Hindawi
International Journal of Antennas and Propagation
Volume 2018, Article ID 6367571, 2 pages
https://doi.org/10.1155/2018/6367571

Editorial

Flexible and Conformal Antennas and Applications

Maggie Y. Chen,[1] **Félix A. Miranda**,[2] **Xing Lan**,[3] **and Xuejun Lu**[4]

[1]*Ingram School of Engineering, Texas State University, San Marcos, TX 78666, USA*
[2]*NASA Glenn Research Center, Cleveland, OH 44135, USA*
[3]*NG Next, Northrop Grumman Corporation, Redondo Beach, CA 90278, USA*
[4]*Department of Electrical and Computer Engineering, University of Massachusetts, Lowell, MA 01854, USA*

Correspondence should be addressed to Maggie Y. Chen; maggie.chen@txstate.edu

Received 14 March 2018; Accepted 14 March 2018; Published 6 June 2018

There are numerous ongoing research efforts in flexible antenna technology since these antennas can enable communications in curved surfaces not suitable for traditional rigid antennas, as well as exhibiting wide adaptability, low mass density, small volume, lightweight, and low cost. A considerable effort is being carried out on the novel antenna configurations exhibiting agile operating frequencies, tunable bandwidth, switchable polarization, and reconfigurable radiation pattern. Due to the significant research efforts and fast development in the field, International Journal of Antennas and Propagation set out to publish a special issue devoted to the topic of Flexible and Conformal Antennas and Applications. The result is a collection of ten outstanding articles submitted by investigators representing seven countries across Asia, Europe, and North America.

For additive manufacturing and direct write printing, material selection and manufacturing process are critical to the antenna and radio frequency (RF) components' overall electrical and mechanical performance. M. A. Monne et al. from Texas State University, in "Material Selection and Fabrication Processes for Flexible Conformal Antennas," discuss extensively the major fabrication techniques and associated materials used for the fabrication of flexible conformal antennas, including 3D printing technology, wearable textile technology, substrate-integrated waveguide technology, and membrane technology. The application of each type of fabrication technique is analyzed through experimental results, which further underlines the importance of material selection and the various fabrication processes. E. S. Rosker et al. from Northrop Grumman Corporation and UCLA, in "Printable Materials for the Realization of High Performance RF Components: Challenges and Opportunities," thoroughly discuss the attributes and challenges of additive manufacturing and direct writing techniques for the development of a variety of RF components including antennas, filters, and transmission lines. In this very comprehensive paper, the authors discuss printing methods, ink formulation, and post-processing approaches necessary to attain RF components and devices with performance comparable to those developed using conventional techniques and address future areas of research where further work is needed to optimize the performance and exploit the full potential of printed RF components.

Various types of flexible antennas were designed and reported. J. Zhou et al. from Xidian University, in "Design, Fabrication, and Testing of Active Skin Antenna with 3D Printing Array Framework," report the design, fabrication, and testing of a novel active skin antenna which consists of an encapsulation shell, antenna skin, and RF and beam control circuits. An active skin antenna prototype with 32 microstrip antenna elements was fabricated using a hybrid manufacturing method. 3D printing technology was applied to fabricate the array framework, and the different layers were bonded to form the final antenna skin by using traditional composite processes. The proposed design and fabrication technique is suitable for the development of a conformal load-bearing antenna or smart skin antenna installed in the structural surface of aircraft, warships, and armored vehicles. L. Zhao et al. from Nanjing University of Posts and Telecommunications, in "A Ring-Focus Antenna with Splash Plate in

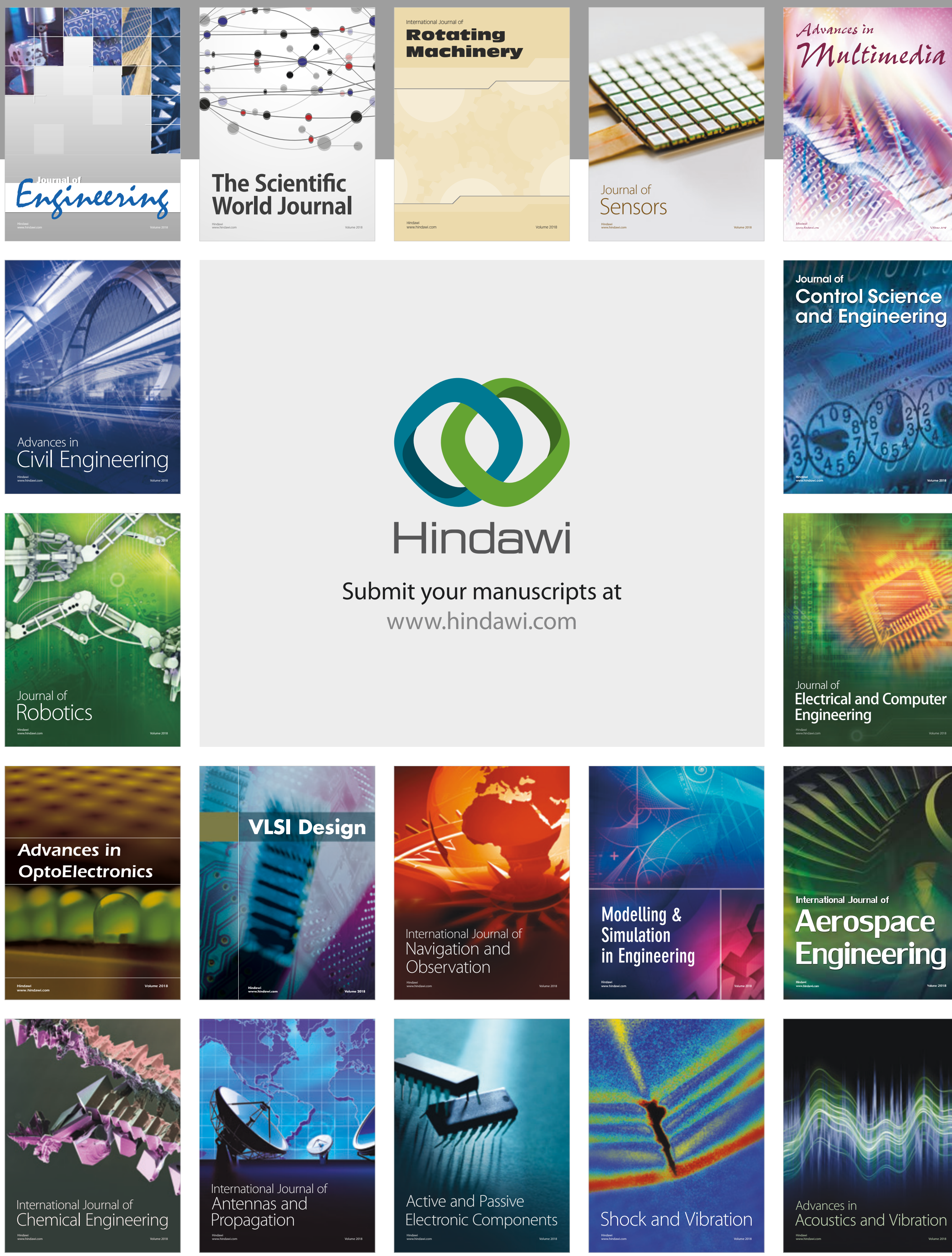
Ka-Band," report a ring-focus antenna fed by a splash plate for Ka-band communications. In this paper, the authors introduce a new theory for the splash-plate feed design. Their simulation also shows a very good agreement with the measurement data. The measured efficiency satisfies the requirement for Ka-band communications. K. N. Paracha et al. from Universiti Teknologi Malaysia, in "Low-Cost Printed Flexible Antenna by Using an Office Printer for Conformal Applications," report a coplanar waveguide- (CPW-) fed Z-shaped planar antenna printed using an ink-jet printer on a flexible polyethylene terephthalate (PET) substrate. The radiation efficiency of 62% was achieved at 2.45 GHz. The performance of the printed antenna under various bending conditions is also tested for conformal applications for the future 5G network. C. Y. Cheung et al. from Hong Kong have demonstrated a printed inverted-F antenna (PIFA) in the paper titled "Miniaturized Printed Inverted-F Antenna for Internet of Things: A Design on PCB with a Meandering Line and Shorting Strip." This antenna employs a smart meandering line and shorting strip design technique to further reduce the overall size, profile, and cost and increase the antenna's various electrical performances. This technique can be adapted and widely applied to various Internet of Things (IoT) and numerous other wireless applications due to its merits.

Flexible high-speed digital switching, amplifiers, and digital beamforming networks are critical to realize flexible phased-array antenna. M. A. Monne et al. from Texas State University, in "Inkjet-Printed Flexible MEMS Switches for Phased-Array Antennas," report a fully ink-jet-printed flexible MEMS switch for phased-array antennas. The physical structure of the printed MEMS switch consists of an anchor with a clamp-clamp beam, a sacrificial layer, and bottom transmission lines. 5 mil Kapton® polyimide film is used as a flexible substrate material. Layer-by-layer fabrication process and material evaluation are illustrated. The MEMS switch has a low actuation voltage of 1.2 V, current capacity of 0.2195 mA, a current on-off ratio of 2195 : 1, and an RF insertion loss of 5 dB up to 13.5 GHz. Printed MEMS switch technology is a promising candidate for flexible and reconfigurable phased-array antennas and other RF and microwave frequency applications.

Numerical simulation of an antenna system can be used as guidance towards flexible antenna development. S. Asaly et al. from Ariel University, in "Accurate 3D Mapping Algorithm for Flexible Antennas," report a new accurate 3D flexible antenna surface mapping technology using a small-sized monocamera and known patterns on the antenna surface. This method demonstrated up to 0.1-millimeter antenna mapping accuracy from 1 m distance. The method provides an effective tool for accurate 3D mapping of a flexible antenna surface. D. Subitha and J. M. Mathana from Anna University, in "Design of Low-Complexity Hybrid Precoder and Inkjet-Printed Antenna Array for Massive MIMO Downlink Systems," propose two design methodologies to reduce the complexity of massive multiple input multiple output (MIMO) systems. The first one is the design of a low-complexity hybrid precoder based on zero-forcing (ZF) precoding algorithm and Neumann series approximation. The second one is the design of a flexible, environment friendly, simple 128-element Z-shaped coplanar waveguide (CPW) monopole array at the frequency of 2.4 GHz. The performance of the proposed designs are evaluated in terms of probability of error in the hybrid precoding algorithm and radiation characteristics like gain, directivity, and return loss for the printed antenna design.

Uniformly, these authors highlight both the promise and the challenges faced by this emerging field of antenna development. In summary, this special issue provides a snapshot of the current development of flexible and conformal antennas across the globe. Hopefully, this publication will provide a benchmark for future development of innovative, high-performance, low-cost, rapid deployable, and flexible antennas for various applications.

Maggie Y. Chen
Félix A. Miranda
Xing Lan
Xuejun Lu


Journal of Engineering
The Scientific World Journal
International Journal of Rotating Machinery
Journal of Sensors
Advances in Multimedia
Advances in Civil Engineering
Journal of Control Science and Engineering
Hindawi
Submit your manuscripts at
www.hindawi.com
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