

APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY JOURNAL

August 2021
Vol. 36 No. 8
ISSN 1054-4887

The ACES Journal is abstracted in INSPEC, in Engineering Index, DTIC, Science Citation Index Expanded, the Research Alert, and to Current Contents/Engineering, Computing & Technology.

The illustrations on the front cover have been obtained from the research groups at the Department of Electrical Engineering, The University of Mississippi

THE APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY
<http://aces-society.org>

EDITORS-IN-CHIEF

Atef Elsherbeni
Colorado School of Mines, EE Dept.
Golden, CO 80401, USA

Sami Barmada
University of Pisa, ESE Dept.
56122 Pisa, Italy

ASSOCIATE EDITORS

Mohammed Hadi
Kuwait University, EE Dept.
Safat, Kuwait

Alistair Duffy
De Montfort University
Leicester, UK

Wenxing Li
Harbin Engineering University
Harbin 150001, China

Maokun Li
Tsinghua University
Beijing 100084, China

Mauro Parise
University Campus Bio-Medico of Rome
00128 Rome, Italy

Yingsong Li
Harbin Engineering University
Harbin 150001, China

Riyadh Mansoor
Al-Muthanna University
Samawa, Al-Muthanna, Iraq

Lijun Jiang
University of Hong Kong, EEE Dept.
Hong Kong

Shinishiro Ohnuki
Nihon University
Tokyo, Japan

Kubilay Sertel
The Ohio State University
Columbus, OH 43210, USA

Antonio Musolino
University of Pisa
56126 Pisa, Italy

Abdul A. Arkadan
Colorado School of Mines, EE Dept.
Golden, CO 80401, USA

Salvatore Campione
Sandia National Laboratories
Albuquerque, NM 87185, USA

Wei-Chung Weng
National Chi Nan University, EE Dept.
Puli, Nantou 54561, Taiwan

Alessandro Formisano
Seconda Universita di Napoli
81031 CE, Italy

Piotr Gas
AGH University of Science and Technology
30-059 Krakow, Poland

Long Li
Xidian University
Shaanxa, 710071, China

Steve J. Weiss
US Army Research Laboratory
Adelphi Laboratory Center (RDRL-SER-M)
Adelphi, MD 20783, USA

Jiming Song
Iowa State University, ECE Dept.
Ames, IA 50011, USA

Maokun Li
Tsinghua University, EE Dept.
Beijing 100084, China

Atif Shamim
King Abdullah University of Science and Technology (KAUST)
Thuwal 23955, Saudi Arabia

Marco Ajona López
La Laguna Institute of Technology
Torreon, Coahuila 27266, Mexico

Paolo Mezzanotte
University of Perugia
I-06125 Perugia, Italy

Luca Di Renzo
Politecnico di Milano
20133 Milano, Italy

Lei Zhao
Jiangsu Normal University
Jiangsu 221116, China

Sima Noghanian
Commscope
Sunnyvale, CA 94089, USA

Qiang Ren
Beihang University
Beijing 100191, China

Nunzia Fontana
University of Pisa
56122 Pisa, Italy

Stefano Selleri
DINFO - University of Florence
50139 Florence, Italy

Amedeo Capozzoli
Universita di Naoli Federico II, DIETI
I-80125 Napoli, Italy

Yu Mao Wu
Fudan University
Shanghai 200433, China

EDITORIAL ASSISTANTS

Matthew J. Inman
University of Mississippi, EE Dept.
University, MS 38677, USA

Shanell Lopez
Colorado School of Mines, EE Dept.
Golden, CO 80401, USA

EMERITUS EDITORS-IN-CHIEF

Duncan C. Baker
EE Dept. U. of Pretoria
0002 Pretoria, South Africa

Allen Glisson
University of Mississippi, EE Dept.
University, MS 38677, USA

Ahmed Kishk
Concordia University, ECS Dept.
Montreal, QC H3G 1M8, Canada

Robert M. Bevensee
Box 812
Alamo, CA 94507-0516

Ozlem Kilic
Catholic University of America
Washington, DC 20064, USA

David E. Stein
USAF Scientific Advisory Board
Washington, DC 20330, USA

EMERITUS ASSOCIATE EDITORS

Yasushi Kanai
Niigata Inst. of Technology
Kashiwazaki, Japan

Alexander Yakovlev
University of Mississippi, EE Dept.
University, MS 38677, USA

Levent Gurel
Bilkent University
Ankara, Turkey

Mohamed Abouzahra
MIT Lincoln Laboratory
Lexington, MA, USA

Ozlem Kilic
Catholic University of America
Washington, DC 20064, USA

Erdem Topsakal
Mississippi State University, EE Dept.
Mississippi State, MS 39762, USA

Sami Barmada
University of Pisa, ESE Dept.
56122 Pisa, Italy

Fan Yang
Tsinghua University, EE Dept.
Beijing 100084, China

Rocco Rizzo
University of Pisa
56123 Pisa, Italy

William O'Keefe Coburn
US Army Research Laboratory
Adelphi, MD 20783, USA

EMERITUS EDITORIAL ASSISTANTS

Khaleb ElMaghoub
Trimble Navigation/MIT
Boston, MA 02125, USA

Kyle Patel
Colorado School of Mines, EE Dept.
Golden, CO 80401, USA

Christina Bonninton
University of Mississippi, EE Dept.
University, MS 38677, USA

Anne Graham
University of Mississippi, EE Dept.
University, MS 38677, USA

Madison Lee
Colorado School of Mines, EE Dept.
Golen, CO 80401, USA

Allison Tanner
Colorado School of Mines, EE Dept.
Golden, CO 80401, USA

Mohamed Al Sharkawy
Arab Academby for Science and Technology, ECE Dept.
Alexandria, Egypt

AUGUST 2021 REVIEWERS: REGULAR PAPERS

Mehmet Belen	Luis Ramirez
Guan-Yu Chen	Imaculate Rosaline
Pasquale Dottorato	Abas Sabouni
Mohsen Eslami Nazari	Tale Saeidi
Andrey Grigoriev	Luca Sani
Mohammed Hadi	Stefano Selleri
Julie Huffman	Yuewu Shi
Tianqi Jiao	Hamidreza Siampour
Zhu Jun	Yi Sui
Long Li	Prabhu Sundaramoorthy
Yingsong Li	Mehmet Tabakcioglu
Shengyuan Luo	Junwu Tao
Michel Ney	Christopher Trueman
Mahdi Oliaei	Jiangong Wei
Balachandra Pattanaik	Julia Wolff
Andrew Peterson	Huanhuan Yang
Mohammd Pourbagher	Hao Zhang
Dudla Prabhakar	Mohammad Zoofaghari
Azhagumurugan R.	Le Zuo

AUGUST 2021 REVIEWERS: EXPRESS PAPERS

Ercument Arvas	Shinichiro Ohnuki
Quang Nguyen	Hassan Ragheb
Huthaifa Obeidat	Mariselvam V.

THE APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY JOURNAL

Vol. 36 No. 8

August 2021

TABLE OF CONTENTS – REGULAR PAPERS

A Novel Design of Aperiodic Arrays for Ultrawideband Beam Scanning and Full Polarization Reconfiguration Ziyu Zhang, Jia Liu, Jianxun Su, and Jiming Song.....	946
Fast Range Decoupling Algorithm for Metamaterial Aperture Real-time Imaging Yuteng Gao, Wencan Peng, Min Wang, Chenjiang Guo, and Jun Ding.....	953
Time-dependent Schrödinger Equation based on HO-FDTD Schemes Min Zhu, Fei Fei Huo, and Ben Niu.....	964
RK-HO-FDTD Scheme for Solving Time-dependent Schrodinger Equation Min Zhu and Yi Wang.....	968
A Recovery Performance Study of Compressive Sensing Methods on Antenna Array Diagnosis from Near-Field Measurements Oluwole John Famoriji and Thokozani Shongwe	973
Performance Investigations of a Quad-band Microstrip Antenna for Body Wearable Wireless Devices Varshini Karthik and T. Rama Rao	980
Design of Compact Reconfigurable Antenna Array for WLAN Applications Yazeed M. Qasaymeh.....	989
Compact High Gain Multiband Antenna Based on Split Ring Resonator and Inverted F Slots for 5G Industry 4.0 Applications Ranjan Mishra, Rajeev Dandotiya, Ankush Kapoor, and Pradeep Kumar	999
Design of Cylindrical Conformal Array Antenna based on Microstrip Patch Unit Tianming Bai, Di Jiang, Sha Luo, and Kai Zhu	1008
Sub-6 GHz Quad-Band Reconfigurable Antenna for 5G Cognitive Radio Applications Sivakumar Ellusamy and Ramachandran Balasubramanian	1015
Size-Reduced Equilateral Triangular Metamaterial Patch Antenna Designed for Mobile Communications Guoxiang Dai, Xiaofei Xu, and Xiao Deng	1026

Analysis of the Serrated Ground Plane for a Low-Loss Reflectarray Antenna Jiawei Ren, Hongjian Wang, Weichun Shi, and Minzheng Ma.....	1031
SDR Based Modulation Performance of RF Signal under Different Communication Channel Shabana Habib.....	1043
Light Wave Propagation Model for Indoor Visible Light Communication Systems Employing Small LED Sources Marwa M. A. Elsaaty, Adel Zaghloul, and Khalid. F. A. Hussein.....	1050
Signal Propagation Modeling Based on Weighting Coefficients Method in Underground Tunnels Yusuf Karaca and Özgür Tamer.....	1059
Characteristic Analysis and Control of a Rotary Electromagnetic Eddy Current Brake Qiao Ren, Jimin Zhang, Hechao Zhou, and Jinnan Luo	1065
Modelling of Electromagnetic Fields for Shielding Purposes Applied in Instrumentation Systems Ahmad M. Dagamseh, Qasem M. Al-Zoubi, Qasem M. Qananwah, and Hamzeh M. Jaradat	1075
Electromagnetic Acoustic Transducer for Detection and Characterization of Hidden Cracks inside Stainless Steel Material Houssem Boughedda, Tarik Hacib, Yann Le Bihan, Mohamed Chelabi, and Hulusi Acikgoz	1083
Reduction of Cogging Torque in AFPM Machine Using Elliptical-Trapezoidal-Shaped Permanent Magnet Salman Ali, Junaid Ikram, Christopher P. Devereux, Syed S. H. Bukhari, Shahid A. Khan, Nasrullah Khan, and Jong-Suk Ro	1090
Characteristics Analysis of Double-Sided Permanent Magnet Linear Synchronous Motor with Three-Phase Toroidal Windings Xiaobao Chai, Jikai Si, Yihua Hu, Yingsheng Li, and Dongshu Wang.....	1099

TABLE OF CONTENTS – EXPRESS PAPERS

Electronically Reconfigurable WLAN Band-Notched MIMO Antenna for Ultra-wideband Applications Asim Quddus, Rashid Saleem, Salman Arain, Syed Rizwan Hassan, and M. Farhan Shafique	1108
Circuit Modelling Methodology for Dual-band Planar Antennas Kim Ho Yeap, Tobias Meister, Zi Xin Oh, and Humaira Nisar.....	1112

Novel Methodology to Assess RF Performance of Co-located MIMO Radar Systems Transmitting Binary Phased Coded Waveforms Nivia Colon-Diaz, Dan Janning, Patrick M. McCormick, James T. Aberle, and Daniel W. Bliss	1116
Model Order Reduction of Cardiac Monodomain Model using Deep Autoencoder Based Neural Networks Riasat Khan and Kwong T. Ng	1120