

CONTENTS

ABSTRACT	i
ACKNOWLEDGEMENTS	ii
GLOSSARY	iii
Chapter 1. Introduction	1
1.1 Background	1
1.2 Motivation	3
1.3 HF antenna human exposure assessment	4
1.4 Thesis outline	5
Publications	9
References	10
Chapter 2. Literature Review	14
2.1 Introduction	14
2.1.1 BBC HF antennas	15
2.1.2 International Exposure Guidelines and Basic Definitions	21
2.1.3 SAR and Current Density	22
2.1.4 Basic Restrictions and Reference Level	24
2.1.5 Voxel Phantoms	27
2.2 Numerical Methods and Techniques	28
2.2.1 Method of Moments	29
2.2.2 Finite Difference Time Domain Method	31
2.2.3 Finite Integration Technique	34
2.2.4 Boundary conditions	36
2.2.5 Numerical Simulation Software and Techniques	37

2.2.6	Equivalence Principles	39
2.3	Conclusion	40
	References	41
Chapter 3.	Plane-wave Illumination of Human Phantom	45
3.1	Introduction	45
3.2	Various human phantoms for plane-wave radiation modelling method	47
3.3	Modelling techniques and effects	48
3.3.1	Homogenous phantom	48
3.3.2	Heterogeneous phantom	53
3.3.3	Perfect matching layers	55
3.4	Equivalent principle and FDTD hybrid methods for whole-body SAR calculation	57
3.5	Whole-body SAR calculations	59
3.5.1	Phantom complexity	62
3.5.2	Effects of ground coupling	72
3.6	Conclusions	79
	References	82
Chapter 4.	Analysis of E-field Strength with the Near-Field of a HF Antenna	84
4.1	Introduction	84
4.2	Modelling of the antenna radiating element	85
4.3	Analyses of antenna complexity	88
4.4	Ground characteristics of HF transmission sites	95
4.5	HF broadcasting transmission site ground environments	105
4.5.1	Local terrain topography	105
4.5.2	Skelton C array ground slope modelling and simulation	105

4.5.3	Array infrastructure	108
4.5.4	Power comparison	115
4.5.5	Summary of high power full Skelton C curtain array antenna 766 field distributions over different ground conditions	121
4.6	Conclusions	127
	Reference	128
	Chapter 5. Simplification Techniques for full Wave Antenna Modelling with a Human Phantom	129
5.1	Introduction	129
5.2	Hybrid numerical method	129
5.3	Full scale modelling and equivalence principles	130
5.4	Conclusions	137
	References	138
	Chapter 6. Field Measurement	139
6.1	Introduction	139
6.2	Measurement methodology setup	139
6.3	Comparisons of calculated results and measured results	146
6.4	Conclusions	159
	References	161
	Chapter 7. Conclusions and Future Work	162
7.1	Discussion and conclusions	162
7.2	Limitations	165
7.3	Future work	166
	Appendix A-1	168
	Appendix A-2	176
	Appendix B	187

