
**ELECTROMAGNETIC
WAVES PIER 127**

**Progress
In
Electromagnetics
Research**

© 2012 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 127**

**Progress
In
Electromagnetics
Research**

Chief Editor: Weng Cho Chew

**EMW Publishing
Cambridge, Massachusetts, USA**

CONTENTS

OPTIMAL DESIGN FOR HIGH-TEMPERATURE BROADBAND RADOME WALL WITH SYMMETRICAL GRADED POROUS STRUCTURE

L. C. Zhou, Y. M. Pei, R. B. Zhang, and D. N. Fang

1	Introduction	1
2	Symmetrical Graded Porous Structure	3
3	Methods	5
4	Results and Discussion	9
5	Conclusion	12

AN ELECTRONICALLY CONTROLLABLE METHOD FOR RADAR CROSS SECTION REDUCTION FOR A MICROSTRIP ANTENNA

Y. P. Shang, S. Q. Xiao, J. L. Li, and B.-Z. Wang

1	Introduction	15
2	Design of the Reference Antenna	16
3	RCS Reduction Design of the Antenna	17
4	Combination of Three Loading Schemes	25
5	Radiation Performances	26
6	Conclusion	27

THEORETICAL STUDY OF SUPERCONDUCTING ANNULAR RING MICROSTRIP ANTENNA WITH SEVERAL DIELECTRIC LAYERS

O. Barkat

1	Introduction	31
2	Theoretical Model	32
3	Numerical Results	39
4	Conclusions	46

**CALCULATION OF SHAPE DERIVATIVES WITH
PERIODIC FAST MULTIPOLE METHOD WITH
APPLICATION TO SHAPE OPTIMIZATION OF
METAMATERIALS***W. Wang and N. Nishimura*

1	Introduction	49
2	Periodic Boundary Value Problem	51
3	Sensitivity Analysis	53
4	Numerical Results	56
5	Concluding Remarks	61
	Appendix A. A Proof of Corollary 3	62

**FABRICATION OF CARBON NANOTUBES ON
INTERDIGITATED METAL ELECTRODE FOR
SWITCHABLE NANOPHOTONIC DEVICES***Q. Dai, H. Butt, R. Rajasekharan, T. D. Wilkinson
and G. A. J. Amaratunga*

1	Introduction	65
2	Electromagnetic Simulation of the CNT Electrode Geometry	66
3	Proposed Device Geometry	69
4	Fabrication Process	69
5	Electro-optic Analysis	73
6	Conclusions	75

**BANDWIDTH IMPROVEMENT OF MICROSTRIP
ANTENNA ARRAY USING DUMMY EBG PATTERN
ON FEEDLINE***M. Gujral, J. L.-W. Li, T. Yuan, and C.-W. Qiu*

1	Introduction	79
2	Design Considerations	81
3	S-parameters and Bandwidths	83
4	Radiation Effects	87
5	Concluding Remarks	89

**INVERSE DESIGN OF DIELECTRIC MATERIALS BY
TOPOLOGY OPTIMIZATION***M. Otomori, J. Andkjær, O. Sigmund, K. Izui, and S. Nishiwaki*

1	Introduction	94
2	Formulation	96

3	Theoretical Bounds	100
4	Numerical Implementation	105
5	Numerical Examples	105
6	Conclusion	117

THE APPLICATION OF MODIFIED PHASE EXTRACTED BASIS FUNCTIONS IN SCATTERING ANALYSIS OF DIELECTRIC-COATED TARGETS

X. Niu, Z. Nie, and S. He

1	Introduction	121
2	The MPE Basis Function	123
3	Combined with the TDS for Solving the Thin Dielectric-Coated Targets	127
4	Modified TDS for Solving the Coated Targets	133
5	Conclusion	135

ADAPTIVE BEAMFORMING WITH LOW SIDE LOBE LEVEL USING NEURAL NETWORKS TRAINED BY MUTATED BOOLEAN PSO

Z. D. Zaharis, K. A. Gotsis, and J. N. Sahalos

1	Introduction	139
2	Formulation	141
3	Mutated Boolean PSO	143
4	Minimum Variance Distortionless Response	144
5	NN-MBPSO Based Adaptive Beamforming	144
6	Numerical Results	146
7	Conclusion	150

ANALYTICAL FIELD CALCULATION FOR LINEAR TUBULAR MAGNETIC GEARS USING EQUIVALENT ANISOTROPIC MAGNETIC PERMEABILITY

W. Li and K. T. Chau

1	Introduction	155
2	Analytical Model	157
3	Magnetic Field Solution	160
4	Calculation Results and Verification	163
5	Conclusions	167
	Appendix A	168

**A NOVEL MULTILAYER DUAL-MODE SUBSTRATE
INTEGRATED WAVEGUIDE COMPLEMENTARY
FILTER WITH CIRCULAR AND ELLIPTIC CAVITIES
(SICC AND SIEC)***Z.-G. Zhang, Y. Fan, Y.-J. Cheng, and Y.-H. Zhang*

1	Introduction	173
2	Filter Analysis and Design	175
3	Experiment Results	184
4	Conclusion	185

**AN EXTENDED DELAY-RATIONAL MACROMODEL
FOR ELECTROMAGNETIC INTERFERENCE ANALYSIS
OF MIXED SIGNAL CIRCUITS***M. Luo and K. Huang*

1	Introduction	189
2	Theory	191
3	Numerical Examples	198
4	Conclusions	206

**AN EFFICIENT METHOD FOR COMPUTING HIGHLY
OSCILLATORY PHYSICAL OPTICS INTEGRAL***Y. M. Wu, L. J. Jiang, and W. C. Chew*

1	Introduction	211
2	Highly Oscillatory PO Integrals on the Right-angle Trapezoid Domain	215
3	Highly Oscillatory PO Integral on the Triangular Patch	226
4	Analysis of the Critical Point Contributions on a Triangular Patch by the Numerical SDP Method and Comparison with the Traditional Asymptotic Approximation Approach	231
5	Numerical examples	238
6	Conclusion	249
	Appendix A. Derivation of $F(x)$ in Equation (17)	250
	Appendix B. Closed-form Formula Cases for I_2^{analytic}	251

**APPLICATIONS OF COMPRESSED SENSING FOR
MULTIPLE TRANSMITTERS MULTIPLE AZIMUTH
BEAMS SAR IMAGING***J. Li, S. S. Zhang, and J. F. Chang*

1	Introduction	259
---	--------------------	-----

2	Compressed Sensing	261
3	CS Applied for MTMAB SAR	262
4	Simulation Results	267
5	Conclusion	273

EFFICIENT MODEL ORDER REDUCTION FOR FEM ANALYSIS OF WAVEGUIDE STRUCTURES AND RESONATORS

G. Fatyga, K. Nyka, and M. Mrozowski

1	Introduction	277
2	Theory	280
3	Numerical Results	286
4	Conclusion	292

TRANSPOSE RETURN RELATION METHOD FOR DESIGNING LOW NOISE OSCILLATORS

*J. L. Jimenez-Martin, V. Gonzalez-Posadas, A. Parra-Cerrada
A. Blanco-del-Campo and D. Segovia-Vargas*

1	Introduction	298
2	General Considerations about Leeson's Model	300
3	Classic Optimization Methods	303
4	Transpose Return Relations Method	305
5	Practical Example	308
6	Conclusions	315

STUDY AND SIMULATION OF AN EDGE COUPLE SPLIT RING RESONATOR (EC-SRR) ON TRUNCATED PYRAMIDAL MICROWAVE ABSORBER

*H. Nornikman, B. H. Ahmad, M. Z. A. Abdul Aziz, F. Malek
H. Imran and A. R. Othman*

1	Introduction	319
2	Split Ring Resonator (SRR) Unit Cell	321
3	The Truncated Pyramidal Microwave Absorber Design	323
4	Results	326
5	Conclusion	330

**EFFICIENT GEOSYNCHRONOUS CIRCULAR SAR
RAW DATA SIMULATION OF EXTENDED 3-D SCENES***Q. Liu, W. Hong, W.-X. Tan, and Y.-R. Wu*

1	Introduction.....	335
2	GeoCSAR Signal Model	337
3	Raw Data Simulation.....	340
4	Simulation Results	343
5	Conclusions	348

**THE “SLOPE” EFFECT OF COHERENT TRANSPON-
DER IN InSAR DEM***Q.-F. Liu, S.-Q. Xing, X.-S. Wang, J. Dong, D.-H. Dai, and Y.-Z. Li*

1	Introduction.....	351
2	The Quality Map of CT	352
3	The “Slope” Effect of CT’s DEM	356
4	Simulation and Analysis	363
5	Conclusion	367

**SYNTHESIS OF THINNED LINEAR AND PLANAR
ANTENNA ARRAYS USING BINARY PSO ALGORITHM***W.-B. Wang, Q.-Y. Feng, and D. Liu*

1	Introduction.....	371
2	Thinned Array	372
3	Modified Binary PSO.....	374
4	Numerical Results	377
5	Conclusions	384

**THE REFLECTION AND TRANSMISSION OF ELEC-
TROMAGNETIC WAVES BY A UNIAXIAL CHIRAL
SLAB***J.-F. Dong and J. Li*

1	Introduction.....	389
2	Formulations	390
3	Numerical Examples and Discussion	395
4	Conclusion	400

THE *REAL-VALUED* TIME-DOMAIN *TE*-MODES IN LOSSY WAVEGUIDES*O. A. Tretyakov and M. Kaya*

1	Introduction	405
2	Formulation of the Problem	407
3	Transverse-longitudinal Decompositions	409
4	Complete Set of the <i>TE</i> -Time-domain Modes	411
5	Energetic Characteristics of the Modal Waves	415
6	Evolutionary Equation for $h_n(z, t)$	417
7	The <i>Real-valued</i> Time-harmonic <i>TE</i> -modes	417
8	Fundamental Solution	423
9	Discussion	424

UTILIZATION OF SCREEN PRINTED LOW CURING TEMPERATURE COBALT NANOPARTICLE INK FOR MINIATURIZATION OF PATCH ANTENNAS

<i>M. Nelo, A. K. Sowpati, V. K. Palukuru, J. Juuti, and H. Jantunen</i>		
1	Introduction	428
2	Experimental Details	429
3	Results and Discussion	433
4	Conclusion	440

COMPLEX POINT SOURCE FOR THE 3D LAPLACE OPERATOR*M. J. González-Morales, R. Mahillo-Isla, C. Dehesa-Martínez and E. Gago-Ribas*

1	Introduction	445
2	Complexified Green's Function for the 3D Laplace Operator in Free Space	447
3	Complex Point Source in the Real Space	448
4	Validation of the Results	450
5	Conclusions	454
	Appendix A. Physical Description of the Potential	454

PRINCIPLE COMPONENT ANALYSIS AND FUZZY LOGIC BASED THROUGH WALL IMAGE ENHANCEMENT*M. M. Riaz and A. Ghafoor*

1	Introduction	461
2	Image Enhancement	463
3	Simulation and Results	474
4	Conclusion	476

NON LINEAR OPTIMIZATION TECHNIQUE FOR THE REDUCTION OF THE FREQUENCY SCANNING EFFECT IN A PHASED ARRAY BASED ON BROADBAND INJECTION-LOCKED THIRD HARMONIC SELF-OSCILLATING MIXERS*M. Fernandez, S. Ver Hoeye, C. Vazquez, G. Hotopan, R. Camblor and F. Las Heras*

1	Introduction	479
2	Design and Optimization of the IL3HSOM	481
3	Analysis of the Synchronized Solutions	484
4	Broadband Antenna Array Based on IL3HSOM	487
5	Conclusions	496

SCATTERING OF ELECTROMAGNETIC PLANE WAVE BY A CIRCULAR DISK WITH SURFACE IMPEDANCE*A. D. U. Jafri, Q. A. Naqvi, and K. Hongo*

1	Introduction	501
2	Statement of the Problem and Expressions for Incident Wave	502
3	The Expressions for the Fields Scattered by a Disk	504
4	Results and Discussion	519

DESIGN AND ANALYSIS OF PLANAR ULTRA-WIDE-BAND ANTENNA WITH DUAL BAND-NOTCHED FUNCTION*F. Zhu, S. Gao, A. T. Ho, C. H. See, R. A. Abd-Alhameed, J. Li and J. Xu*

1	Introduction	524
2	Antenna Structure and Design	525
3	Simulated and Measured Results	528
4	Discussion and Comparison of the Proposed Band-notched Antenna Against Recent Available Published Designs	531

5 Conclusion	533
--------------------	-----

A NOVEL DUAL-LOOP COUPLER FOR ONE-PORT CYLINDRICAL CAVITY PERMITTIVITY MEASUREMENT

H. Zhang, B.-Q. Zeng, L. Ao, and Z. Zhang

1 Introduction.....	537
2 Background	538
3 Method	541
4 Results & Discussions	543
5 Conclusion	549

A MODIFIED TAGUCHI'S OPTIMIZATION ALGORITHM FOR BEAMFORMING APPLICATIONS

Z. D. Zaharis

1 Introduction.....	554
2 Taguchi's Optimization Method.....	555
3 Beamforming Problem Definition	556
4 Convergence Rate Results	559
5 Beamforming Examples	561
6 Conclusion	565