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Microwave Photonics: Deep Interactions between Microwaves and Lightwaves

Xihua Zou
Attila Szep
Chao Wang
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Xihua Zou
Southwest Jiaotong University
School of Information Science and Technology
Chengdu 610031, China

and

University of Duisburg-Essen
Institute of Optoelectronics
Duisburg 47057, Germany
E-mail: zouxihua@swjtu.edu.cn

Attila Szep
Air Force Research Laboratory
Wright Patterson AFB, Ohio 45433, United States
E-mail: szepata@yahoo.com

Chao Wang
University of Kent
School of Engineering and Digital Arts
Canterbury, CT2 7NT, United Kingdom
E-mail: C.Wang@kent.ac.uk

In recent years, research of microwave photonics (MWP) has progressed at an unprecedented pace, concentrating on deep interactions between microwaves and lightwaves for the generation, distribution, processing, control, and sensing of microwave, millimeter-wave, and terahertz signals. In addition to the growing interest from academic research and laboratory trials, MWP has increasingly evolved as an enabling technology for diverse fields and engineering applications, such as large-capacity wireless-fiber communications, remote radio-frequency sensing, low-noise signal sources, and military systems. Therefore, along with the celebration of the International Year of Light 2015, we are pleased to launch such a special section focusing on deep interactions between microwaves and lightwaves in *Optical Engineering* (the flagship journal of SPIE and a journal mostly technique and engineering oriented), to highlight the latest advances in the field of MWP, ranging from concepts, theories, and approaches, to devices, systems, applications, and engineering implementations.

In this MWP special section, 19 papers (including 2 invited papers) contributed by authors from Asia-Pacific, Europe, and America have been accepted for publication after rigorous and anonymous peer review. As an overall review of these papers, related topics include wireless-fiber communications and links (6 papers), microwave signal processing (7), microwave signal generation (3), and sensing and detection (3). The distributions of topics really reflect the technology readiness level of current MWP.

For more details, we start with introducing the two invited papers. In “Review of physical layer networking for optical-wireless integration,” C. Lim, K. Lee, and A. Nirmalathas from University of Melbourne present the latest advances on physical networking options and enabling system technologies for optical and wireless access backhaul infrastructure. The other is entitled “Stimulated Brillouin scattering gain bandwidth reduction and applications in microwave photonics and optical signal processing,” by S. Preussler and T. Schneider from Technische Universität Braunschweig. This paper describes ultranarrow stimulated Brillouin scattering (SBS) gain bandwidth and its applications in high-resolution microwave and optical signal processing.

Regarding the topic of wireless-fiber communications and links, the papers study digital linearization (by J. Ning et al.), elimination of cross-modulation distortions (by X. Liang, et al.), dispersion compensation (by T. Pu et al.), multifunction-stabilized photonic link (by A. Zhang, et al.), and uplink connection for radio-over fiber systems (by C. Zhang, et al.).

Within the topic of microwave signal processing, we have significant contributions on a tunable fractional-order photonic differentiator (by S. Sun et al.), optical single-sideband modulation (by S. Song), photonic digital-to-analog conversion (by F. Zhang et al.), a broadband radiofrequency converter (by R. M. Borges et al.), an all-optical correlator (by J. Sun et al.), and a microwave photonic filter (by E. Xu et al.).

Meanwhile, photonic microwave signal generation based on several techniques, including frequency quadrupling (by M. Zhu et al.), a tunable optoelectronic oscillator with fine step (by Y. Teng et al.), and a flat optical frequency comb (D. Chen et al.), is demonstrated.

Also, several papers address MWP applications in sensing and detection, such as a fiber-wireless sensor system (by J. Wang et al.), an optoelectronic oscillator–based sensor interrogation (by H. Chen et al.), and microwave characterization of Mach-Zehnder modulators (by H. Wang et al.).

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**Xihua Zou** is a full professor at the Southwest Jiaotong University, China, and a Humboldt Research Fellow at the University of Duisburg-Essen, Germany. He has authored over 80 papers in high-impact, peer-reviewed journals in the field of microwave photonics. He was the recipient of National Outstanding Expert in Sci&Tech of China (2014), nomination for the Award for Excellent Doctoral Dissertation of China (2011), Award for Young Scientist of Sichuan Province, China (2013), and Outstanding Reviewer of Optics Communications (2015).

**Attila Szep** is a senior electronics engineer in the Air Force Research Laboratory in Dayton, Ohio. Currently his duties include conducting in-house research in quantum computing and information processing and RF photonic integrated circuits for various RF and EO sensor applications. He received his undergraduate degree in electrical engineering from the California State University, Northridge, California, and his master's and PhD degrees in electrophysics from the University of Southern California, Los Angeles.

**Chao Wang** is a lecturer at the University of Kent. From 2011 to 2012, he was a NSERC postdoctoral fellow at the University of California, Los Angeles. His research interests include microwave photonics and ultrafast imaging. He has authored over 80 peer-reviewed journal and conference papers. He was the recipient of graduate fellowships from IEEE Photonics Society (2009) and IEEE Microwave Theory and Techniques Society (2010), and EU Marie Curie Career Integration Grant award (2014).