## **CONTENTS**

Chapter 1	PRINCIPLES OF FINITE METHODS IN ELECTROMAGNETIC SCATTERING	1
1.1	Introduction	_
1.1	Finite Methods	1
		3
1.3	Mesh Termination	29
1.4	Conclusion	62
	References	65
Chapter 2	A FINITE ELEMENT METHOD FOR	
	COMPOSITE SCATTERERS	69
2.1	Introduction	69
2.2	Formulation	73
2.3	Finite Element Method	79
2.4	Numerical and Experimental Results	95
2.5	Conclusions	105
2.6	Future Developments	105
	References	110
Chapter 3	COUPLED FINITE ELEMENT AND	
-	BOUNDARY ELEMENT METHODS IN	
	ELECTROMAGNETIC SCATTERING	113
3.1	Introduction	113
3.2	General Formulation	115
3.3	Implementation and Numerical Results	126
3.4	Conclusion	130
	References	131

xii Contents

Chapter 4	ABSORBING BOUNDARY CONDITIONS FOR THE DIRECT SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS ARISING IN ELECTROMAGNETIC		
	SCATTERING PROBLEMS	133	
4.1	Introduction	133	
4.2	Derivation of the BGT Operators	136	
4.3	Alternate Boundary Condition for 2-D Scattering	140	
4.4	Performance of Boundary Operators	143	
4.5	Absorbing Boundary Condition for the FEM	150	
4.6	Improvement in the ABC-Based Solution	158	
4.7	ABC for 3-D Scalar and Vector Fields	162	
	References	172	
Chapter 5	APPLICATION OF THE CONTROL REGION APPROXIMATION TO TWO-DIMENSIONAL ELECTROMAGNETIC SCATTERING	175	
F 1			
5.1 5.2	Introduction	175	
5.2 5.3	Problem Formulation	177	
5.4	Asymptotic Boundary Conditions Discretization	180	
5.4 5.5		186	
5.6	Solution of Discrete Equations Cross Section Calculation	192	
5.7	Numerical Results	193	
5.8	Conclusion	198	
0.0	References	206 208	
Chapter 6	COUPLED POTENTIALS FOR ELECTROMAGNETIC FIELDS IN INHOMOGENEOUS MEDIA	211	
6.1	Introduction	211	
6.2	Coupled Potential Formulation	213	
6.3	Numerical Algorithm	225	
6.4	Computer Validations	234	
6.5	Discussion	244	
	References	245	

Contents		xiii
Chapter 7	THE METHOD OF CONFORMING	

Chapter 7	THE METHOD OF CONFORMING		
	BOUNDARY ELEMENTS FOR TRANSIENT ELECTROMAGNETICS	249	
P7 1	Introduction	249	
$7.1 \\ 7.2$	Initial Boundary Value Problem	249 251	
· ·	•	251	
7.3	Method of Conforming Boundary Elements Radiation Boundary Condition	260	
7.4 $7.5$	Field Singularities at Wedges and Corners	265	
7.6	Numerical Results	$\frac{203}{272}$	
7.0 7.7	Discussion	280	
1.1	References	281	
Chapter 8	THE FINITE-DIFFERENCE		
	TIME-DOMAIN METHOD FOR		
	NUMERICAL MODELING OF		
	ELECTROMAGNETIC WAVE		
	INTERACTIONS WITH		
	ARBITRARY STRUCTURES	287	
8.1	Introduction	288	
8.2	General Characteristics of FD-TD	290	
8.3	Basic FD-TD Algorithm Details	293	
8.4	Contour Path Interpretation	304	
8.5	Radiation Boundary Conditions	312	
8.6	FD-TD Modeling Validations in 2-D	329	
8.7	FD-TD Modeling Validation in 3-D	340	
8.8	Penetration and Coupling in 2-D and 3-D	345	
8.9	Modeling Very Complex 3-D Structures	356	
8.10	Microstrip and Microwave Circuits	361	
8.11	Inverse Scattering Reconstructions	363	
8.12	Very Large-Scale Software	366	
8.13	Conclusion	368	
	References	369	
	INDEX	375	