

**SPECIAL ISSUE**

## PHASED ARRAY TECHNOLOGIES

*B. R. Epstein, R. H. Olsson III, and R. Rotman*

**487 Digital Phased Arrays: Challenges and Opportunities**

*By C. Fulton, M. Yeary, D. Thompson, J. Lake, and A. Mitchell*

**INVITED PAPER** This paper overviews the many interrelated aspects of the digital beamforming trade space, covering data distribution within the array, data processing, calibration, and fixed versus adaptive beamforming.

**504 True Time Delay in Phased Arrays**

*By R. Rotman, M. Tur, and L. Yaron*

**INVITED PAPER** The physics of phase arrays requires the introduction of precise delays of the signal at each array element. Implementations of true time delay are reviewed in this paper.

**519 The Evolution to Modern Phased Array Architectures**

*By J. S. Herd and M. D. Conway*

**INVITED PAPER** Phased array costs can be minimized by utilizing high-volume commercial microwave manufacturing and packaging techniques, coupled with digital array architectures.

**530 Benefits of Digital Phased Array Radars**

*By S. H. Talisa, K. W. O'Haver, T. M. Comberiate, M. D. Sharp, and O. F. Somerlock*

**INVITED PAPER** Digital phased arrays offer many promises with respect to beam agility, bandwidth, and application flexibility. However, mitigation of elemental nonlinearities, clock jitter, and other challenges must be carefully considered.

**544 Unconventional Phased Array Architectures and Design Methodologies—A Review**

*By P. Rocca, G. Oliveri, R. J. Mailloux, and A. Massa*

**INVITED PAPER** Phased arrays do not have to have a well-ordered planar layout of radiating elements. Sparse arrays, unusual layouts, and time sequencing of the array elements can reduce array size while preserving the required beam characteristics.

**561 Analog and RF Interference Mitigation for Integrated MIMO Receiver Arrays**

*By H. Krishnaswamy and L. Zhang*

**INVITED PAPER** This paper describes how directional and spectral interference mitigations in the analog and RF domain are achieved through innovative beamforming architectures.

**576 The Role of FPGAs in the Push to Modern and Ubiquitous Arrays**

*By L. A. Miller*

**INVITED PAPER** Field-programmable gate arrays (FPGAs) are playing an increasing role in beamforming operations. Lower power consumption and faster data throughputs expand the potential applications of FPGAs in phased arrays.

**DEPARTMENTS**

**479 POINT OF VIEW**

Patents: When They Make Sense and When They Do Not  
*By C. R. Hutter*

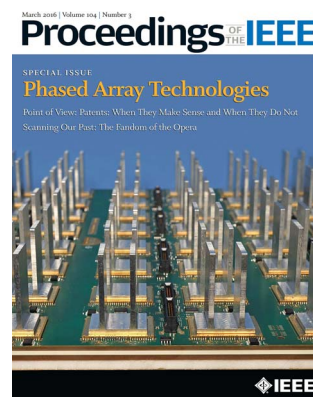
**482 SCANNING THE ISSUE**

Phased Array Technologies  
*By B. R. Epstein, R. H. Olsson III, and R. Rotman*

**673 SCANNING OUR PAST**

The Fandom of the Opera: How the Audience for a Centuries-Old Art Form Has Incubated Electrical and Electronics Technologies  
*By M. Schubin*

**683 FUTURE SPECIAL ISSUES/SPECIAL SECTIONS**



**On the Cover:** This month's cover photo features an electronic backplane of a Multipurpose Phased Array Radar panel for weather and air traffic control. The panel was constructed by applying modern low-cost manufacturing techniques for arrays. Photo Credit: MIT/Lincoln Laboratory.

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## SPECIAL ISSUE: Phased Array Technologies

- 586 Design of Energy- and Cost-Efficient Massive MIMO Arrays**  
By A. Puglielli, A. Townley, G. LaCaille, V. Milovanović, P. Lu, K. Trotskovsky, A. Whitcombe, N. Narevsky, G. Wright, T. Courtade, E. Alon, B. Nikolić, and A. M. Niknejad  
**|INVITED PAPER|** This paper discusses how multiuser massive microwave and mm-wave MIMO can support communications among many users over a given allocation of spectrum, along with manageable array form factors and power consumption.
- 607 High-Sensitivity Phased Array Receivers for Radio Astronomy**  
By K. F. Warnick, R. Maaskant, M. V. Ivashina, D. B. Davidson, and B. D. Jeffs  
**|INVITED PAPER|** Large-scale radio astronomy arrays are applying new generations of sparse arrays and phased array feeds, now in development for observatories worldwide, with the aim of achieving unprecedented sensitivity and flexibility.
- 623 A New Era in Elemental Digital Beamforming for Spaceborne Communications Phased Arrays**  
By P. K. Bailleul  
**|INVITED PAPER|** Phased arrays for space applications face extreme challenges, especially in the context of size, weight, and power consumption. Digital arrays are especially attractive in addressing these challenges.
- 633 On the Design of Phased Arrays for Medical Applications**  
By O. M. Bucci, L. Crocco, R. Scapatucci, and G. Bellizzi  
**|INVITED PAPER|** New advancements in elemental beamforming for medical applications, including the application of superdirectivity, are presented in this paper. Microwave medical imaging and the therapeutic delivery of nonionizing radiation to targeted cancerous sites in patients are discussed.
- 649 Multifunction Phased Array Radar for Aircraft and Weather Surveillance**  
By J. E. Stailey and K. D. Hondl  
**|INVITED PAPER|** Multifunction phased array radar (MPAR) is a multiagency initiative to investigate the feasibility of replacing aircraft surveillance and weather radar fleets in the United States with a network of phased array radars based on a single, scalable networked array architecture.
- 660 Adaptive-Weather-Surveillance and Multifunction Capabilities of the National Weather Radar Testbed Phased Array Radar**  
By S. M. Torres, R. Adams, C. D. Curtis, E. Forren, D. E. Forsyth, I. R. Ivić, D. Priegnitz, J. Thompson, and D. A. Warde  
**|INVITED PAPER|** The National Weather Radar Testbed is a phased array radar established to evaluate the potential of phased array technology in predicting weather while performing air traffic surveillance from a common platform.

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