

## LIST OF CONTENTS

DEDICATION	v
MOTTO	vi
ACKNOWLEDGMENT	vii
UCAPAN TERIMAKASIH UNTUK PROF. DR. KUSMINARTO	viii
LIST OF CONTENTS	ix
LIST OF FIGURES	xii
LIST OF TABLES	xvi
LIST OF ABBREVIATIONS	viii
PUBLICATIONS ARISING FROM THIS WORK	xix
ABSTRACT	xx
CHAPTER 1 INTRODUCTION	1
1.1 Background	1
1.2 Problem statement	5
1.3 Research objectives	6
1.4 Research significance	7
1.5 Originality of study	8
1.6 Thesis organization	9
CHAPTER 2 LITERATURE REVIEW	10
2.1 Overview of X-ray computed tomography	10
2.1.1 Basic principles of CT	12
2.1.2 Data acquisition	13
2.1.3 Image reconstruction	16
2.1.4 Different generation of CT	18
2.1.5 Micro- computed tomography	21
2.1.6 Interactions of X-rays with matter	22
2.1.7 Attenuation of the X-ray	25
2.2 Image quality of computed tomography	27

2.2.1 Spatial resolution	29
2.2.2 Contrast resolution	34
2.2.3 Image noise	36
2.2.4 Image artifacts	37
2.3 Digital image processing	38
2.3.1 Medical imaging characteristic	39
2.3.2 Digital image analysis	41
2.3.3 Image processing with MATLAB	44
2.4 Research hypothesis	46
<b>CHAPTER 3 BASIC THEORY AND PREVIOUS MEASUREMENTS</b>	<b>47</b>
3.1 Measures of linear attenuation coefficient	47
3.2 Transfer theory in relation to a spatial resolution	53
3.3 Measures of spatial resolution	56
3.3.1 Point spread function (PSF)	56
3.3.2 Line spread function (LSF)	59
3.3.3 Edge spread function (ESF)	61
3.4 Measures of contrast sensitivity	76
<b>CHAPTER 4 MATERIALS AND METHODS</b>	<b>78</b>
4.1 Research methodology	78
4.2 Materials	79
4.3 Methods and measurements	83
4.3.1 Measurement of linear attenuation coefficient	83
4.3.1.1 Experimental setup	83
4.3.1.2 Sample preparation	85
4.3.1.3 Measurement procedures	88
4.3.2 Measurement of spatial resolution	90
4.3.2.1 Experimental setup	92
4.3.2.2 Phantom design and fabrication	94

4.3.2.3 Measurement procedures	96
4.3.3 Measurement of contrast sensitivity	101
4.4 Method validation process	103
<b>CHAPTER 5 RESULTS AND DISCUSSIONS</b>	<b>105</b>
5.1 Results	105
5.1.1 Linear attenuation coefficients	105
A. Plastic material	106
B. Plexiglas material	109
C. Silicone rubber material	112
D. Paraffin wax material	115
E. Soap (sodium palmate) material	118
5.1.2 Spatial resolution of CT system	122
A. Edge spread function (ESF)	127
B. line spread function (LSF)	141
C. Full-width at half maximum (FWHM)	145
5.1.3 Contrast sensitivity of the CT system	147
5.1.4 Repeatability of the spatial resolution method	151
5.2 Discussion of the Results	157
<b>CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS</b>	<b>165</b>
6.1 Conclusion	165
6.2 Recommendations	166
<b>LIST OF REFERENCES</b>	<b>168</b>
<b>APPENDICES</b>	<b>178</b>
Appendix 1 Graphs obtained using ImageJ software of the (ESFs) data	178
Appendix 2 Data obtained from the repeatability process of the method	185
Appendix 3 SPSS data of the repeatability process	190
Appendix 4a Publication Paper arising from this study (1)	195
Appendix 4b Publication Paper arising from this study (2)	201