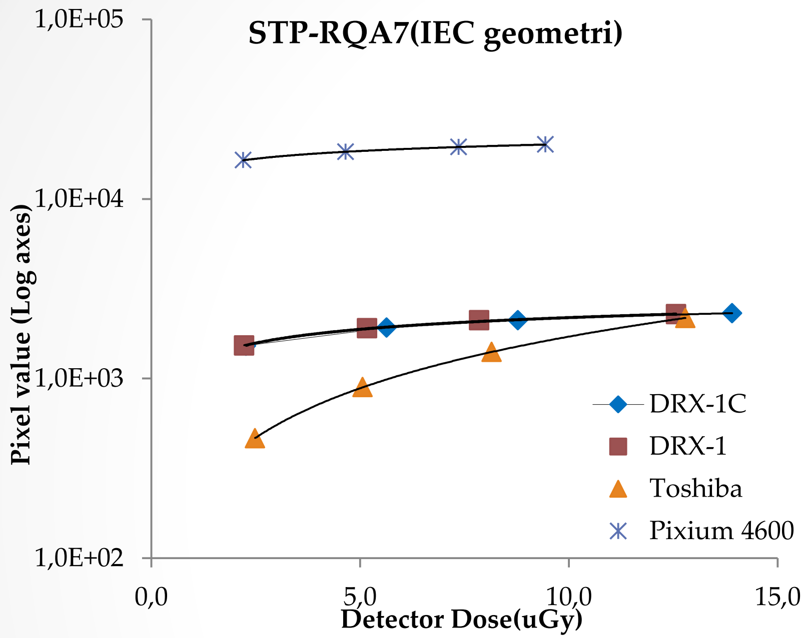
Beam hardening filtering (G1)

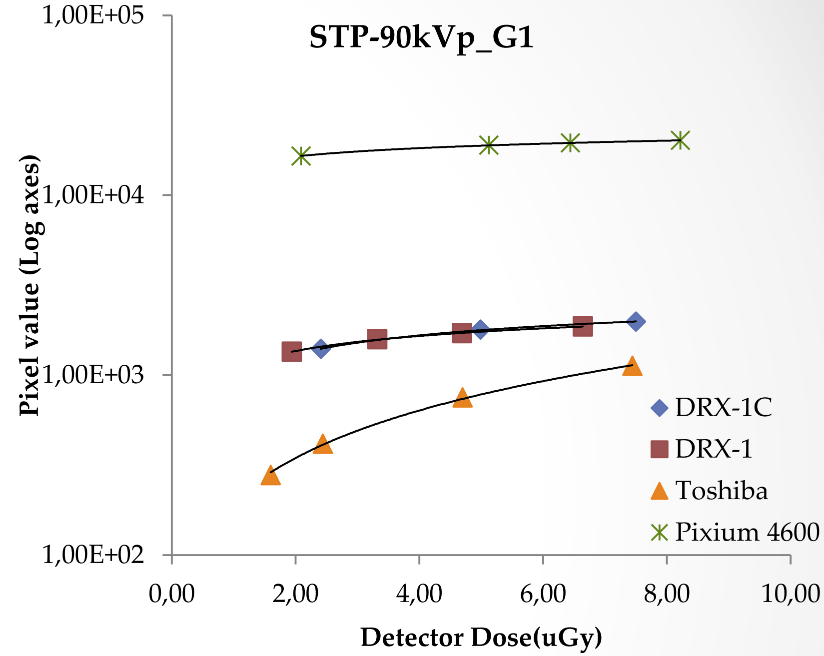


Scatter + focus un harpness (G3)

90 kVp, 25 cm PMMA, AEC control, AK measurements in the Bucky

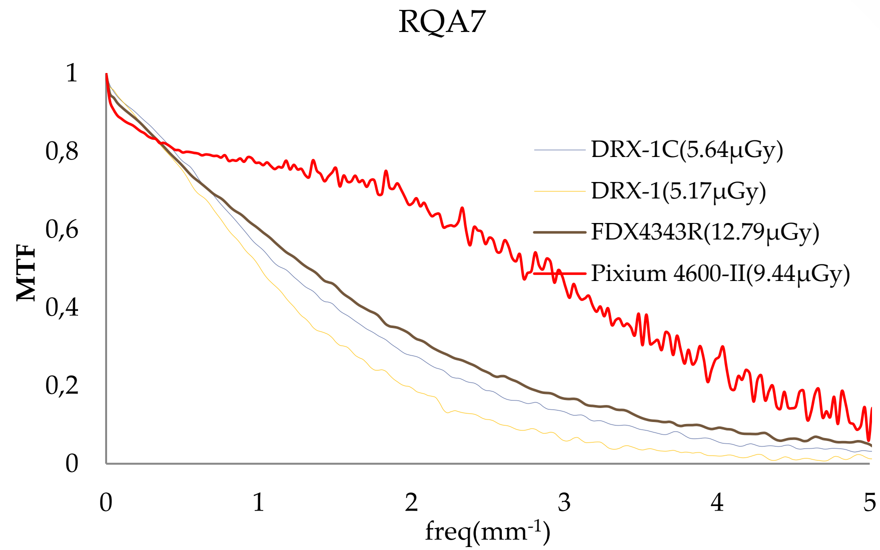
SIGNAL TRANSFER PROPERTY-STP

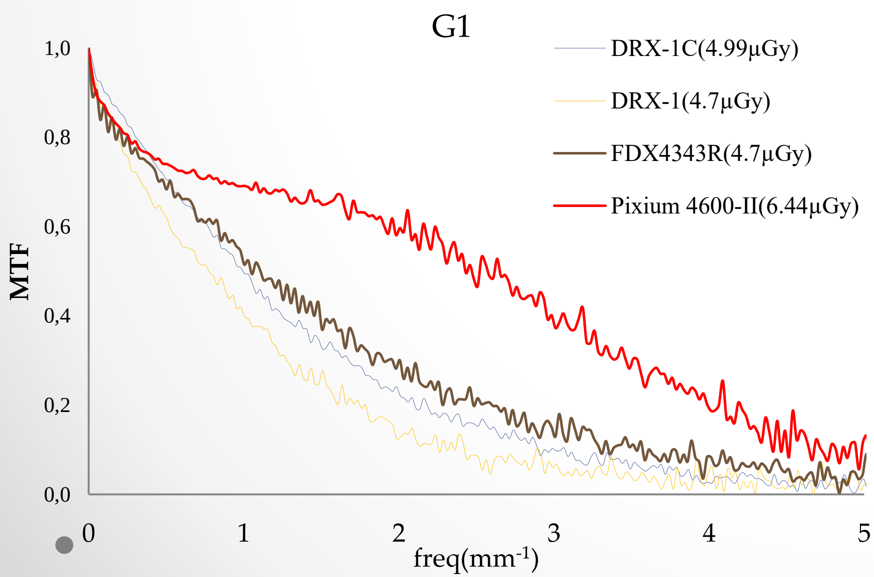


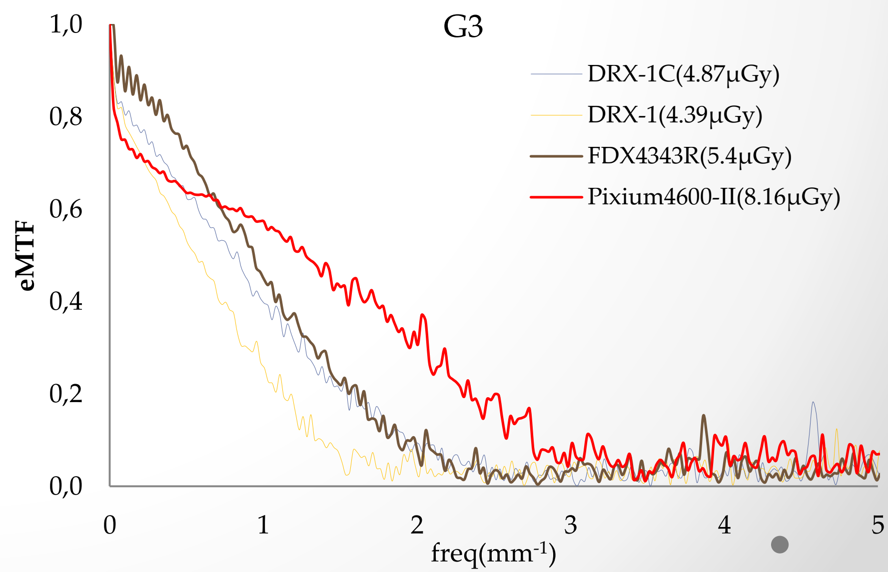


	Signal Transfer Properties Functions	
Systems	RQA Geometry	G1 Geometry
DRX-1C	y=435.62ln(K)+1166	y=515.71ln(K)+947.45
DRX-1	y=442.29ln(K)+1180.9	y=416.89ln(K)+1071.6
Toshiba FDX4343R	y=164.83K+53.535	y=144.87K+56.106
Pixium 4600	y=2509.9ln(K)+14450	y=2560.8ln(K)+14593

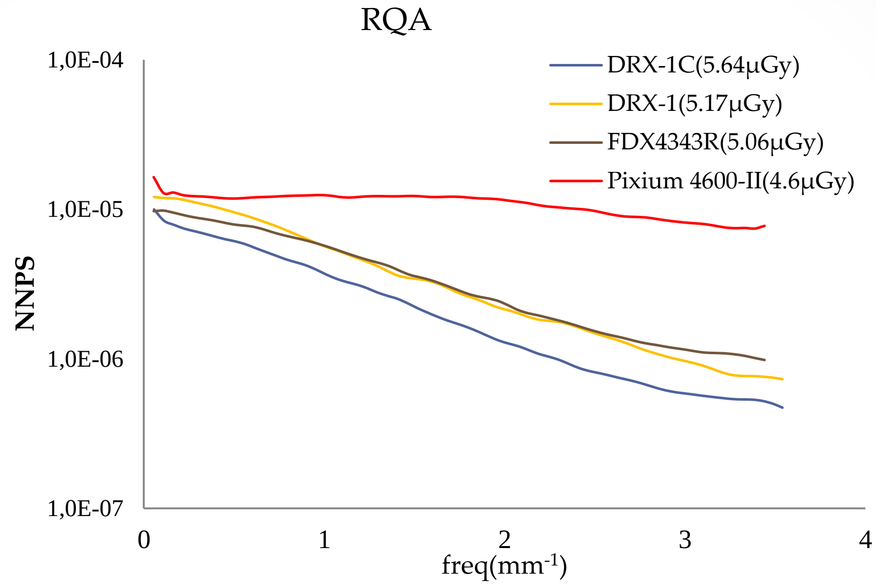
MTF RESULTS FOR DIFFERENT DIGITAL RADIOGRAPHY SYSTEMS

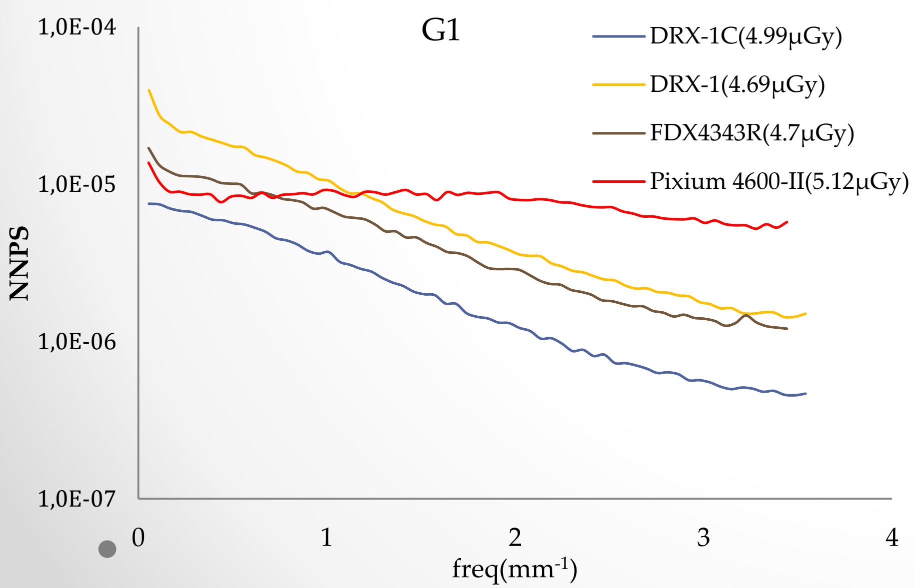


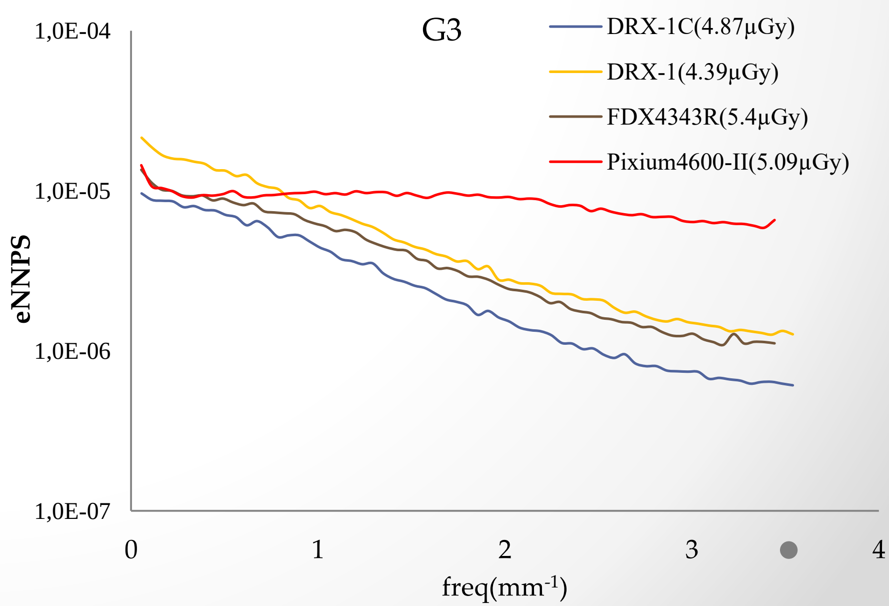




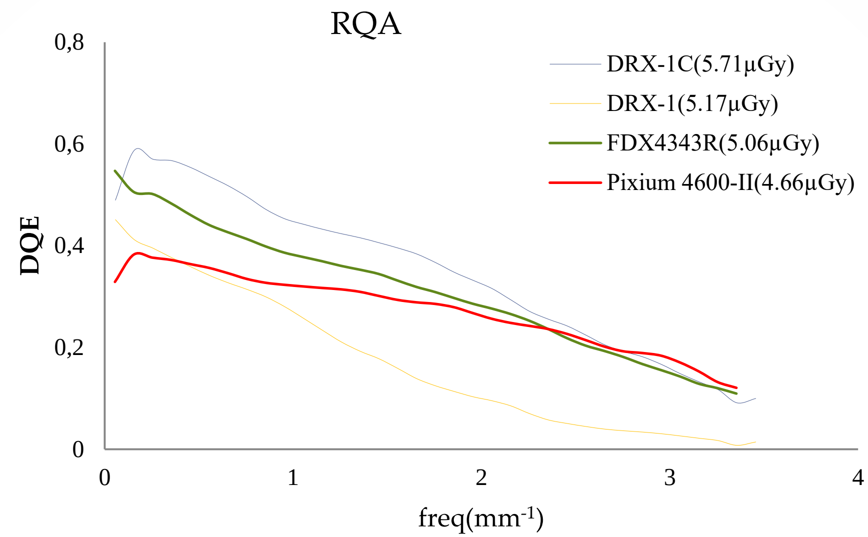
NNPS RESULTS FOR DIFFERENT DIGITAL RADIOGRAPHY SYSTEMS

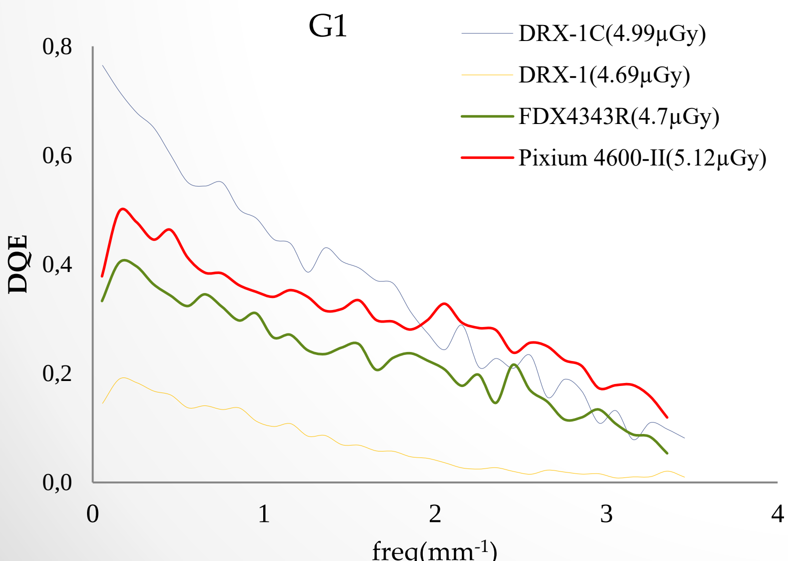


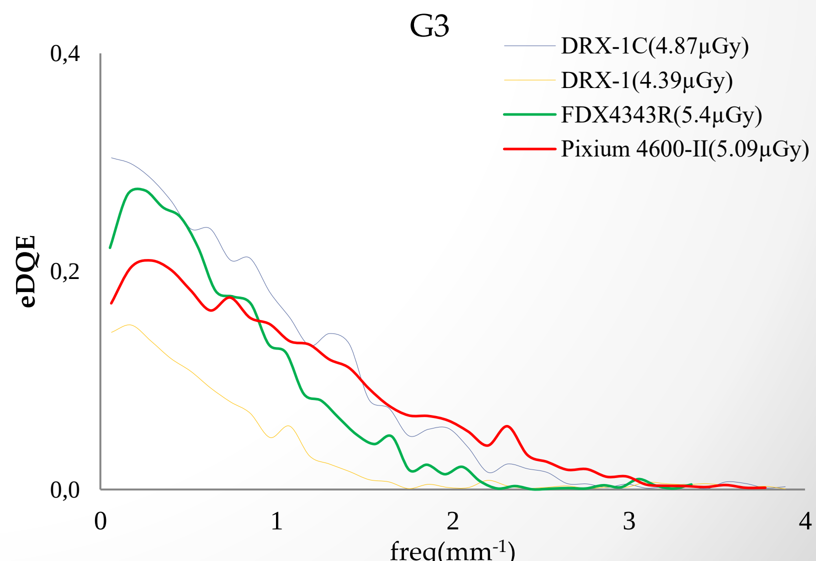




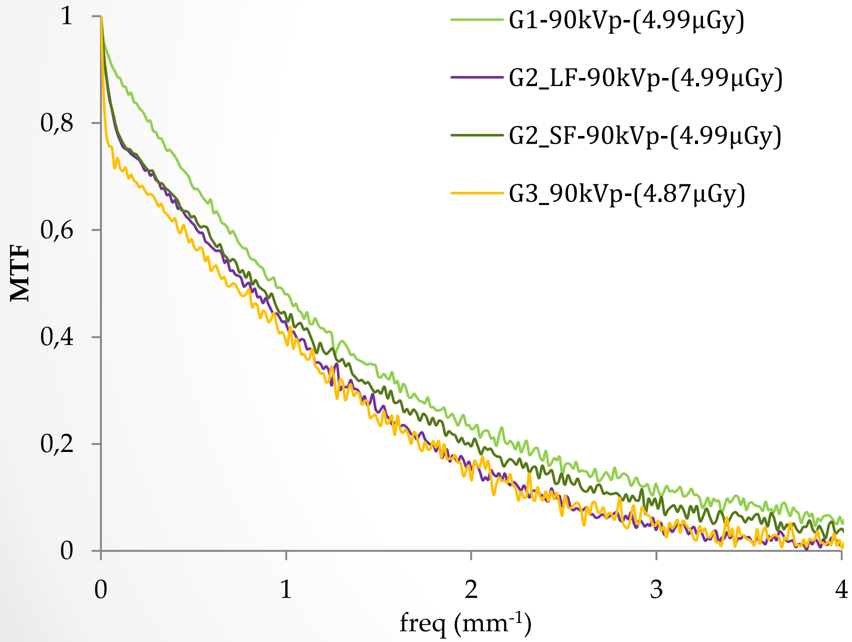
DQE-EDQE RESULTS FOR DIFFERENT DIGITAL RADIOGRAPHY SYSTEMS

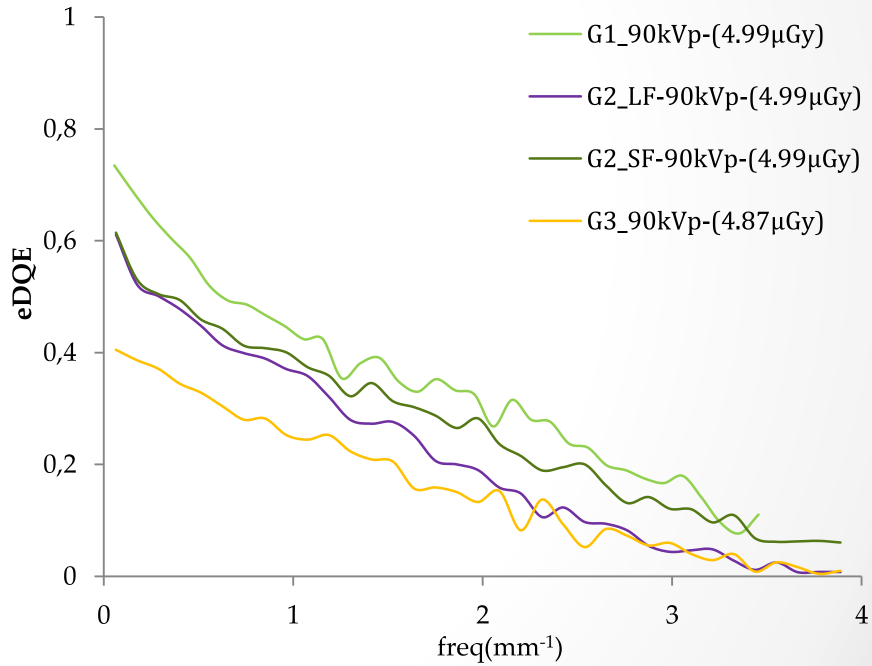






COMPARISON OF THREE GEOMETRIES FOR DRX -1C SYSTEM





Optimization of clinical image quality

CONCLUSION

Could we simplify the eDQE procedure ?

Could we do some standardization for eDQE ?

Why to measure the eDQE ?

- Optimization of the clinical techniques
- Comparison of the clinical performance of different systems
- Reliable definition of speed for digital system

Thank you

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