
**ELECTROMAGNETIC
WAVES** **PIER 116**

Progress

In

Electromagnetics

Research

© 2011 EMW Publishing. All rights reserved.

No part of this publication may be reproduced. Request for permission should be addressed to the Publisher.

All inquiries regarding copyrighted material from this publication, manuscript submission instructions, and subscription orders and price information should be directed to: EMW Publishing, P. O. Box 425517, Kendall Square, Cambridge, Massachusetts 02142, USA.

ISSN 1070-4698

E-ISSN 1559-8985

**ELECTROMAGNETIC
WAVES** **PIER 116**

Progress

In

Electromagnetics

Research

Chief Editor: Weng Cho Chew

EMW Publishing

Cambridge, Massachusetts, USA

CONTENTS

FOUR-OCTAVE SIX-PORT RECEIVER AND ITS CALIBRATION FOR BROADBAND COMMUNICATIONS AND SOFTWARE DEFINED RADIOS*C. de la Morena-Álvarez-Palencia and M. Burgos-García*

1	Introduction	1
2	Fundamentals of the Six-port Receiver	2
3	Description of the Six-port Receiver	3
4	Channelized Auto-calibration Method	7
5	Measurement Results	10
6	Conclusion	18

INVERSE SCATTERING OF THREE-DIMENSIONAL PEC OBJECTS USING THE LEVEL-SET METHOD*M. R. Hajishemi and M. El-Shenawee*

1	Introduction	23
2	Formulation	26
3	Numerical Results	33
4	Conclusions	42

A MEMORY EFFICIENT AND FAST SPARSE MATRIX VECTOR PRODUCT ON A GPU*A. Dziekonski, A. Lamecki, and M. Mrozowski*

1	Introduction	49
2	Programming GPUs	51
3	Compression Storages for Efficient SpMV	51
4	Performance Tests	55
5	Conclusions	60

MAGNETIC RESONANCE BRAIN IMAGE CLASSIFICATION BY AN IMPROVED ARTIFICIAL BEE COLONY ALGORITHM*Y. Zhang, L. Wu, and S. Wang*

1	Introduction	66
2	Methodology	67
3	Scaled Chaotic ABC	69
4	Experiments and Discussions	71

5 Conclusions 76

CONSISTENT FORMALISM FOR THE MOMENTUM OF ELECTROMAGNETIC WAVES IN LOSSLESS DISPERSIVE METAMATERIALS AND THE CONSERVATION OF MOMENTUM

Y. He, J. Shen, and S. He

1 Introduction 82
 2 Modeling 83
 3 Momentum Density, Momentum Flow and Momentum Conservation 85
 4 Energy Density, Energy of Wave Packet and Energy Conservation 92
 5 Discussion and Conclusion 100
 Appendix A. 101

A RIGOROUS TREATMENT OF VERTICAL DIPOLE IMPEDANCE LOCATED ABOVE LOSSY DPS, MNG, ENG, AND DNG HALF-SPACE

Y. Ra'di, S. Nikmehr, and S. Hosseinzadeh

1 Introduction 108
 2 Problem Formulation 109
 3 Exact Solution of Integral with Approximated Integrand 112
 4 Numerical Results and Discussion 116
 5 Conclusion 118

THE EFFECT OF PLY ORIENTATION ON THE PERFORMANCE OF ANTENNAS IN OR ON CARBON FIBER COMPOSITES

A. Galehdar, W. S. T. Rowe, K. Ghorbani, P. J. Callus, S. John and C. H. Wang

1 Introduction 124
 2 Conductivity Measurements of CFRP 125
 3 The Effect of a CFRP Ground Plane on an Antenna 130
 4 Conclusion 134

USE OF HIGH-IMPEDANCE SCREENS FOR ENHANCING ANTENNA PERFORMANCE WITH ELECTROMAGNETIC COMPATIBILITY

M.-S. Lin, C.-H. Huang, and C.-N. Chiu

1	Introduction	138
2	Configuration of HIS-added Monopole Antenna	139
3	Investigation on the Performance of HIS	140
4	Approach to Designing HIS-added Antennas	145
5	Conclusion	154

ARTIFICIAL MAGNETIC PROPERTIES OF DIELECTRIC METAMATERIALS IN TERMS OF EFFECTIVE CIRCUIT MODEL

L. Y. Liu, J. B. Sun, X. J. Fu, J. Zhou, Q. Zhao, B. Fu, J. P. Liao and D. Lippens

1	Introduction	160
2	Derivation of the Model	161
3	Numerical Verification and Discussion	165
4	Conclusion	167

PREDICTION OF THE ELECTROMAGNETIC FIELD IN METALLIC ENCLOSURES USING ARTIFICIAL NEURAL NETWORKS

M. Luo and K. Huang

1	Introduction	171
2	Geometry of the System	173
3	Model Based on ANN Technique	174
4	Examples and Discussion	177
5	Conclusion	181

CHARACTERIZATION OF ANTENNA INTERACTION WITH SCATTERERS BY MEANS OF EQUIVALENT CURRENTS

C. G. González, Y. Álvarez López, A. D. Casas and F. Las-Heras Andrés

1	Introduction	186
2	The Sources Reconstruction Method	187
3	Application Examples	190
4	Conclusions	200

**HYBRID TDIE-TDPO METHOD FOR STUDYING ON
TRANSIENT RESPONSES OF SOME WIRE AND
SURFACE STRUCTURES ILLUMINATED BY AN
ELECTROMAGNETIC PULSE**

W. Luo, W.-Y. Yin, M.-D. Zhu, and J.-Y. Zhao

1	Introduction	204
2	Formulation	205
3	Numerical Results and Discussion	209
4	Conclusion	216

**3D EXPERIMENTAL DETECTION AND DISCRIMI-
NATION OF MALIGNANT AND BENIGN BREAST
TUMOR USING NN-BASED UWB IMAGING SYSTEM**

*S. A. Alshehri, S. Khatun, A. B. Jantan, R. S. A. Raja Abdullah
R. Mahmud and Z. Awang*

1	Introduction	222
2	Method	224
3	Results	230
4	Conclusion	235

**COMPRESSION AND RADIATION OF HIGH-POWER
SHORT RF PULSES. I. ENERGY ACCUMULATION IN
DIRECT-FLOW WAVEGUIDE COMPRESSORS**

K. Sirenko, V. Pazynin, Y. Sirenko, and H. Bağcı

1	Introduction	239
2	Mathematical Model and Characteristics of Microwave Compressors	242
3	Compressor Design and Energy Accumulation	251
4	Brief Description of the Numerical Technique	266
5	Conclusion	267

**COMPRESSION AND RADIATION OF HIGH-POWER
SHORT RF PULSES. II. A NOVEL ANTENNA ARRAY
DESIGN WITH COMBINED COMPRESSOR/RADIATOR
ELEMENTS**

K. Sirenko, V. Pazynin, Y. Sirenko, and H. Bağcı

1	Introduction	272
2	Mathematical Model and Characteristics of Antennas	273
3	Radiation of Compressed Pulses by Simple Antennas	279

4 Compression and Beamed Radiation of Pulses by a New Array Design 284
 5 Conclusions 293

OPTIMUM DESIGN FOR IMPROVING MODULATING-EFFECT OF COAXIAL MAGNETIC GEAR USING RESPONSE SURFACE METHODOLOGY AND GENETIC ALGORITHM

L. Jian, G. Xu, J. Song, H. Xue, D. Zhao, and J. Liang

1 Introduction 298
 2 Modulating-effect of Coaxial Magnetic Gear 299
 3 Shape Factors of Ferromagnetic Segments and Their Impact on Modulating-effect 303
 4 Design Optimization 307

TIME-DOMAIN MEASUREMENT OF TIME-CODED UWB CHIPLESS RFID TAGS

A. Ramos, A. Lazaro, D. Girbau, and R. Villarino

1 Introduction 313
 2 UWB Chipless RFID Operation Principle and System Theory 315
 3 Time-domain Measurement Techniques 320
 4 Experimental Results 322
 5 Conclusions 327

BALANCED SINGLE- AND DUAL-BAND BPFs USING RING RESONATORS

C.-H. Lee, C.-I. G. Hsu, H.-H. Chen, and Y.-S. Lin

1 Introduction 334
 2 Design of Balanced Single-band BPF 335
 3 Design of Balanced Dual-band BPF 341
 4 Conclusion 344

AN ARTIFICIAL NERVE NETWORK REALIZATION IN THE MEASUREMENT OF MATERIAL PERMITTIVITY

Q. Chen, K.-M. Huang, X. Yang, M. Luo, and H. Zhu

1 Introduction 347
 2 BP Algorithm 349
 3 Measurement Apparatus 352
 4 Normalization of the Training Samples 353
 5 Construction of the Sample Space [32] 354

6	The Reconstruction Results	356
7	Conclusion	357

**RF DIRECTIONAL MODULATION TECHNIQUE USING
A SWITCHED ANTENNA ARRAY FOR PHYSICAL
LAYER SECURE COMMUNICATION APPLICATIONS**

T. Hong, M.-Z. Song, and Y. Liu

1	Introduction	363
2	The Principle of RF Directional Modulation Signal Using a Switched Antenna Array	366
3	Frequency Domain Analysis of RF Directional Modulation Signal	369
4	Simulation Results	372
5	Conclusion	375

**A NOVEL STRATEGY FOR TOPSIDE IONOSPHERE
SOUNDER BASED ON SPACEBORNE MIMO RADAR
WITH FDCD**

J. Chen, Z. Li, and C. S. Li

1	Introduction	381
2	Principle of Topside Ionosphere Sounding	382
3	MIMO Ionosphere Sounder	384
4	System Parameters Design	386
5	Simulation and Discussions	388
6	Conclusions	390

**DESIGN AND SIMULATION OF L-SHAPED CHIRAL
NEGATIVE REFRACTIVE INDEX STRUCTURE**

J. Li, F.-Q. Yang, and J.-F. Dong

1	Introduction	395
2	Negative Refractive Index in Chiral Media	396
3	Design and Simulation of Microwave Frequency Band Chiral Structure	397
4	Design and Simulation of Optical Frequency Band Chiral Structure	402
5	Conclusion	404

DISPERSION AND LOSSES IN SURFACE WAVEGUIDES CONTAINING DOUBLE NEGATIVE OR CHIRAL META-MATERIALS

J. R. Canto, C. R. Paiva, and A. M. Barbosa

1	Introduction	409
2	Modal Analysis Using a Causal Dispersive Model	411
3	Further Numerical Results and Discussion	417
4	Concluding Remarks	420
	Appendix A. Modal Equation	420

EFFICIENT ANALYSIS OF SCATTERING FROM MULTIPLE 3-D CAVITIES BY MEANS OF A FE-BI-DDM METHOD

Z.-W. Cui, Y.-P. Han, C.-Y. Li, and W.-J. Zhao

1	Introduction	425
2	Formulation	427
3	Numerical Results	432
4	Conclusion	436

IMPLEMENTATION OF THE FDTD METHOD BASED ON LORENTZ-DRUDE DISPERSIVE MODEL ON GPU FOR PLASMONICS APPLICATIONS

K. H. Lee, I. Ahmed, R. S. M. Goh, E. H. Khoo, E. P. Li and T. G. G. Hung

1	Introduction	441
2	Formulations	443
3	GPU Implementation	445
4	Numerical Results and Discussion	450
5	Conclusion	454

CUDA IMPLEMENTATION IN THE EM SCATTERING OF A THREE-LAYER CANOPY

W.-Q. Jiang, M. Zhang, H. Chen, and Y.-G. Lu

1	Introduction	457
2	EM Scattering from the Three-layer Canopy	459
3	Serial Algorithm and CUDA Parallel Algorithm	464
4	Conclusion	470

APPLICATION OF THE NEWTON METHOD TO IMPROVE THE ACCURACY OF TOA ESTIMATION WITH THE BEAMFORMING ALGORITHM AND THE MUSIC ALGORITHM

J.-H. Lee, Y. S. Jeong, S.-W. Cho, W.-Y. Yeo, and K. Pister

1	Introduction	476
2	Beamforming and MUSIC Algorithm for Time Delay Estimation [3]	477
3	Proposed Algorithm	479
4	Numerical Results	481
5	Conclusion	511

DESIGN OF DIFFERENT SELECTIVITY DUAL-MODE FILTERS WITH E-SHAPED RESONATOR

C.-L. Wei, B.-F. Jia, Z.-J. Zhu, and M.-C. Tang

1	Introduction	517
2	E-Shaped Dual-mode Open Stub Loaded Resonator	518
3	Bandpass Filters Based on E-Shaped Dual-Mode Resonator	521
4	Simulation and Experimental Results	526
5	Conclusion	529

MULTI-CHANNEL SPCMB-TOPS SAR FOR HIGH-RESOLUTION WIDE-SWATH IMAGING

W. Xu, P. P. Huang, and Y. K. Deng

1	Introduction	533
2	SPCMB-TOPS Mode	534
3	SPCMB-TOPS SAR RAW Data	538
4	Imaging Approach	538
5	Simulation Experiment	546
6	Conclusion	549

A NEW WIDE-STOPBAND LOW-PASS FILTER WITH GENERALIZED COUPLED-LINE CIRCUIT AND ANALYTICAL THEORY

Y. Wu, Y. Liu, S. Li, and C. Yu

1	Introduction	553
2	The Circuit Structure and Theory of the Proposed LPF	555
3	Characteristics of the Proposed LPF	558
4	Microstrip Examples and Measurements	561
5	Conclusion	564