
**ELECTROMAGNETIC
WAVES** **PIER 137**

Progress

In

Electromagnetics

Research

© 2013 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 137**

Progress

In

Electromagnetics

Research

Chief Editor: Weng Cho Chew

EMW Publishing

Cambridge, Massachusetts, USA

CONTENTS

**BRAIN MR IMAGE CLASSIFICATION USING
MULTISCALE GEOMETRIC ANALYSIS OF RIPPLET***Sudeb Das, Manish Chowdhury, and Malay K. Kundu*

1	Introduction	1
2	Ripplet Transform Type-I (RT)	4
3	Feature Reduction	6
4	Classification through LS-SVM	6
5	Proposed System	7
6	Experimental Results and Comparisons	9
7	Conclusion	15

**EFFICIENT IMPLEMENTATION OF THE CAPON
BEAMFORMING USING THE LEVENBERG-
MARQUARDT SCHEME FOR TWO DIMENSIONAL
AOA ESTIMATION***Sung-Woo Cho and Joon-Ho Lee*

1	Introduction	19
2	LM-based Implementation of the Capon AOA estimation . . .	20
3	Numerical Results	26
4	Conclusion	29

**A NOVEL SYNTHESIS TECHNIQUE FOR MICROWAVE
BANDPASS FILTERS WITH FREQUENCY-DEPENDENT
COUPLINGS***Natalia Leszczynska, Lukasz Szydlowski, and Michal Mrozowski*

1	Introduction	35
2	Synthesis	37
3	Filter Designs	41
4	Conclusions	48

**FAST ESTIMATION OF FREQUENCY AND 2-D DOAS
FOR CYLINDRICAL CONFORMAL ARRAY ANTENNA
USING STATE-SPACE AND PROPAGATOR METHOD***Weijian Si, Liangtian Wan, Lutao Liu, and Zuoxi Tian*

1	Introduction	51
---	------------------------	----

2	The Elements Configuration on Cylindrical Carriers and the Narrowband Data Model	53
3	Joint Frequency and Angle Estimation	56
4	Cramer-Rao Lower Bound	64
5	Simulation Results	66
6	Conclusions	69

REDUCE THE HAND-EFFECT BODY LOSS FOR LTE MOBILE ANTENNA IN CTIA TALKING AND DATA MODES

Kun Zhao, Shuai Zhang, Zhinong Ying, Thomas Bolin and Sailing He

1	Introduction	73
2	Antenna Design	74
3	Radiation Efficiency in Talking and Data Modes	76
4	Measurement	83
5	Conclusion	83

PARALLEL SHOOTING AND BOUNCING RAY METHOD ON GPU CLUSTERS FOR ANALYSIS OF ELECTROMAGNETIC SCATTERING

Pengcheng Gao, Yubo Tao, and Hai Lin

1	Introduction	87
2	Parallel SBR Scheme	88
3	Numerical Results	94
4	Conclusion	97

TH-UWB RECEIVER BASED ON TWO PDFS APPROXIMATION IN MULTIUSER SYSTEMS

Wang Chen, Qiang Gao, Huagang Xiong, Li Fei, and Qiong Li

1	Introduction	101
2	System Model	104
3	Distribution Approximation of the Total Disturbance	105
4	Detection Scheme	109
5	Simulation Results and Discussion	109
6	Conclusion	112
	Appendix A.	113

NEW NEGATIVE COUPLING STRUCTURE FOR SUB-STRATE-INTEGRATED CAVITY RESONATORS AND ITS APPLICATION TO DESIGN OF AN ELLIPTIC RESPONSE FILTER

Kangho Lee, Tae-Hak Lee, Young-Sik Kim, and Juseop Lee

1	Introduction	117
2	Coupling Structure and Filter Design	118
3	Fabrication and Measurement	124
4	Conclusions	125

A NOVEL, HIGH-SPEED IMAGE TRANSMITTER FOR WIRELESS CAPSULE ENDOSCOPY

Md. R. Basar, Fareq Malek, Mohd I. M. Saleh, Mohd S. Idris Khairudi M. Juni, Azuwa Ali, Nur A. Mohd Affendi and Nuriziani Hussin

1	Introduction	130
2	Design Consideration	131
3	Circuit Design	134
4	Results and Discussion	138
5	Conclusions	143

CREATE A UNIFORM STATIC MAGNETIC FIELD OVER 50 T IN A LARGE FREE SPACE REGION

Fei Sun and Sailing He

1	Introduction and Background	149
2	Transformation Optics for Static Magnetic Fields	151
3	Enhance a Static Magnetic Field with TO	151
4	Summary	155

ANALYSIS OF PROPAGATION AND POLARIZATION CHARACTERISTICS OF ELECTROMAGNETIC WAVES THROUGH NONUNIFORM MAGNETIZED PLASMA SLAB USING PROPAGATOR MATRIX METHOD

Xiong Yin, Hou Zhang, Shuji Sun, Zhenwei Zhao, and Yanli Hu

1	Introduction	160
2	Propagator Matrix Method (PMM) for Magnetized Plasma	162
3	Numerical Verification and Results Analysis	169
4	Conclusion	181

TWO APPROACHES FOR INCOHERENT PROPAGATION OF LIGHT IN RIGOROUS NUMERICAL SIMULATIONS

Andrej Campa, Janez Krc, and Marko Topic

1	Introduction	187
2	Theory and Two Approaches	189
3	Results — Application of the Models	194
4	Discussion	198
5	Conclusion	199

CIRCULARLY POLARIZED SPIDRON FRACTAL SLOT ANTENNA ARRAYS FOR BROADBAND SATELLITE COMMUNICATIONS IN KU-BAND

Son Trinh-Van, Han Byul Kim, Gina Kwon, and Keum Cheol Hwang

1	Introduction	203
2	Single Spidron Fractal Slot Antenna	205
3	Antenna Array and Feeding Network	210
4	Fabrication and Measurement	212
5	Conclusion	216

RECURSIVE IMPLEMENTATION OF NATURAL FREQUENCY-BASED RADAR DETECTION USING THE LRT SCHEME

Joon-Ho Lee and So-Hee Jeong

1	Introduction	219
2	Late Time Response in Terms of the Natural Frequency	220
3	Likelihood Ratio Test	220
4	Recursive Implementation of the LRT Detection Scheme	221
5	Bound of Absolute Values of the Derivatives	222
6	Recursive Update Using Polynomial Approximation	224
7	Error Bounds	225
8	Optimization of Error Bound	226
9	Numerical Results	228
10	Conclusions	234

**AN ULTRA-LOW LOSS SPLIT RING RESONATOR BY
SUPPRESSING THE ELECTRIC DIPOLE MOMENT
APPROACH**

*Lei Zhu, Fanyi Meng, Fang Zhang, Jiahui Fu, Qun Wu, Xumin Ding
and Joshua L.-W. Li*

1	Introduction	240
2	Loss Mechanisms for the SRR	241
3	Realizations of the Ultra-low Loss SRR	245
4	Conclusion	250

**A COST-EFFECTIVE METHOD FOR HIGH-QUALITY
60 GHZ OPTICAL MILLIMETER WAVE SIGNAL
GENERATION BASED ON FREQUENCY
QUADRUPLING**

*Nael A. Al-Shareefi, Syed I. S. Hassan, Fareq Malek, Razali Ngah
Sura A. Abbas and Syed A. Aljunid*

1	Introduction	256
2	Principle	257
3	Numerical Simulation Results	262
4	Conclusion and Future Work	268
	Appendix A.	269

**A MINIATURIZED TRIPLE-BAND METAMATERIAL
ANTENNA WITH RADIATION PATTERN
SELECTIVITY AND POLARIZATION DIVERSITY**

H.-X. Xu, G.-M. Wang, and M.-Q. Qi

1	Introduction	276
2	Theory, Fundamentals and Antenna Design	277
3	Illustrative Results and Discussions	282
4	Conclusion	289

**AN EFFICIENT SAR JAMMER WITH DIRECT RADIO
FREQUENCY PROCESSING (DRFP)**

Qingfu Liu, Jian Dong, Xuesong Wang, Shiqi Xing, and Bo Pang

1	Introduction	293
2	The Principles of DRFP	294
3	Experiments and Analysis	301
4	Conclusions	305
	Appendix A. DRFP with Fast-time Modulations	306

MEASUREMENT EVALUATION OF THE TGN RADIO CHANNEL MODELS USEFULNESS IN PREDICTING WLAN PERFORMANCE

Kamil Staniec and Michal Kowal

1	Introduction	311
2	The Radio Channel in the Multipath Environment	312
3	The Radio Channel Power Delay Models	314
4	On the Test Environments, Simulations and Measurement Setup	315
5	The WLAN TGn Indoor Radio Channel Model	318
6	Measurements — Evaluation of the Radio Channel Models Performance	324
7	Conclusions	329

A NOVEL SPARSE STEPPED CHAOTIC SIGNAL AND ITS COMPRESSION BASED ON COMPRESSIVE SENSING

Jiefang Yang and Yunhua Zhang

1	Introduction	335
2	Overview of Compressive Sensing	337
3	Sparse Stepped Chaotic Signal (SSCS) Model	339
4	CS-Subaperture Algorithm	340
5	Experiment	344
6	Conclusion	353

NEAR INFRARED FILTERING PROPERTIES IN PHOTONIC CRYSTAL CONTAINING EXTRINSIC AND DISPERSIVE SEMICONDUCTOR DEFECT

Chi-Chung Liu and Chien-Jang Wu

1	Introduction	359
2	Basic Equations	361
3	Numerical Results and Discussion	363
4	Conclusion	367

MODIFIED DIFFERENTIAL EVOLUTION ALGORITHM FOR PATTERN SYNTHESIS OF ANTENNA ARRAYS

Xin Li, Wentao Li, Xiaowei Shi, Jing Yang, and Jianfeng Yu

1	Introduction	371
2	Modified Differential Evolution Algorithm	373

3	Array Pattern Synthesis Employing MDE	378
4	Conclusions	385

A THEORETICAL MODEL FOR THE FREQUENCY-DEPENDENT DIELECTRIC PROPERTIES OF CORNEAL TISSUE AT MICROWAVE FREQUENCIES

Mehrdad Saviz and Reza Faraji-Dana

1	Introduction	389
2	The Structure and Composition of Cornea	391
3	The Cornea Model	394
4	Results and Discussion	399
5	Conclusion	402

A NEW SCHEME FOR THE DESIGN OF BALANCED FREQUENCY TRIPLER WITH SCHOTTKY DIODES

Jian Guo, Jie Xu, and Cheng Qian

1	Introduction	407
2	Circuits Description	409
3	Simulations	413
4	Assembly and Test Bench Setup	418
5	Test Results and Discussion	419
6	Conclusions	421

COMPACT EBG STRUCTURE FOR ALLEVIATING MUTUAL COUPLING BETWEEN PATCH ANTENNA ARRAY ELEMENTS

Mohammad Tariqul Islam and Md. Shahidul Alam

1	Introduction	425
2	EBG Geometry & Bandgap Characterization	427
3	EBG for Mutual Coupling Improvement	431
4	Conclusion	434

USE OF ALIGNED CARBON NANOTUBES AS ELECTRIC FIELD SENSORS

Chieh-Lien Lu, Hsin-Jung Tsai, Bee-Yu Wei, and Wen-Kuang Hsu

1	Introduction	439
2	Experimental	440
3	Results and Discussion	442
4	Conclusion	450

THE INFLUENCE OF HUMAN HEAD MODEL WEARING METAL-FRAME SPECTACLES TO THE CHANGES OF SAR AND ANTENNA GAIN: SIMULATION OF FRONTAL FACE EXPOSURE

*Mohd H. Mat, Fareq Malek, William G. Whittow
Suzanna H. Ronald, Muhammad S. Zulkefli, Norshafinash Saudin
and Latifah Mohamed*

1	Introduction	453
2	Methodology	455
3	Antenna Gains and SAR Levels at 900 MHz	465
4	Conclusions	468

MAGNETIC RESPONSE AND NEGATIVE REFRACTION AT OPTICAL FREQUENCIES ON THE BASIS OF ELECTRONIC TRANSITIONS IN RARE-EARTH IONS DOPED CRYSTALS

Xiaojian Fu, Yuanda Xu, and Ji Zhou

1	Introduction	475
2	Magnetic Dipole Transition	477
3	Negative Refraction Behavior	479
4	Conclusions	482

ELIMINATION OF NUMERICAL DISPERSION FROM ELECTROMAGNETIC TIME DOMAIN ANALYSIS BY USING RESOURCE EFFICIENT FINITE ELEMENT TECHNIQUE

*S. M. Raiyan Kabir, B. M. A. Rahman, Arti Agrawal
and Ken T. V. Grattan*

1	Introduction	487
2	Derivation of the Method	489
3	The Meshes	492
4	Results of the Simulations	495
5	Numerical Dispersion	498
6	Comparing Numerical Dispersion of Meshes by Simulation . .	504
7	Comparison with the FDTD Method	508
8	Conclusion	509

SUPER/ZERO SCATTERING CHARACTERISTICS OF CIRCULAR SRR ARRAYS

Yuan Zhang, Erik Forsberg, and Sailing He

1	Introduction	513
2	The Dispersion Relation of SRR Arrays	514
3	Super and Zero Scattering Properties of a Circular Array of 8 SRR Elements	517
4	Scattering Spectrum of a Circular 16 Element SRR Array . .	522
5	Conclusion	524

ARBITRARY LOSS FACTORS IN THE WAVE PROPAGATION BETWEEN RHM AND LHM MEDIA WITH CONSTANT IMPEDANCE THROUGHOUT THE STRUCTURE

*Mariana Dalarsson, Martin Norgren, Tatjana Asenov
and Nebojsa Dončov*

1	Introduction	527
2	Problem Formulation	530
3	Solutions of the Field Equations	530
4	Numerical Model of Metamaterials	532
5	Graphical Presentation and Discussion of the Results	533
6	Conclusion	534

A NOVEL QUAD-BAND (GSM850 TO IEEE 802.11A) PIFA FOR MOBILE HANDSET

Pengcheng Li, Jin Pan, Deqiang Yang, Zaiping Nie, and Jun Xing

1	Introduction	539
2	Antenna Design and Parametric Study	540
3	Measured Results	545
4	Conclusions	546

ELECTRIC TIME DOMAIN REFLECTOMETRY SENSORS FOR NON-INVASIVE STRUCTURAL HEALTH MONITORING OF GLASS FIBER COMPOSITES

Gaurav Pandey, Erik T. Thostenson, and Dirk Heider

1	Introduction	551
2	Electric Time Domain Reflectometry	554
3	TDR Based Sensors for Strain and Damage Sensing	555
4	Results and Discussion	559

5 Conclusions 562

FEM-BASED METHOD FOR THE SIMULATION OF DIELECTRIC WAVEGUIDE GRATING BIOSENSORS

Thomas Guillod, Florian Kehl, and Christian Hafner

1 Introduction 566
 2 Numerical Methods 568
 3 Comparison between the Methods 572
 4 Sensor Sensitivity 574
 5 Results 578
 6 Conclusions 581

NOVEL IN-LINE MICROSTRIP COUPLED-LINE BANDSTOP FILTER WITH SHARP SKIRT SELECTIVITY

Gui Liu and Yongle Wu

1 Introduction 585
 2 Circuit Structure and Design Theory 586
 3 Full-wave Simulation and Measurement 593
 4 Conclusion 595

BROADBAND MODIFIED RECTANGULAR MICROSTRIP PATCH ANTENNA USING STEPPED CUT AT FOUR CORNERS METHOD

Alishir MoradiKordalivand and Tharek A. Rahman

1 Introduction 599
 2 RMPAs Model 600
 3 Concept of Stepped Cut at Four Corners Method 602
 4 Design Process of Proposed Broadband MRMPA Using SCFC Method 605
 5 Simulation and Measurement Results 610
 6 Conclusion 615

A NOVEL THREE-STEP IMAGE FORMATION SCHEME FOR UNIFIED FOCUSING ON SPACEBORNE SAR DATA

Wei Yang, Jie Chen, Hongceng Zeng, Jian Zhou, Pengbo Wang and Chunsheng Li

1 Introduction 621

2 Unified Geometry for Spaceborne SAR 623
 3 Unified SAR Image Formation Scheme 630
 4 Simulation and Discussions 637
 5 Conclusions 639

A SYNCHRONOUS WIDEBAND FREQUENCY-DOMAIN METHOD FOR LONG-DISTANCE CHANNEL MEASUREMENT

Chufeng Hu, Zhou Zhou, and Shuxia Guo

1 Introduction 643
 2 The Measurement Method 645
 3 Experiments and Their Result Analysis 647
 4 Conclusions 650

A BROADBAND OUT-OF-PHASE POWER DIVIDER FOR HIGH POWER APPLICATIONS USING THROUGH GROUND VIA (TGV)

Yunlong Lu, Gaole Dai, Xingchang Wei, and Erping Li

1 Introduction 654
 2 Investigation of Through Ground Via 655
 3 Configuration and Analysis of the Proposed Power Divider .. 656
 4 Simulation and Measurement 662
 5 Conclusion 665

MODELING SAR IMAGES BASED ON A GENERALIZED GAMMA DISTRIBUTION FOR TEXTURE COMPONENT

Gui Gao, Xianxiang Qin, and Shilin Zhou

1 Introduction 669
 2 The Proposed GTT Model 671
 3 Parameter Estimator of the GTT Model Based on MoLC 673
 4 Experimental Results 676
 5 Conclusion 680
 Appendix A. The Derivation of m -th Order Moments of the GTT Distribution 680
 Appendix B. Proof of the Relationship between Distributions ... 682

DEVELOPMENT OF PYRAMIDAL MICROWAVE ABSORBER USING SUGAR CANE BAGASSE (SCB)

*Liyana Zahid, Fareq Malek, Hassan Nornikman
Nur A. Mohd Affendi, Azuwa Ali, Nuriziani Hussin
Badrul H. Ahmad and Mohamad Z. A. Abd Aziz*

1	Introduction	687
2	Materials and Methods	689
3	Results and Discussion	692
4	Conclusions and Future Work	698

MULTIFREQUENCY MONOPOLE ANTENNAS BY LOADING METAMATERIAL TRANSMISSION LINES WITH DUAL-SHUNT BRANCH CIRCUIT

*Hexiu Xu, Guangming Wang, Yuan Yuan Lv, Meiqing Qi, Xi Gao
and Shuo Ge*

1	Introduction	704
2	Theory of the K-ECSSRRP-loaded Microstrip-fed ENG and DNG Monopoles	705
3	Multifrequency Monopoles Loaded with Single CMTL Element	709
4	Monopoles Loaded with Multiple CMTL Elements	717
5	Conclusion	721

FEATURES EXTRACTION OF ROTATIONALLY SYMMETRIC BALLISTIC TARGETS BASED ON MICRO-DOPPLER

*Xiaoyi Pan, Wei Wang, Jin Liu, Dejun Feng, Yongcai Liu
and Guoyu Wang*

1	Introduction	727
2	The Model of m-D for Rotationally Symmetric BT	728
3	Feature Extraction Algorithm via EHT	732
4	Analyses with Measured Data	734
5	Conclusions	737

EFFICIENT NEURAL NETWORK APPROACH FOR 2D DOA ESTIMATION BASED ON ANTENNA ARRAY MEASUREMENTS

*Marija Agatonović, Zoran Stanković, Ivan Milovanović
Nebojša Dončov, Leen Sit, Thomas Zwick, and Bratislav Milovanović*

1	Introduction	741
---	------------------------	-----

2	Problem Formulation	744
3	MLP Neural Networks	745
4	System Setup	747
5	Direction of Arrival Estimation Using MLP Neural Networks	749
6	Modeling Results	749
7	Conclusion	754

APPLICATION OF CHIRAL LAYERS AND METAMATERIALS FOR THE REDUCTION OF RADAR CROSS SECTION

*Kimia Nikooei Tehrani, Ali Abdolali, Davoud Zarifi
and Farrokh Hojjat-Kashani*

1	Introduction	759
2	Theory and Formulation	760
3	Numerical Examples and Results	764
4	Application of Semi-planar Chiral Metamaterial Structures as Microwave Absorbers	767
5	Conclusions	769