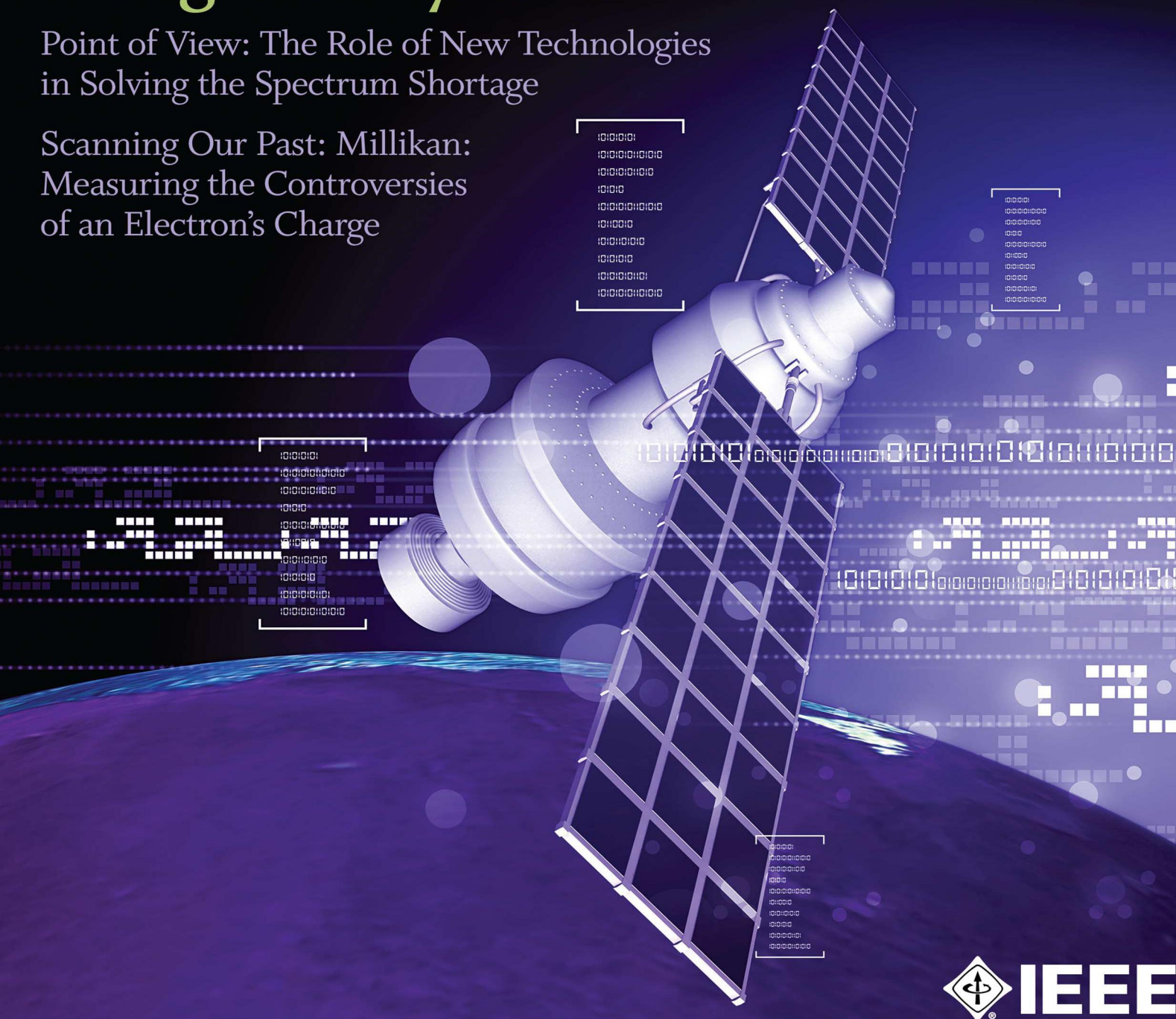


SPECIAL ISSUE

Vulnerabilities, Threats, and Authentication in Satellite-Based Navigation Systems

Point of View: The Role of New Technologies in Solving the Spectrum Shortage

Scanning Our Past: Millikan: Measuring the Controversies of an Electron's Charge



SPECIAL ISSUE

VULNERABILITIES, THREATS, AND AUTHENTICATION IN SATELLITE-BASED NAVIGATION SYSTEMS

Edited by M. G. Amin, P. Closas, A. Broumandan, and J. L. Volakis

1174 Known Vulnerabilities of Global Navigation Satellite Systems, Status, and Potential Mitigation Techniques

By R. T. Ioannides, T. Pany, and G. Gibbons

INVITED PAPER This paper provides a thorough motivation of GNSS vulnerabilities and their potential impact in terms of technical, political, and socioeconomic contexts. Categorization of attacks and surveying of state-of-the-art countermeasures are discussed.

1195 Desired Features of Adaptive Antenna Arrays for GNSS Receivers

By I. J. Gupta, I. M. Weiss, and A. W. Morrison

INVITED PAPER This paper highlights requirements for future and smaller GNSS receiver antenna arrays that operate in contested environments. Emphasis is on sophisticated signal processing techniques that account for interelement coupling and platform effects.

1207 Robust GNSS Receivers by Array Signal Processing: Theory and Implementation

By C. Fernández-Prades, J. Arribas, and P. Closas

INVITED PAPER The article provides a comprehensive, thorough overview of multiantenna techniques that are specifically designed for GNSS receivers, including tradeoffs, implementation challenges, and technology trends.

1221 Small and Adaptive Antennas and Arrays for GNSS Applications

By J. L. Volakis, A. J. O'Brien, and C.-C. Chen

INVITED PAPER This paper discusses antenna array design aspects for GNSS receivers. Particular focus is on miniaturized adaptive arrays providing jamming rejection capabilities with lightweight implementations.

1233 Impact and Detection of GNSS Jammers on Consumer Grade Satellite Navigation Receivers

By D. Borio, F. Dovis, H. Kuusniemi, and L. Lo Presti

INVITED PAPER This paper provides a comprehensive discussion of jamming effects on commercial GNSS receivers. The main types of jammers are discussed as well as state-of-the-art detection methods.

1246 Overview of Spatial Processing Approaches for GNSS Structural Interference Detection and Mitigation

By A. Broumandan, A. Jafarnia-Jahromi, S. Daneshmand, and G. Lachapelle

INVITED PAPER Different spatial processing methods, namely, antenna array processing, moving receiver, and cloud-based spoofing countermeasures, are analyzed in detail.

1258 GNSS Spoofing and Detection

By M. L. Psiaki and T. E. Humphreys

INVITED PAPER The paper discusses numerous defense strategies ranging from special signal processing within a traditional GNSS receiver to employing advanced encryption-based techniques on GNSS measurements.

DEPARTMENTS

1163 POINT OF VIEW

The Role of New Technologies in Solving the Spectrum Shortage

By J. Reed, M. Vassiliou, and S. Shah

1169 SCANNING THE ISSUE

Vulnerabilities, Threats, and Authentication in Satellite-Based Navigation Systems

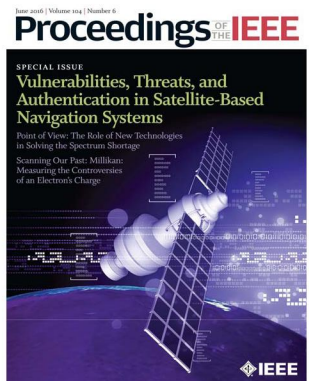
By M. G. Amin, P. Closas, A. Broumandan, and J. L. Volakis

1354 SCANNING OUR PAST

Robert A. Millikan: Measuring the Controversies of an Electron's Charge

By J. Vardalas

1360 FUTURE SPECIAL ISSUES/SPECIAL SECTIONS



On the Cover: Our cover this month features a satellite orbiting Earth, working as part of a Global Satellite Navigation System to provide autonomous geospatial positioning information.

[Continued on page 1162 ▶]

SPECIAL ISSUE: Vulnerabilities, Threats, and Authentication in Satellite-Based Navigation Systems

1271 Coding Aspects of Secure GNSS Receivers

By J. T. Curran, M. Navarro, M. Anghileri, P. Closas, and S. Pfletschinger

[INVITED PAPER] An introduction on how to capitalize on the presence of coding schemes to mitigate the effects of jamming signals is provided. Potential receiver enhancements are proposed to increase robustness for coding schemes employed by current GNSS signals, while message authentication codes are discussed to ensure system integrity.

1288 Concepts, Development, and Validation of Multiantenna GNSS Receivers for Resilient Navigation

By M. Cuntz, A. Konovaltsev, and M. Meurer

[INVITED PAPER] This paper addresses radio-frequency interference mitigation and spoofing detection approaches. Several signal processing techniques are discussed to improve robustness for weak signal conditions, jamming, and counterfeit GNSS signals.

1302 Sparse Arrays and Sampling for Interference Mitigation and DOA Estimation in GNSS

By M. G. Amin, X. Wang, Y. D. Zhang, F. Ahmad, and E. Aboutanios

[INVITED PAPER] The paper considers sparse arrays and sparse signal processing for jammer direction finding and mitigation. Sparse array aperture design is provided based on co-array concepts and guided by the signal-to-interference-and-noise ratio criterion.

1318 Interference Localization for Satellite Navigation Systems

By A. G. Dempster and E. Cetin

[CONTRIBUTED PAPER] This paper provides an overview of existing systems for rapid radio-frequency interference which implement power, angle, frequency difference, and time-delay-based techniques of sensor networks consisting of spatially distributed sensor nodes.

1327 Protecting GNSS Receivers From Jamming and Interference

By G. X. Gao, M. Sgammini, M. Lu, and N. Kubo

[INVITED PAPER] The paper provides an overview of various approaches for protecting GNSS receivers against interference. External aiding using inertial systems, spatial filtering via antenna array beamforming, signal conditioning and filtering in the time-frequency domain, and vector tracking are among the discussed approaches.

1339 Multisensor Navigation Systems: A Remedy for GNSS Vulnerabilities?

By D. A. Grejner-Brzezinska, C. K. Toth, T. Moore, J. F. Raquet, M. M. Miller, and A. Kealy

[INVITED PAPER] The authors review advances in image-based PNT, IMUs, magnetic, and RF-based systems. They conclude that a combination of these approaches along with high processing speeds provide for more reliable continuous, accurate, and robust PNT solutions.

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