Hindawi Publishing Corporation
International Journal of Microwave Science and Technology
Volume 2012, Article ID 132136, 2 pages
doi:10.1155/2012/132136

Editorial

Microwave and Millimeter-Wave Sensors, Systems, and Techniques for Electromagnetic Imaging and Materials Characterization

Andrea Randazzo,[1] Kristen M. Donnell,[2] and Yeou Song (Brian) Lee[3]

[1] *Applied Electromagnetics Group, Department of Naval, Electrical, Electronic, and Telecommunication Engineering, University of Genoa, 16145 Genoa, Italy*
[2] *Applied Microwave Nondestructive Testing Laboratory (amntl), Department of Electrical and Computer Engineering, Missouri University of Science and Technology, Rolla, MO 65409, USA*
[3] *Department of Quality, Anritsu Company, Morgan Hill, CA 95037, USA*

Correspondence should be addressed to Andrea Randazzo, andrea.randazzo@unige.it

Received 24 October 2012; Accepted 24 October 2012

Microwave and millimeter-wave sensors, systems, and techniques have been acquiring an ever-growing importance in the field of imaging and materials characterization. This interest is primarily motivated by the many advantages of microwaves and millimeter waves. First of all, these systems are capable of directly measuring quantities related to dielectric properties of inspected objects. Furthermore, nowadays microwave and millimeter-wave instrumentation is relatively low cost, especially with respect to other systems (e.g., X-rays). These systems are also relatively compact, allowing portability of the devices and consequently the possibility of performing in-situ measurements. Moreover, the systems are safe to the user as a result of the low transmission energy required for performing the inspection and the nonhazardous behavior of the radiation in the microwave and millimeter-wave frequency bands.

In recent years, several systems and techniques have been proposed in the scientific literature for electromagnetic imaging and materials characterization. Several applicative fields have been explored (e.g., nondestructive testing, biomedical imaging, and subsurface sensing), and novel solutions have been proposed. However, innovative apparatuses still must be developed, in order to mitigate the drawbacks of existing systems and to provide ever better measurement capabilities. Moreover, since the underlying mathematical model is commonly nonlinear and ill posed, novel solution algorithms and processing paradigms are needed for extracting key information from the measured data and for presenting the inspection results to nontechnical users/personnel of these assessment systems.

This special issue reports state-of-the-art contributions to the research in this field, which consider different aspects and problems related to sensors, systems, and techniques applied to microwave and millimeter-wave imaging.

In the paper "*Wide range temperature sensors based on one-dimensional photonic crystal with a single defect*" by A. Kumar et al., the transmission characteristics of a one-dimensional photonic crystal structure with a defect have been studied. The authors analyzed the behavior of the refractive index as a function of temperature of the medium. It has been found that the average shift in central wavelength of defect modes can be utilized in the design of a temperature sensor.

The paper "*Complex permittivity measurements of textiles and leather in a free space: an angular-invariant approach*" by B. Kapilevich et al. describes a system for complex permittivity measurements of textiles and leathers in a free space at 330 GHz. The role of Rayleigh scattering is considered, and the incidence-angular invariance has been estimated experimentally. It has been found that if the incidence angle exceeds the angular-invariant limit of about 25–30 degrees, the uncertainty caused by the Rayleigh scattering drastically increases, thus, preventing accurate measurements of the real and imaginary parts of the dielectric properties.

In "*Buried object detection by an inexact newton method applied to nonlinear inverse scattering*" by M. Pastorino and A. Randazzo, an algorithm for buried object detection is proposed. The method is based on the regularized solution of the full nonlinear inverse scattering problem formulated in terms of integral equations involving the Green's function for half-space geometries. An efficient two-step inexact Newton algorithm is employed. Capabilities and limitations of the method are evaluated by means of numerical simulations.

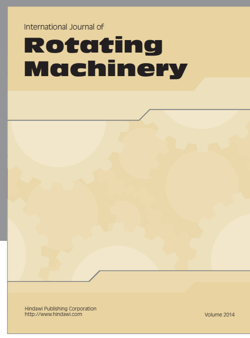
In "*Location and shape reconstruction of 2d dielectric objects by means of a closed-form method: preliminary experimental results*" by G. L. Gragnani and M. D. Mendez, an analytical approach for the identification of the location and shape of dielectric targets, starting from microwave measurements, is considered. A closed-form singular value decomposition of the scattering integral operator is derived and is used for determining the radiating components of the equivalent source density. The capabilities of the approach are demonstrated by considering real scattering data belonging to the Fresnel database. As a result of the closed-form solution, very short computational times have been obtained.

Finally, the application of swarm optimization methods to microwave imaging is reviewed in the paper "*Swarm optimization methods in microwave imaging*" by A. Randazzo. Swarm optimization methods are recently proposed stochastic algorithms inspired by the collective social behavior of natural entities (e.g., birds, ants, etc.). These algorithms have been proven to be quite effective in several applicative fields, such as intelligent routing, image processing, antenna synthesis, component design, and, clearly, microwave imaging. Recent approaches based on swarm methods are reviewed and critically discussed.

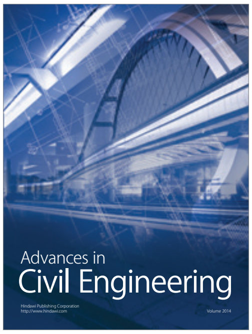
We wish to thank all the authors for their important contributions, the reviewers for their valuable suggestions, and the Editorial Board and Publisher for their fundamental support in the publication of this special issue.

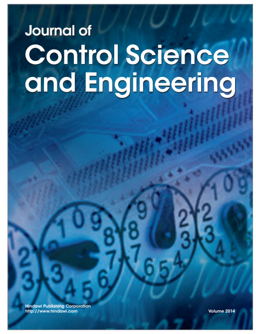
Andrea Randazzo
Kristen M. Donnell
Yeou Song (Brian) Lee


Journal of
Engineering

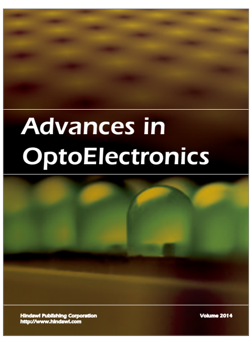
The Scientific
World Journal

International Journal of
Rotating
Machinery

Journal of
Sensors

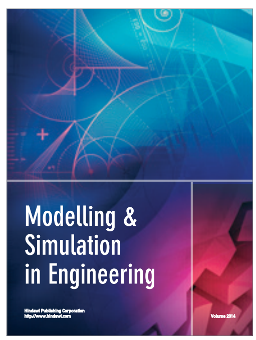
International Journal of
Distributed
Sensor Networks

Advances in
Civil Engineering


Journal of
Control Science
and Engineering

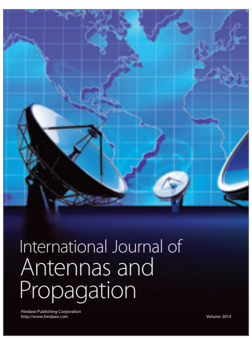
Journal of
Robotics

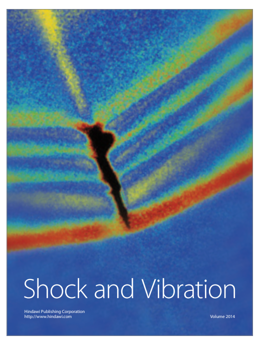
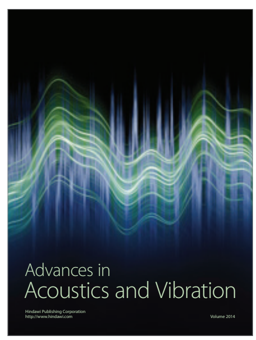
Journal of
Electrical and Computer
Engineering

Advances in
OptoElectronics

VLSI Design

International Journal of
Navigation and
Observation

Modelling &
Simulation
in Engineering

International Journal of
Aerospace
Engineering

International Journal of
Chemical Engineering

International Journal of
Antennas and
Propagation

Active and Passive
Electronic Components

Shock and Vibration

Advances in
Acoustics and Vibration