

APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY JOURNAL

**Special Issue on Finite Difference
Methodologies for Microwave, Optical and
Photonics, and Superconducting Device
Design**

Guest Editors:

Yasushi Kanai, Niigata Institute of Technology, Japan

James B. Cole, Northrop-Grumman, Inc, USA

Saswatee Banerjee, Facebook Research Lab, Cork, Ireland

March 2024
Vol. 39 No. 3
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 ARC research group at the Department of Electrical Engineering, Colorado School of Mines

Published, sold and distributed by: River Publishers, Alsbjergvej 10, 9260 Gistrup, Denmark

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

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

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

Luca Di Rienzo
Politecnico di Milano
20133 Milano, Italy

Yingsong Li
Harbin Engineering University
Harbin 150001, China

Alessandro Formisano
Seconda Università di Napoli
81031 CE, Italy

Lei Zhao
Jiangsu Normal University
Jiangsu 221116, China

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

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

Sima Noghanian
Commscope
Sunnyvale, CA 94089, USA

Giulio Antonini
University of L Aquila
67040 L Aquila, Italy

Long Li
Xidian University
Shaanxa, 710071, China

Nunzia Fontana
University of Pisa
56122 Pisa, Italy

Antonino Musolino
University of Pisa
56126 Pisa, Italy

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

Stefano Selleri
DINFO - University of Florence
50139 Florence, Italy

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

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

Fatih Kaburcuk
Sivas Cumhuriyet University
Sivas 58140, Turkey

Mona El Helbawy
University of Colorado
Boulder, CO 80302, USA

Santanu Kumar Behera
National Institute of Technology
Rourkela-769008, India

Huseyin Savci
Istanbul Medipol University
34810 Beykoz, Istanbul

Sounik Kiran Kumar Dash
SRM Institute of Science and Technology
Chennai, India

Daniele Romano
University of L Aquila
67100 L Aquila, Italy

Zhixiang Huang
Anhui University
China

Vinh Dang
Sandia National Laboratories
Albuquerque, NM 87109, USA

Alireza Baghai-Wadji
University of Cape Town
Cape Town, 7701, South Africa

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

Ibrahim Mahariq
American University of the Middle East
Kuwait and University of
Turkish Aeronautical Association
Turkey

Kaikai Xu
University of Electronic Science
and Technology of China
China

Sheng Sun
University of Electronic Science and
Tech. of China
Sichuan 611731, China

Wenxing Li
Harbin Engineering University
Harbin 150001, 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

Mohamed Abouzahra
MIT Lincoln Laboratory
Lexington, MA, USA

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

Levent Gurel
Bilkent University
Ankara, Turkey

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

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

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

Alistair Duffy
De Montfort University
Leicester, UK

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

Rocco Rizzo
University of Pisa
56123 Pisa, Italy

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

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

Mohammed Hadi
Kuwait University, EE Dept.
Safat, Kuwait

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

Maokun Li
Tsinghua University
Beijing 100084, China

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

Shinishihiro Ohnuki
Nihon University
Tokyo, Japan

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

Salvatore Campione
Sandia National Laboratories
Albuquerque, NM 87185, USA

Toni Bjorninen
Tampere University
Tampere, 33100, Finland

Paolo Mezzanotte
University of Perugia
I-06125 Perugia, Italy

Yu Mao Wu
Fudan University
Shanghai 200433, China

Amin Kargar Behbahani
Florida International University
Miami, FL 33174, USA

Laila Marzall
University of Colorado, Boulder
Boulder, CO 80309, USA

Qiang Ren
Beihang University
Beijing 100191, China

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 Bonnington
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.
Golden, CO 80401, USA

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

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

MARCH 2024 REVIEWERS

**Mariem Abdi
Max J. Ammann
Tohid Aribi
Saswatee Banerejee
Bhattacharya
Mahendran C.
James B. Cole
Thippesha D.
Ravi Kumar Goyal
Yasushi Kanai
Rafał Lech
Lihua Li
Nithizethe Mhuadthongon**

**Igor Minin
Giacomo Paolini
Anna Pietrenko-Dabrowska
Natarajamani S.
Luca Scorrano
Lu Wang
Dariusz Wojcik
Yanlin Xu
Hongzheng Zeng
Qiwei Zhan
Yonghong Zhou
Theodoros Zygiridis**

TABLE OF CONTENTS

Women’s History Month Special Article: Interview with Professor Mahta Moghaddam
Sima Noghian 176

Special Issue Preface 182

Nonstandard Finite Difference Time Domain Methodology to Simulate Light Propagation
in Nonlinear Materials
James B. Cole 183

A Path Integral Representation Model to Extend the Analytical Capability of the
Nonstandard Finite-difference Time-domain Method
Tadao Ohtani, Yasushi Kanai, and Nikolaos V. Kantartzis 189

A Simple, Method of Moments Solution for the Integral Equations for Multiple Dielectric
Bodies of Arbitrary Shape in Time Domain
Sadasiva M. Rao 201

Impact Evaluation of an External Point Source to a Generalized Model of the Human Neck
Anna A. Varvari, Dimitrios I. Karatzidis, Tadao Ohtani, Yasushi Kanai,
and Nikolaos V. Kantartzis 215

Reconfigurable Multifunctional Transmission Metasurface Polarizer Integrated with
PIN Diodes Operating at Identical Frequencies
Jianyu Lin, Dongying Li, and Wenxian Yu 222

Parameter Sensitivity Analysis of 3D-Printed W-Band Reflective Fresnel Lens Antenna
based on Acrylonitrile Butadiene Styrene Plastic
Shunichi Futatsumori 231

An Efficient MLFMA for Accurately Analyzing Electromagnetic Radiation and Coupling
Characteristics of Large-scale Antenna Arrays Mounted on Platform
Lei Yin, Ning Ding, Peng Hou, Zhongchao Lin, Xunwang Zhao, Shugang Jiang,
and Yongchang Jiao 237

Wideband Simultaneous Dual Circularly Polarized Phased Array Subarray with Scalable Characteristics for Satellite Communications Yunqi Zhang, Jiateng Chen, Xuping Li, Rui Yang, Qizheng Zhao, Xueyan Song, and Wenjia Zhou	246
A Dual Circularly Polarized Ultrawideband Rectenna with High Efficiency for Wireless Energy Harvesting Jian Liu and Jun Yi Li	254
Wideband Low-Profile Fabry-Perot Cavity Antenna with Metasurface Xueyan Song, Ang Dong, XuPing Li, YunQi Zhang, Haoyuan Lin, Hailong Yang, and Yapeng Li	262
Broadband Dual-frequency High Isolation Base Station Antenna with Low RCS Structure Loaded Pei-Pei Ma, Fang-Fang Fan, and Xin-yi Zhao	268