Editorial
Special Issue on Advances in Integrated Microwave Photonics

THE field of integrated microwave photonics explores the incorporation of photonic integration technology for the generation, processing, and measurement of radio-frequency and microwave signals and is one of the fastest growing fields in signal processing. The last 10 years have seen a strong trend towards integration of microwave photonics functionalities on a single chip, with the scope to reduce size, weight, power, and cost.

At present, the field of integrated microwave photonics has adopted significantly distinct approaches, technological tools, and focused applications compared to the recent past. A new research paradigm is to explore general purpose and programmable signal processors capable of synthesizing a multitude of on-demand signal processing tasks. On the other hand, incorporation of new technological tools such as on-chip frequency combs, opto-acoustic interactions, and plasmonics opens new ways of manipulating RF signals. From the applications side, emerging concepts such as 5G communications and the Internet of Things (IoT) are expected to shape development of new systems focusing on high operating frequencies in the millimeter-waves, low power consumption, and high level of integration with electronics.

The aim of this Special Issue is thus to highlight these recent advances in the field of integrated microwave photonics, both in terms of new technological tools being employed in the field, and their application to emerging massive takeover applications. The eight manuscripts included in the issue span the range of topics mentioned above.

From the *new technological tools* point of view, the use of on-chip frequency combs and of acousto-optic effects (such as stimulated Brillouin scattering) have recently started to be very successfully explored in their potential to provide high-performance delay lines and ultra-high selectivity microwave filters. In this issue, X. Xue *et al.* describe the use of microresonator-based Kerr combs to implement low-phase-noise microwave and optical frequency synthesizers, channelized receivers, programmable signal processors, and true time delay. Heterogeneous integration of III-V materials on silicon allow us to create basic blocks for radio-over-fiber transceivers, as discussed by K. Van Gasse *et al.* The exploration of on-chip stimulated Brillouin scattering is described by Y. Liu *et al.* with the aim of creating high optimized microwave signal processing functionality.

From the *novel applications* perspective, we are assisting at a strong drive originating from 5G and IoT to create a new IMWP system with low size, power, and cost and operating at very high (millimeter wave) frequencies. Photonics-based beamforming applications are taking an important place in this quest. In their paper, G. Serafino *et al.* focus on photonic-assisted beamforming architectures for application to 5G communications. They implement photonic phase shifters for radio signals that are simultaneously capable of ultrafast beamsteering and broad instantaneous bandwidth. A. Waqas *et al.*, instead, report on the design and characterization of cascaded Mach-Zehnder architectures for microwave photonic integrated delay lines, displaying a higher time-bandwidth product compared to resonant-type optical delay lines. G. J. Schneider *et al.* report novel optical modulator architectures capable of simultaneous beamforming and data modulation, based on an optical polar-vector modulator approach, as done in the integrated analog electronics domain. L. R. Chen *et al.* discuss IMWP subsystems on the silicon photonic platform that are capable of arbitrary waveform generation, microwave filtering, and spectral analysis. T. Hao *et al.* describe a technique to create chirped pulsed waveforms by photonic means, using mode locked optoelectronic oscillators, with a wide application range in radar and communication systems.

We wish this Special Issue be beneficial as an introduction to the field for the novice and as an update on the recent advances for the experts, and that it may help to trigger transformative ideas towards the future developments while bridging synergies between device-focused and application-driven approaches.

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