

**SPECIAL ISSUE**

**METAMATERIALS: FUNDAMENTALS & APPLICATIONS IN THE MICROWAVE & OPTICAL REGIMES**

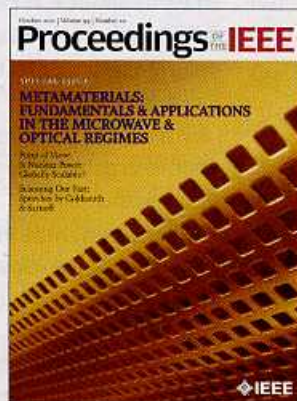
*Edited by G. V. Eleftheriades and N. Engheta*

- 1622 Electromagnetic Design With Transformation Optics**  
*By N. B. Kundtz, D. R. Smith, and J. B. Pendry*  
 | INVITED PAPER | Transformation optics is introduced and reviewed in this article as a powerful technique for designing metamagnetic materials; several novel electromagnetic examples are given and discussed.
- 1634 Anisotropic Transmission-Line Metamaterials for 2-D Transformation Optics Applications**  
*By M. Zedler and G. V. Eleftheriades*  
 | INVITED PAPER | A method for synthesizing transformation optics metamaterials at microwaves is introduced in this article and a few examples of microwave devices are described.
- 1646 Broadband Electromagnetic Cloaking Realized With Transmission-Line and Waveguiding Structures**  
*By P. Alitalo and S. A. Tretyakov*  
 | INVITED PAPER | This paper gives a brief overview of cloaking techniques and describes an alternative approach for cloaking based on transmission-line metamaterials.
- 1660 Bulk Metamaterials Made of Resonant Rings**  
*By R. Marqués, L. Jelinek, M. J. Freire, J. D. Baena, and M. Lapine*  
 | INVITED PAPER | The realization of 3-D magnetic metamaterials at microwave frequencies is discussed in this paper and an exciting application of such materials is described.
- 1669 Optical Metamaterials Based on Optical Nanocircuits**  
*By A. Alù and N. Engheta*  
 | INVITED PAPER | Possible scenarios for the design of metamaterials in the optical regime are put forward, applying the nanocircuit concepts based on suitably arranged collections of nanoparticles.
- 1682 Development of Bulk Optical Negative Index Fishnet Metamaterials: Achieving a Low-Loss and Broadband Response Through Coupling**  
*By J. Valentine, S. Zhang, T. Zentgraf, and X. Zhang*  
 | INVITED PAPER | This paper deals with design, fabrication, and characterization of "fishnet" structures for building broadband low-loss negative-refraction metamaterials and shows how coupling of unit cells improves the results.
- 1691 Bianisotropic Effective Parameters of Optical Metamagnetics and Negative-Index Materials**  
*By A. V. Kildishev, J. D. Borneman, X. Ni, V. M. Shalaev, and V. P. Drachev*  
 | INVITED PAPER | An overview of some principles in development of bianisotropic homogenization techniques for metamaterials is given in this paper with examples in passive and active optical metamaterials.
- 1701 Recent Advances in Metamaterial Transmission Lines Based on Split Rings**  
*By M. Durán-Sindreu, A. Vélez, G. Sisó, P. Vélez, J. Selga, J. Bonache, and F. Martín*  
 | INVITED PAPER | Recent advances in metamaterial transmission lines are reviewed in this paper; a number of enabled microwave applications including compact wideband filters and power splitters are described.

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**DEPARTMENTS**

- 1611 POINT OF VIEW**  
 Is Nuclear Power Globally Scalable?  
*By D. Abbott*
- 1618 SCANNING THE ISSUE**  
 Metamaterials: Fundamentals and Applications in the Microwave and Optical Regimes  
*By G. V. Eleftheriades and N. Engheta*
- 1816 SCANNING OUR PAST**  
 IRE Historical Nuggets: Speeches by Goldsmith and David Sarnoff  
*By J. Calder*
- 1821 FUTURE SPECIAL ISSUES/SPECIAL SECTIONS**



**On the Cover:** This month we review the subject of Metamaterials and our cover illustrates an example of these artificially engineered materials with electromagnetic properties that are inaccessible in nature or which are difficult to obtain in natural materials, but are physically realizable. This issue covers Fundamentals and Applications in the Microwave and Optical Regimes.

**SPECIAL ISSUE: Metamaterials: Fundamentals & Applications in the Microwave & Optical Regimes**

- 1711 Metamaterial Dispersion Engineering Concepts and Applications**  
By C. Caloz  
| INVITED PAPER | The theory and advantages of transmission-line metamaterials are reviewed in this paper; "dispersion engineering" microwave applications are described as are microwave nonreciprocal magnetic devices using ferromagnetic nanowires.
- 1720 Metamaterial-Inspired Engineering of Antennas**  
By R. W. Ziolkowski, P. Jin, and C.-C. Lin  
| INVITED PAPER | Some applications of metamaterials in efficient, electrically small antennas are reviewed in this paper; multiband and multifrequency antennas are also discussed.
- 1732 Narrowband and Wideband Metamaterial Antennas Based on Degenerate Band Edge and Magnetic Photonic Crystals**  
By J. L. Volakis and K. Sertel  
| INVITED PAPER | Electric small antennas based on anisotropic metamaterial structures are described in this paper as are wideband arrays based on metamaterial ideas and the concept of the "current sheet."
- 1746 Evolution of Composite Right/Left-Handed Leaky-Wave Antennas**  
By M. R. M. Hashemi and T. Itoh  
| INVITED PAPER | Application of transmission-line metamaterials in realization of leaky-wave antennas that exhibit unique beam scanning properties is reviewed in this paper; electronically scannable leaky-wave antennas are presented.
- 1755 Steering Phased Array Antenna Beams to the Horizon Using a Buckyball NIM Lens**  
By T. A. Lam, D. C. Vier, J. A. Nielsen, C. G. Parazzoli, and M. H. Tanielian  
| INVITED PAPER | This paper discusses application of metamaterials to phased arrays as applied, for example, to satellite communications, and introduces a metamaterial lens that extends the capabilities of phased arrays.
- 1768 Strong Light Confinement With Periodicity**  
By M. Notomi  
| INVITED PAPER | Strong light confinement in dielectric photonic crystals and cavities capable of confining light in a wavelength-cubed volume are described in this paper.
- 1780 The Fundamental Physics of Directive Beaming at Microwave and Optical Frequencies and the Role of Leaky Waves**  
By D. R. Jackson, P. Burghignoli, G. Lovat, F. Capolino, J. Chen, D. R. Wilton, and A. A. Oliner  
| INVITED PAPER | Directive beaming through periodic structures at microwave and optical frequencies are discussed in this paper, as is the role of weakly-attenuated leaky waves in these structures.
- 1806 Near-Field Plates: Metamaterial Surfaces/Arrays for Subwavelength Focusing and Probing**  
By A. Grbic, R. Merlin, E. M. Thomas, and M. F. Imani  
| INVITED PAPER | Pattern surfaces (1-D and 2-D near-field plates) that can focus microwaves down to subwavelength spots with applications to imaging, sensing, and wireless power transfer are described in this paper.

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